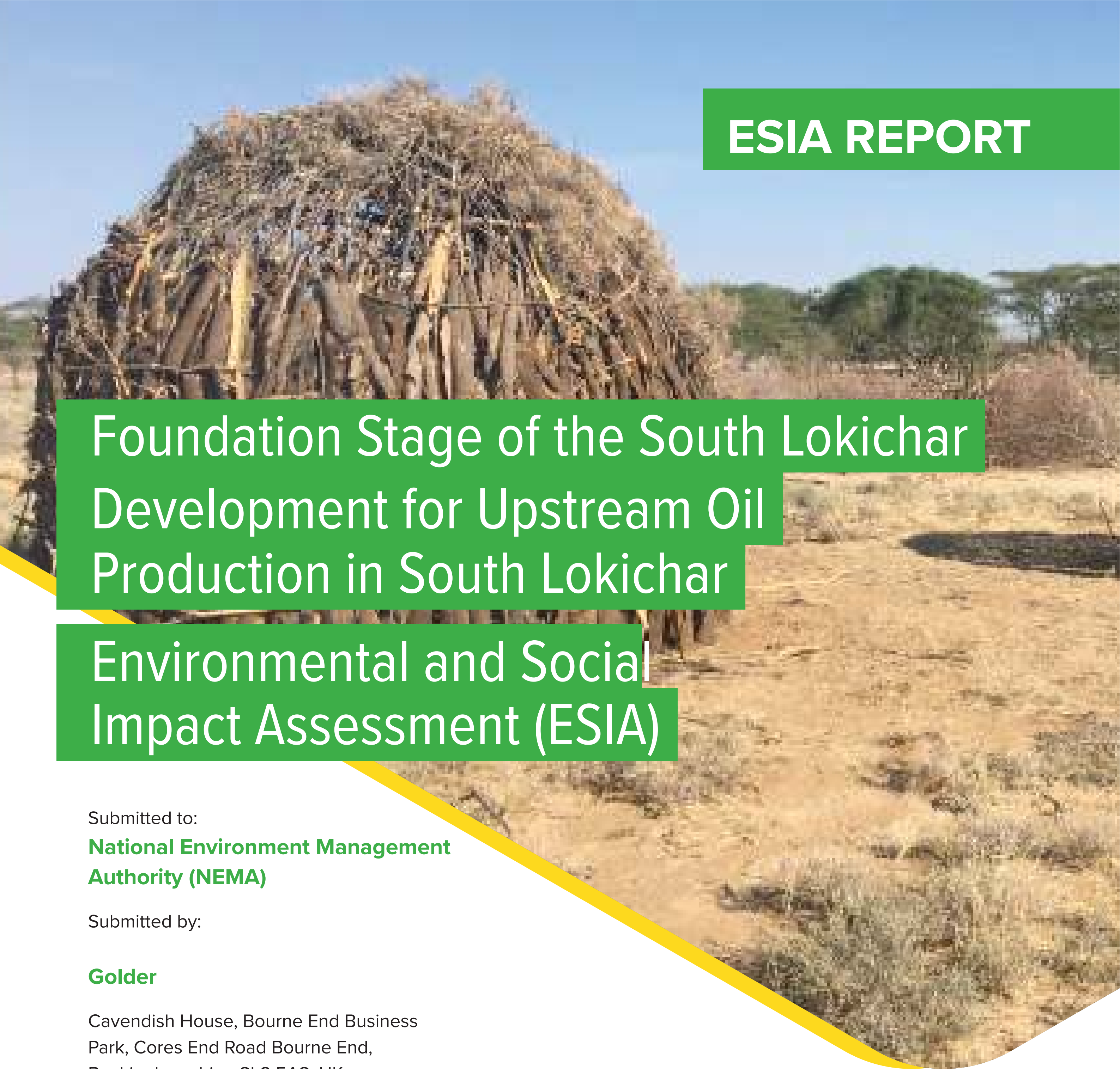

ESIA REPORT

Foundation Stage of the South Lokichar Development for Upstream Oil Production in South Lokichar

Environmental and Social Impact Assessment (ESIA)

Submitted to:

National Environment Management Authority (NEMA)

Submitted by:

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NON-TECHNICAL SUMMARY

Non-Technical Summary

Signature Page

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15 June 2020

1.0 INTRODUCTION

This Non-Technical Summary (NTS) provides an overview of the Environmental and Social Impact Assessment (ESIA) completed for the proposed Foundation Phase of the South Lokichar Development ('the Project'). It has been prepared by Golder Associates (UK) Ltd and Ecologics Consulting Ltd. (NEMA Expert Registration No: 9709). The ESIA is based on the Terms of Reference (ToR) approved by the National Environment Management Authority (NEMA) in March 2016.

Copies of this document and the full ESIA Report for the Project are available online: https://www.tullowoil.com/operations/east-africa/kenya/environmental-social/esia. Copies are also available at all Tullow Community Resource Centres and the Tullow Kenya B.V. (TKBV) office in Nairobi.

The Project, as depicted in Figure NTS-1, includes the construction and operation of facilities needed to extract and process crude oil in South Lokichar from the Twiga, Amosing and Ngamia (TAN) fields, prior to its export to Lamu via the separately permitted and operated Lokichar to Lamu Crude Oil Pipeline Project (LLCOP). The ESIA assesses the potential impacts of the Project on the environment and social setting and, where necessary, describes mitigation and management measures that will be used to reduce those effects, or which might enhance the benefits of the Project.

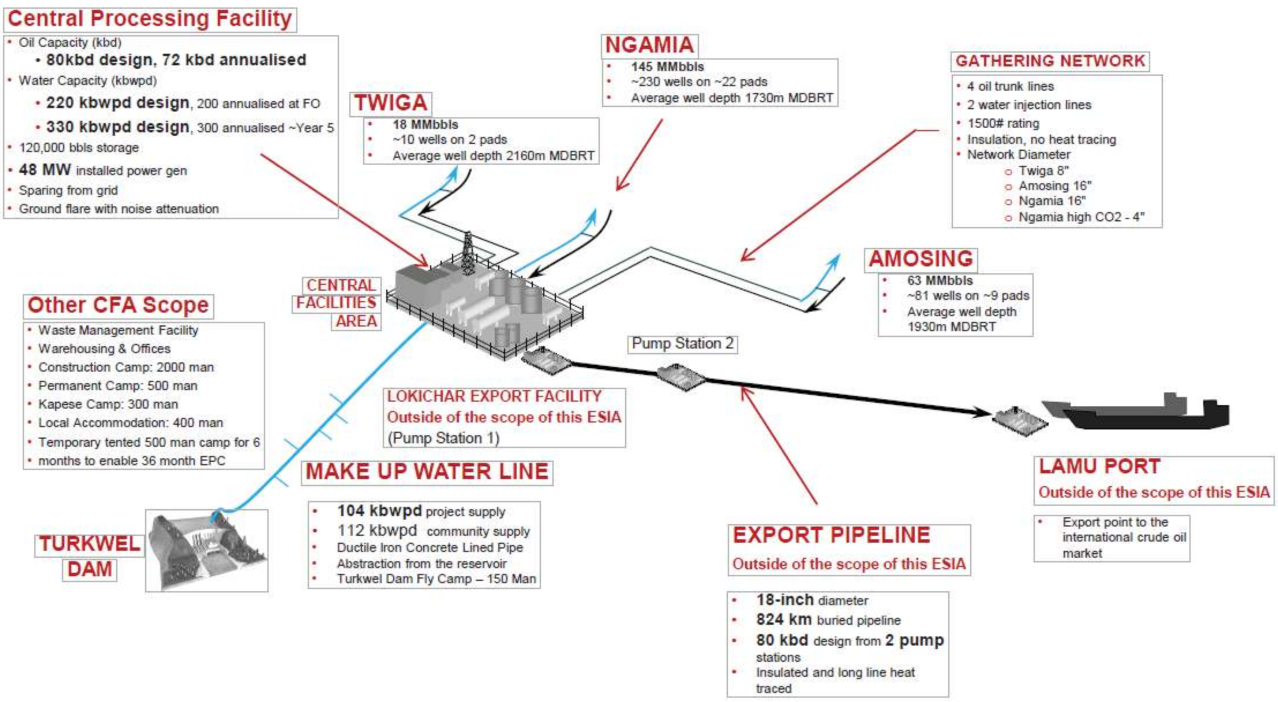

Figure NTS-1: Project Overview

Background

The first onshore well in the South Lokichar Basin commenced drilling in January 2012 and since then several discoveries have been made during the exploration phase. The Project is preceded by the Early Oil Pilot Scheme (EOPS) Phase II, for which a separate ESIA was produced in 2018.

At the time of writing, Tullow Kenya B.V. (TKBV), Africa Oil Kenya B.V. and Total S.A. form the joint venture partners that will execute the Project. TKBV, as main operator of the Project, will be responsible for the implementation of the commitments presented in this ESIA, the NEMA approved Environmental and Social Management Plan (ESMP) and environmental license conditions.

Land will be acquired by the Government of Kenya (GoK) and leased back to TKBV for the Project. The National Land Commission (NLC) will be responsible for all regulatory land acquisition associated with the Project, with TKBV retaining responsibility for ensuring that land acquisition also meets non-regulatory supplemental requirements (for example, those defined in the International Finance Corporation (IFC) Performance Standards (PSs)).

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This ESIA has been prepared in compliance with Kenyan law and regulation and, where relevant, references international standards as part of Good International Industry Practice (GIIP). It specifically references the IFC PSs on Environmental and Social Sustainability and World Bank Group (WBG) IFC General EHS Guidelines. It has also been prepared to align with international conventions to which Kenya is a signatory.

The ESIA has been prepared with due consideration for the multiple stakeholders within the administrative framework of Kenya, at community, County and National level. NEMA is the administrative body responsible for the coordination of environmental management activities in Kenya. NEMA is also responsible for the implementation of all environmental policies, as well reviewing and approving ESIAs.

3.0 IMPACT ASSESSMENT METHODOLOGY

The objective of the ESIA is to identify and quantify impacts that the Project may have on the environment and social receptors, using a staged approach, as detailed in Table NTS-1.

Table NTS-1: Approach to Impact Assessment

Stage	Activity
1	Establish baseline conditions – determine baseline conditions through review of existing published and available site-specific information.
2	Establish the key receptors and their importance.
3	Characterise the magnitude of the impact to the receptor Bio-physical: determine the potential changes to receptors brought about by the Project (including incorporated environmental measures) and assign a magnitude of impact. Social: determine the potential changes to Project Affected People (PAP) brought about by the Project and assign a consequence.
4	Assess the impact significance Bio-physical: determined by the nature and magnitude of impact, combined with the importance of receptor. Social significance of impacts defined by a narrative evaluating direction, consequence, geographic extent and duration of impact
5	Consider the need for monitoring and management – used where there is a need to support the implementation of or monitor the efficacy of any mitigation.

The Area of Influence (AoI) for the ESIA is shown in Figure NTS-2.

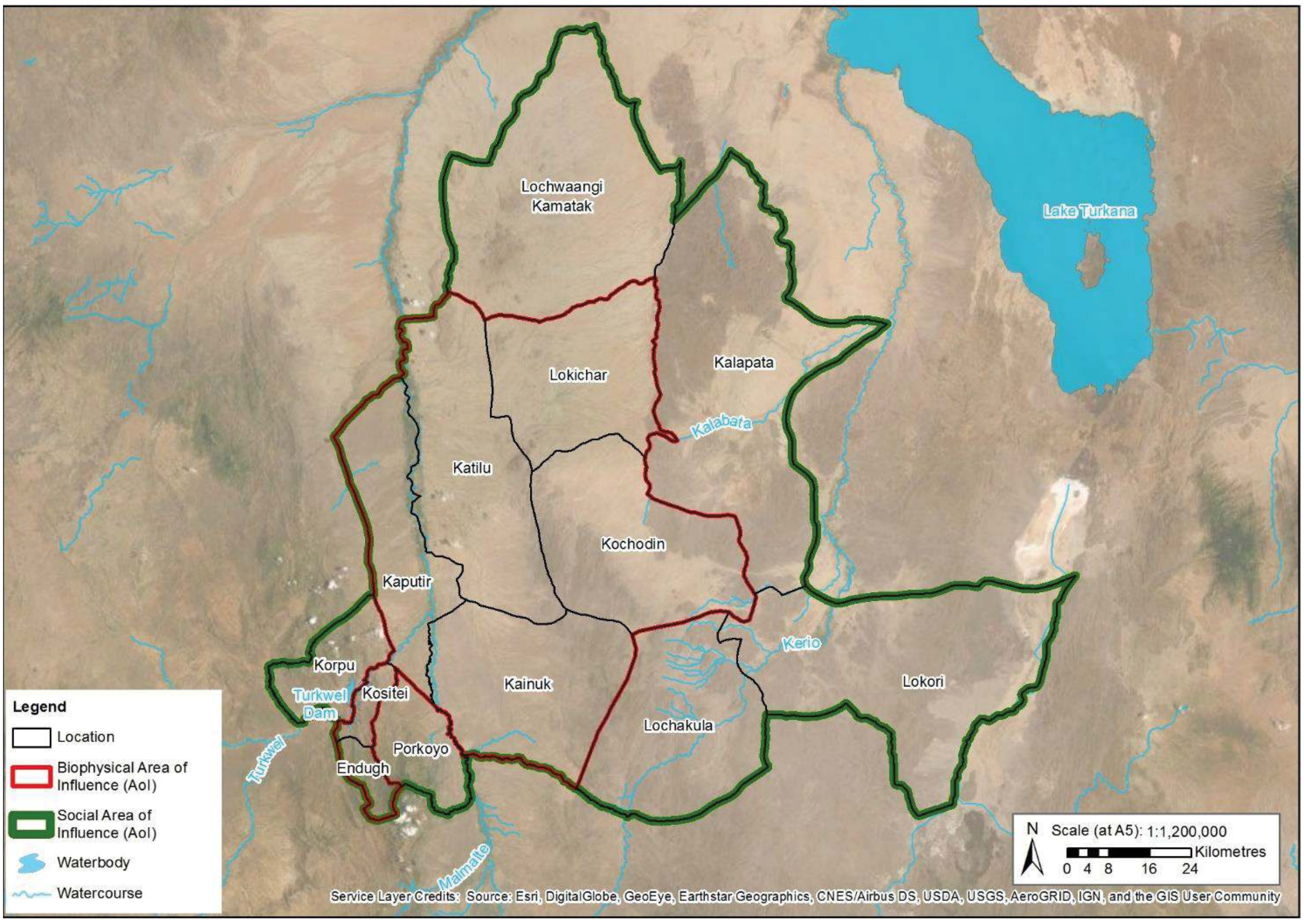

Figure NTS-2: Project Area of Influence

4.0 STAKEHOLDER ENGAGEMENT

Stakeholder Engagement will be completed in line with the Stakeholder Engagement Plan (SEP) which is publicly available on the Tullow website: https://www.tullowoil.com/Media/docs/default-source/operations/kenya-eia/esia-stakeholder-engagement-plan_september-2019.pdf?sfvrsn=2

Stakeholder engagement for the Project has been undertaken since the ESIA scoping stage in December 2015. Future planned engagement relating to this ESIA will include extensive consultation with Stakeholders on this draft ESIA. Consultation is planned at the earliest convenient time (dependent on restrictions relating to Covid-19) in 2020. The primary objective of this consultation is to ensure that stakeholder issues are registered and addressed in the final ESIA and PAP can discuss Project impacts, and proposed mitigation and monitoring measures. Stakeholders including local communities, government, civil society organisations and non-government organisations (NGOs) will be invited to participate in consultation on the draft ESIA.

5.0 PROJECT DESCRIPTION

The Project consists of the following key facilities:

- Use of the existing facilities developed as part of EOPS including wellpads, wells, production facilities and water supply boreholes;

- Use of existing wellpads, which do not form part of EOPS;
- New wellpads and 321 new wells;
- Use of the existing airstrip and basecamp which is leased by TKBV;
- Infield flowlines;
- Central Facilities Area (CFA) which includes a Central Processing Facility (CPF); the Lokichar Export Facility (LEF) associated with LLCOP, an ancillary area, an Integrated Waste Management Facility (IWMF), a permanent accommodation camp, a temporary accommodation camp, a drilling area and a construction laydown area;
- Additional temporary accommodation camps (water pipeline construction camp, rig camp and drilling mini-camp);
- Make-up water facilities;
- An engineered landfill facility (not located within the IWMF); and
- Infrastructure, including roads, power supply network and communications network.

Overview

Oil will be produced from production wells located on multiple wellpads across the TAN fields. An overview of the Project layout is depicted in Figure NTS-3.

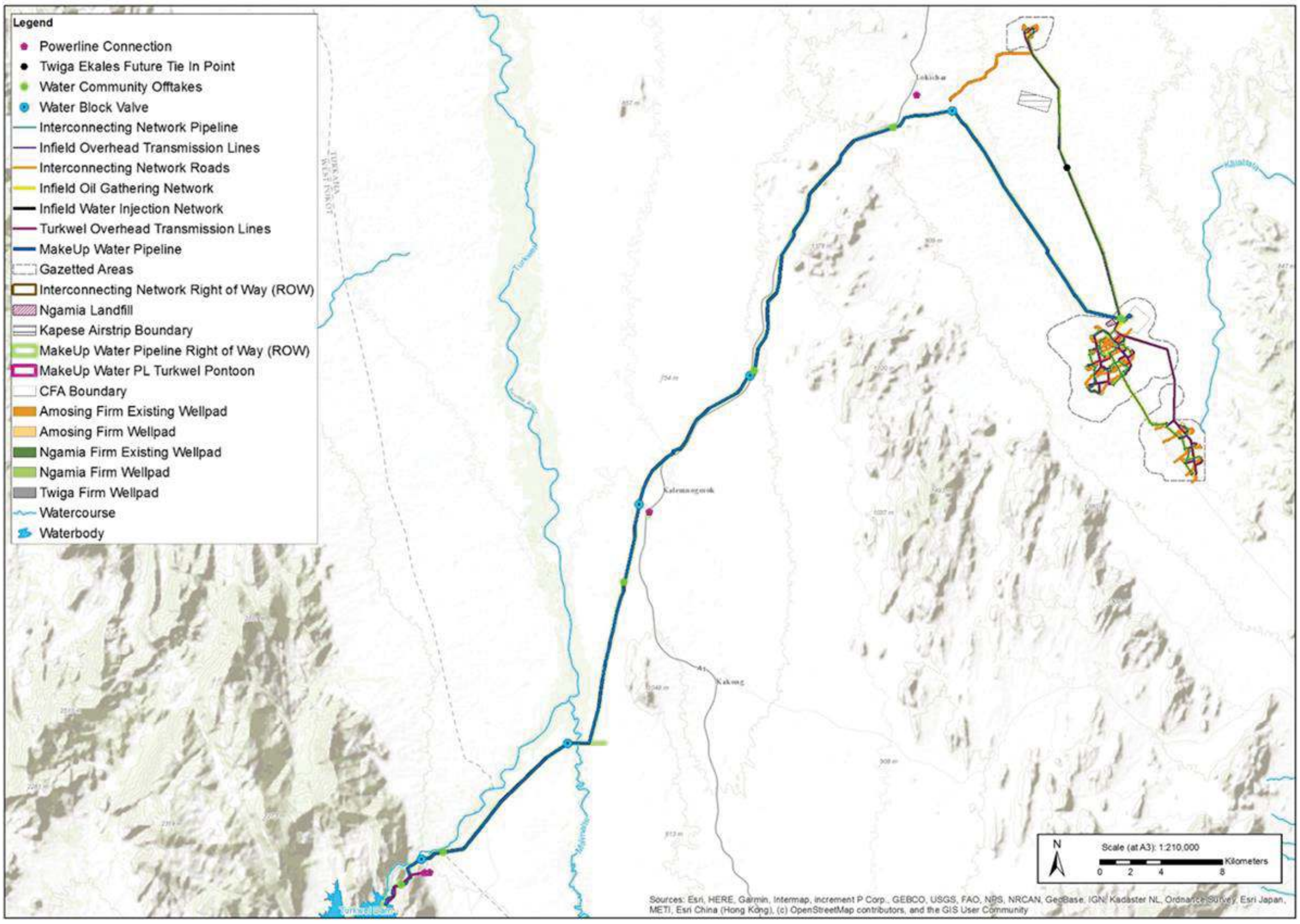

Figure NTS-3: Project Layout

The CPF will process the oil from the production wells to degas the oil, separate the oil and water and stabilise and heat the oil prior to storage and export to the pipeline. Flow from high carbon dioxide (CO_2) wells will be degassed separately prior to co-mingling with main oil treatment process

The construction period for the first 6 wellpads will be completed 15 months from the start of construction, when drilling of the wells required for Project First Oil (FO) will commence. The CFA, CPF and wells required for FO will be constructed by Month 36. The remaining 27 wellpads will be constructed with wells drilled up to Month 66. Operations are assumed to last approximately 25 years.

The Project requires access to approximately 1,085 ha of land to develop the facilities required to construct and operate the Project

Water Demand and Supply

During the early part of the construction phase, water supply will be from a network of existing boreholes. After approximately 18 months, water will be abstracted from the Turkwel Reservoir and transported via a buried pipeline.

Power Supply

During construction the power supply to construction camps, work areas, warehouses and drill rigs shall be provided by standalone diesel generators.

During operations, the power generation for the CPF is provided by two Gas Turbine Generators (GTGs). Wellpads will be powered by new Overhead Transmission Lines (OHTLs) and the permanent camp will be powered from the CPF substation.

Excess Gas

Produced gas from the oil reservoir will primarily be used for power and heat generation. In the first six years of operation, the predicted produced gas flowrate is in excess of the required demand for fuel gas, power and heat. Where there is excess gas, and no feasible, economic alternative use is identified, the Project will carry out flaring using a ground flare. After this initial period, the Project will be gas deficient and power will be imported from the grid to make up the shortfall.

Waste Management

During construction, the Engineering, Procurement and Construction (EPC) contractor will be responsible for waste management and disposal. This will be undertaken in accordance with Kenyan and IFC requirements. Drilling muds will be reused where possible and either buried in the vicinity of the wellpads (water-based muds) or stored on the wellpads prior to treatment and ultimate disposal at the engineered landfill (synthetic-based muds).

During operations, waste will be managed at the IWMF which will be located within the main CFA footprint. The IWMF will include a recycling area, an autoclave for the disinfection of medical waste, effluent and sewage treatment plants for treating wastewater and an incinerator for the disposal of wastes. The engineered landfill will continue to be used during operations for the disposal of non-organic wastes.

Workforce

The construction workforce is estimated to peak between 2,700 and 3,400. The final manpower requirements will be determined during detailed design and construction tendering prior to Final Investment Decision (FID). During operations, approximately 350 personnel will be required including upstream operators, midstream operators, catering personnel and well engineer/servicing personnel. In addition to these personnel, there will be up to 200 people sourced from the local community to fill roles such as guards and cleaners.

6.0 BASELINE SUMMARY

The following subsections provide a brief overview of the existing environmental and socioeconomic baseline conditions in the Project AoI and highlights receptors and resources sensitive to potential impacts.

6.1 Geology, Geohazards and Seismicity

The geological setting of the region is based on secondary research. The geology in the AoI largely comprises Tertiary and Quaternary sediments and volcanic rocks. Soils are locally saline, contain few rocks or stones, and are moderately susceptible to erosion from flood events and wind. The primary geohazards in the area are related to the coarse-textured soils. In low-lying areas, they may be prone to annual or periodic flood events and road washouts or undercutting of project infrastructure is possible. In Turkana and West Pokot the natural earthquake hazard is rated by the World Health Organization (WHO) (2010) as low to medium.

6.2 Soils

The soils baseline incorporates secondary data from official sources and primary data which comprises a collection of surface soil samples (topsoil). The area is characterised by typical desert-like sandy soils with some minimal areas of clay loam. Sand is the dominant particle size at all test pits across the TAN sites, which coincides with the dominantly sandy characteristics of soil which are typical of this region. Total carbon, organic carbon and inorganic carbon values are low across the TAN fields which reflects the naturally very low soil organic matter content of soils in the region. Infiltration testing near Ngamia indicates fine to medium sandy soils and near Amosing, loamy soils.

6.3 Weather and Climate

The meteorological conditions were determined with focus on primary data at Kapese and Ngamia and secondary data from the wider region including Lodwar and Mesoscale Model Interface Program (MMIF) Modelled Data.

Conditions are generally dry with ‘long rains’ of the rainy season in April to June and ‘short rains’ in November with average monthly total precipitation varying between approximately 1 millimetre (mm) and 110 mm. Average and maximum monthly wind speeds at Kapese and Ngamia are low and do not exhibit any distinct seasonal variation with east-north-east prevailing winds at Kapese and north-east, south-east and south-south-east prevailing winds at Ngamia. Recorded average monthly temperatures are similar at both stations and range from approximately 27.5 degrees Celsius (°C) to 31.0°C.

Regarding climate change trends, daily temperature observations indicate increasing trends in the frequency of hot days and hot nights, precipitation patterns indicate an increase in the proportion of rainfall occurring in heavy rain events and in the AoI, the projected median change in mean annual temperature is 1.2°C by the 2030s.

6.4 Air Quality

Primary baseline data is focused on the South Lokichar basin within the AoI. Air quality data was collected at Twiga-1 wellpad, Lokichar town, Kapese camp, Amosing-5 wellpad, and Ngamia 5/6 wellpad. For most of the monitored substances, baseline values are low in comparison to the Air Quality Standards (AQS). Baseline concentrations of total suspended particles were above the AQS. Concentrations of deposited dust vary throughout monitoring locations and the average concentrations recorded at any location (excluding Lokichar) are less than 90% of the relevant Standard.

6.5 Noise and Vibration

Noise baseline data gathering was completed within the AoI during five field surveys between 2015 and 2019. The monitoring locations were associated with potential receptors and include Lokichar, Twiga-1, Amosing-5, Ngami-5/6, and Kapese camp. No vibration data was gathered as part of the ESIA baseline due to the greenfield nature of the Site.

Night-time minimum noise levels were recorded at or near the equipment minimum (~20 A-weighted decibels (dBA)) at several monitoring locations. Higher daytime noise levels were recorded in comparison to night-time levels, which is generally attributed to widespread activities during daylight hours, including vehicle traffic and human and livestock movements. Noise data was gathered to calculate an average daytime and night-time noise level for each of the locations. The average outputs are above the Kenyan standards for both periods at Lokichar (also above IFC standards) and Ngamia 5/6 (daytime greater than IFC standard) and for daytime only at Kapese.

6.6 Water Quality

Due to the ephemeral nature of the surface water in the area, the water quality baseline largely focusses on groundwater quality data. Primary information includes sampling of groundwater wells, surface locations, surface watercourses and surface water bodies and water samples were later analysed in the laboratory.

In general, water quality across the AoI is good with no inexplicable exceedances of project water quality standards. There are some influences of the natural environment (high concentrations of sodium and fluoride).

6.7 Water Quantity

The baseline comprises primary data gathered by Golder or provided by TKBV or its contractors. This includes precipitation data, infiltration tests, groundwater level monitoring and surface water flow monitoring.

The AoI is located in the Rift Valley Basin Area, partly in the Kalabata catchment and partly in the Turkwel catchment (see Figure NTS-4). The Kalabata water course is a sub-catchment of the Kerio basin. The Kalabata River is an ephemeral watercourse that is fed by direct precipitation, run-off and ephemeral flow from luggas that provide a drainage network from the south-west. Flow in the luggas is ephemeral and driven by short duration, intense seasonal rainfall. The Kerio and the Turkwel Rivers both ultimately discharge to Lake Turkana. The Turkwel River receives input from the Malmalte River and discharges from the tailrace of the Turkwel Dam after power production. Discharges from the tailrace mean that flows in the upper reaches of the River Turkwel are typically perennial

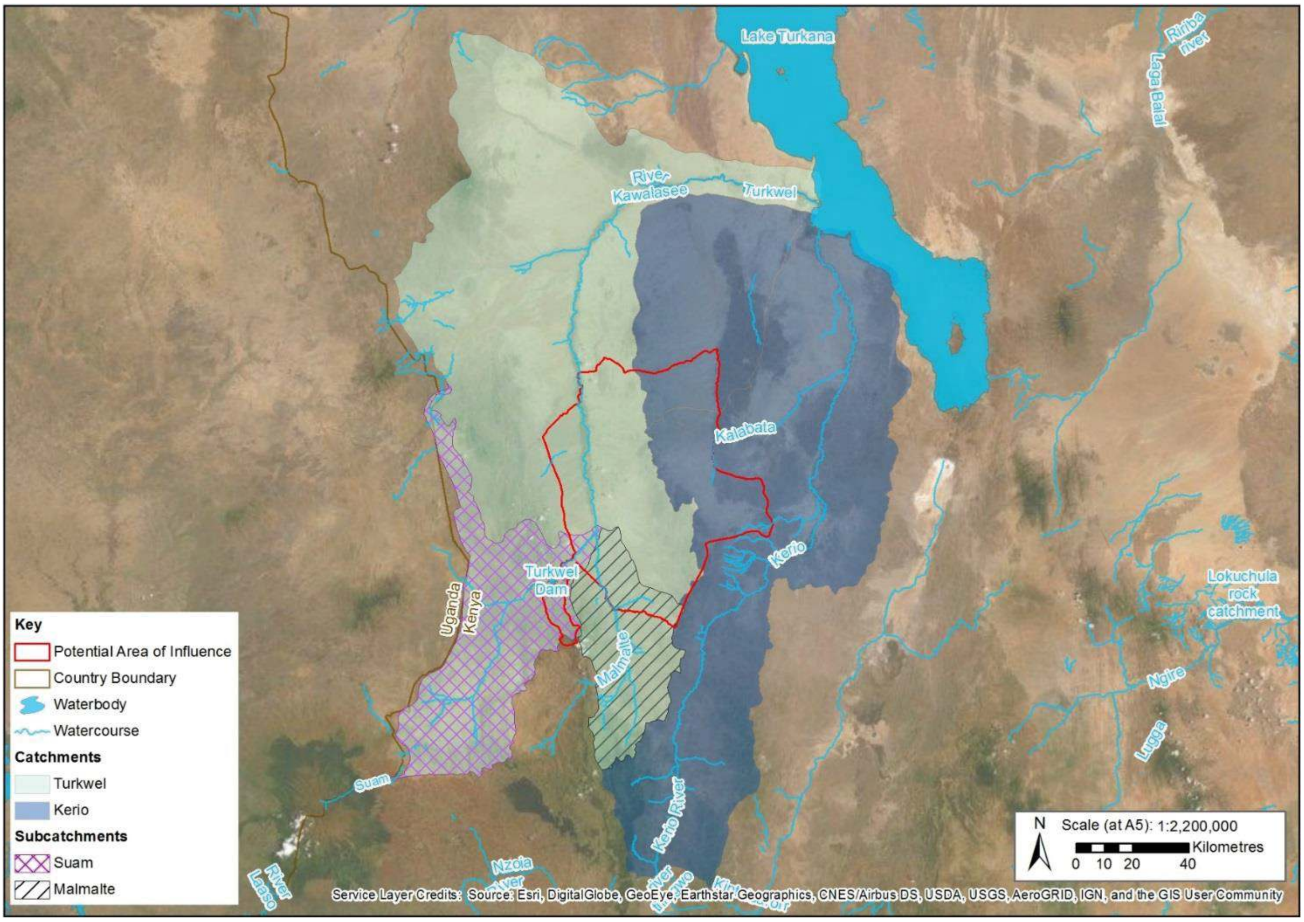

Figure NTS-4: Kalabata and Turkwel Catchments

6.8 Biodiversity, Ecology and Protected Areas

The baseline ecology and biodiversity in the AoI have been characterised using both primary and secondary data. Primary field surveys were designed to collect, process and provide analysis of data gathered within the AoI (including surveys on vegetation, invertebrates, amphibians, reptiles, birds, mammals and fish). The secondary assessment comprised a literature and database review and analysis of existing information.

Vegetation

The field surveys confirmed six broad vegetation communities in differing areas across the AoI. No threatened vegetation communities were recorded. Acacia (thorny tree and shrub) species dominate the vegetation communities, depending on location and degrees of aridity. These communities occur in areas along the large luggas, woodland/bushland on the plains, bushland/thicket mosaic west of the Malmalte River, and the shrubland on steep rocky slopes of the high ridge between Turkwel Dam and the Malmalte River. Forest along the Malmalte River is the only true forest community observed between South Lokichar and the Turkwel Dam.

Euphorbia turkanensis, a range-restricted plant species only known from sites within the AoI, was recorded at various locations along the make-up water pipeline route.

Invertebrates

A total of 6,513 invertebrate specimens were collected. These included spiders, centipedes, millipedes, woodlice, camel spiders, scorpions, and insects. By far the most abundant and diverse invertebrates in the region were the insects, with 12 orders recorded, comprising families and 466 genera.

An invertebrate species of concern was recorded. A single specimen of a ground beetle was collected near Loperot, in the east of the AoI. This genus has never been recorded in Kenya and represents a species new to science.

Amphibians and Reptiles

Eighteen amphibian and reptile species were recorded in the AoI. Apart from the Turkana toad, no species of conservation concern were recorded.

The Turkana toad, an amphibian species of conservation concern, was recorded in the Kalabata River. It is a range-restricted species previously only known from two localities: Loiengalani on the south-eastern shores of Lake Turkana, and the Ewaso Ng'iro River in the Samburu Game Reserve (IUCN, 2019). Its presence in the AoI represents an extension of its known range. It is listed as 'data deficient' by the IUCN, and 'Protected' by Kenyan legislation (KWCMA, 2013).

Birds

Two hundred and seventy-six bird species were recorded in the AoI.

Fifteen species of conservation concern were recorded. These included: the African white-backed vulture and Rüppell's vulture, which are both listed as 'critically endangered' by the IUCN; and the lappet-faced vulture and steppe eagle, which are both listed as 'endangered' by the IUCN. Another two bird species listed as 'vulnerable' and two as 'near threatened' by Kenya legislation, were confirmed within the AoI.

Mammals

Thirty-six mammal species were either directly observed or deduced to be present, based on secondary evidence (for example, tracks and signs). Twenty-five medium and large mammal species[1], and nine small mammal species were recorded over the four seasonal mammal surveys.

Four mammal species of conservation concern were confirmed: African elephant, striped hyena, leopard and lesser kudu. The African elephant, striped hyaena and leopard are all listed as 'endangered' in Kenya.

Fish

Surveys of the Turkwel River, downstream of the Turkwel Dam, and downstream of the confluence with the Malmalte River in the vicinity of Kaputir village were completed.

The Senegal minnow was the most abundant species recorded, while the Cyprinidae was the most diverse family, with seven species recorded. Four cichlid species were recorded, including Nile tilapia. The Nile tilapia has reportedly been stocked in the Turkwel Dam to promote fisheries in that impoundment.

Two Haplochromis species were recorded in the Turkwel River, both species were previously only known from Lake Turkana. The records from the Turkwel River therefore represent a range extension for these species.

6.9 Ecosystem Services

Ecosystem Services are natural products and processes that contribute to human well-being and the personal and social reliance on natural resources.

An ecosystem service prioritisation exercise was undertaken which identified the following key natural resources used in the Project AoI:

- Provisioning services including cultivated foods, grazing/browsing resources for livestock, wild foods, biomass fuel (wood and charcoal) and biological raw materials (used for construction of traditional houses)

[1] Medium and large mammal species include all species except rodents and bats.

from ephemeral stream woodlands and riparian forest ecosystems used by some residents and pastoralists

- Fresh water supplied from Turkwel Dam, ephemeral stream woodland and riparian forest used by some residents and pastoralists
- Cultural services including spiritual values, and educational and inspirational ecosystem services supplied by Acacia-commiphora bushland/thicket, ephemeral stream woodland and riparian forests used by some residents and mobile pastoralists

6.10 Landscape and Visual

The aesthetic quality of the landscape was ascertained through the baseline study. The landscape is predominantly semi-desert with some areas of dense bushland, rocky habitat/stunted bushland, and alluvial woodland.

The desktop study identified the following:

- Settlements are scattered and predominantly comprise of semi-permanent, individual residential dwellings of simple construction (homesteads), larger concentrated settlements and permanent major settlements (e.g. Lokichar).
- Roads are generally compacted bare earth tracks, except for stretches of tarmacked surfaces on the A1 road, which passes down from Lokichar towards Kainuk.
- With respect to artificial lighting, minimal light pollution occurs as the area does not have a built-up nature. Existing facilities at Kapese base present some night-time lighting within the camp area. Further light sources are located at Lokichar; the nearest urban centre to the Upstream facilities, which is located approximately 7.5 kilometres (km) to the south-west of the Twiga oil field.

6.11 Social

The socio-economic baseline includes a wide range of secondary material on general socio-economic data that has been gathered and consolidated between 2015 and early 2019. Primary information was also collected through field visits in West Pokot and Turkana for both socio-economic and health community disciplines.

A brief summary of the main findings for each of the socio-economic sub-categories addressed as part of the socio-economic baseline is presented below.

6.11.1 Administrative Divisions and Governance Structure

Turkana County is divided into seven Sub-counties and West Pokot County is divided into four Sub-Counties. Each Sub-county is further divided into Divisions, Locations and Sub-locations.

Divisions, Locations and Sub-locations are part of a national government administrative structure. This overlaps with the Sub-county structure, however a Ward is part of the newly instituted devolution process. Sub-county Administrators and Ward Administrators are part of the county government administration structure. The Constitution of Kenya (2010) set up these two levels of government, making a shared mandate between the national government and counties.

The primary focus of socio-economic baseline is the two Sub-counties of Turkana South and Turkana East in Turkana County, plus the four Locations adjacent to the Turkwel Dam, the proposed water abstraction point. These Locations are part of three Sub-counties in West Pokot, Pokot West, Pokot North and Pokot Central.

6.11.2 Demographics

The most recent census data from the Kenya Population and Housing Census (KPHC) was conducted in 2019.

The previous census conducted in 2009, counted a total population of 855,399 in Turkana County and 926,976 in 2019. For West Pokot, the total was 512,690 in 2009 and 621,214 in 2019. The new census information shows slower population growth than previously anticipated.

Sub-county figures suggest movement within Turkana County, especially to Turkana East with a population increase of over 50% indicating a shift towards the Project AoI. The socio-economic baseline also reports on migration and vulnerable groups. Turkana and West Pokot migration is driven by seasonal changes due to pastoral culture and lifestyle. Migration of pastoralists and livestock to seek better water sources leads to increased competition for these available resources, especially in times of limited rainfall.

6.11.3 Infrastructure and Services

Infrastructure and services are improving as a result of the devolved system of government. Health facilities are improving and the distance to health facilities has been reduced. There are more Early Childhood Development (ECD) facilities, which has allowed more access to education for small children. Improvements have been generally more noticeable in Lodwar, as a result of increased employment from devolution and the activities of key NGOs. However, some areas have not seen much improvement at all, especially in areas affected by the lack of security along the A1 highway.

West Pokot County infrastructure is similar to that of Turkana County, with poor waste and sanitation systems. Education facilities are also limited, especially for pastoralists. Facilities, including schools, are reportedly minimal unless they are funded by faith-based organisations (FBOs) or NGOs.

6.11.4 Economics, Employment and Livelihoods

Most people in Turkana County and West Pokot County depend on nomadic pastoralism, as well as some crop farming, fishing and weaving for their livelihood. The Kerio River and Turkwel River are key sources of water to support animal husbandry and farming is mainly practiced at household level through irrigation along the Turkwel and Kerio Rivers. Fishing is also practiced in Lake Turkana.

In West Pokot County, apart from agricultural and livestock enterprises, transport, trade and small-scale gold mining is increasing in economic importance. The trade in the market centres is increasing, especially at Makutano, Chepareria, Ortum and Marich townships. Small-scale gold mining activities are present in parts of the county and support thousands of people.

Wage earners constitute only 6% of the population in Turkana County. Unemployment levels are estimated at 70% in contrast to national figures of 42%. Wage earners in West Pokot County constitute only five percent of the population.

Turkana has some of the highest levels of poverty in the country. The Kenya National Bureau of Statistics (KNBS) reports poverty at 94%, and the poverty rates in West Pokot County currently stand at 68.7%, approximately 433,656 people.

6.11.5 Land Use and Ownership

The following describes the baseline land use across the TAN fields, interconnecting network and water pipeline routes.

Twiga, Amosing and Ngamia fields

Land use baseline surveys have been undertaken by TKBV in the three gazetted field areas from 2015 to 2019 to record patterns of land use and numbers of occupied homesteads. The baselines of November 2018 and July 2019 provide an indication only of the numbers and locations of occupied homesteads that could be present when land acquisition surveys are undertaken by the NLC and provide a basis for the assessment of impacts arising from Project land access.

Twiga – Occupied homesteads were identified in 2018 and 2019. The new Lomokamar Primary School classroom in use in November 2019, is located 120 m north of the Twiga field area.

Ngamia – Occupied homesteads were identified in 2018 and 2019.The Ngamia Secondary School lies just inside the south-east boundary of the Ngamia field, approximately 1.8 km away from any planned Project wellpads.

Amosing - Occupied homesteads were identified in 2018 and 2019. The new Lokosemikori Primary School is located near the centre of the Amosing field area, approximately 800 m west of the Amosing-3 wellpad**.** The school was constructed in 2018 but was not yet in use as of November 2019.

Interconnection Routes Between Fields

The routes pass through sparsely populated areas of communal livestock grazing land, all classified as unregistered community land.

The routes of interconnecting buried flowlines and OHTL run for 18.3 km between the Twiga field and the Ngamia field and a shorter 800 m section between the Ngamia and Amosing fields.

Baseline data analysis on land use along the Right of Way (RoW) for the interconnection routes involved a baseline survey undertaken on the ground by TKBV in July 2019 and review by Golder of aerial imagery taken in early 2018 and July 2019 which identified occupied homesteads along the route.

Water Pipeline

The water pipeline runs for approximately 90 km from the Turkwel Dam to the CFA. The pipeline will be buried and pass for approximately 8 km from the Turkwel Dam through land in West Pokot and then for approximately 80 km through land in Turkana County

All land through which the water pipeline passes in Turkana County is understood to be unregistered community land. The approximate eight km stretch in West Pokot is also understood to be unregistered community land, with a small area next to the Turkwel Dam understood to be owned by the Kerio Valley Development Authority (KVDA). Desk based analysis of the 27 m wide construction RoW using aerial images taken in July 2019 identified areas containing buildings and potential homesteads or other signs of land use such as animal shelters.

6.11.6 Community Health and Safety

An estimated half of the facilities are public (government owned), 38% private-for-profit, 10% FBOs and 3% NGOs. According to official County documents, the average distance to a heath facility is 35 km in Turkana County, and 25 km in West Pokot.

The leading causes of morbidity in the area are predominantly communicable and infectious diseases particularly upper respiratory tract infections, malaria, diarrhoeal diseases, skin diseases, and pneumonia. Malnutrition and anaemia also featured among child morbidities, but the burden could be underestimated given that most of the cases (mild-moderate) remain undetected at the community level. Eye and ear infections were also common as were intestinal worms, animal bites and injuries. Human Immunodeficiency Virus (HIV)/ Acquired Immune Deficiency Syndrome (AIDS) and tuberculosis (TB) also cause significant morbidity and mortality, especially among adults. Non-communicable diseases are emerging, particularly hypertension, but these are still overshadowed by the high burden of communicable diseases. Predisposing factors to disease burden in the area include favourable environments for mosquitoes to proliferate, dust that contribute to respiratory ailments, poor access to safe drinking water and sanitation, high levels of poverty and food insecurity, and cultural practices.

6.11.7 Education

There are only 315 primary schools and 32 secondary schools in all of Turkana County. There are polytechnic institutes in Kakuma and Lodwar; two colleges, one focussed on health and the second on teacher training. The only campus university sites are in Lodwar and Lokichoggio, and a Technical Training Institute is being built in Lodwar.

In the Kositei Location, West Pokot Sub-County, there are five primary schools, one each in Turkwel, Kudungole, Chepokachim, Riting and Reres villages. There is only one secondary school at Turkwel.

The low literacy levels of 22.2% in Turkana County can be attributed to many causes that include extreme poverty, understaffing in schools and cultural practices such as early marriages. The literacy levels in West Pokot County stands at approximately 40% but this varies in the Sub-counties and Pokot West Sub-county has a high illiteracy rate of around 67%.

6.11.8 Social Maladies

According to numerous key informants interviewed in Turkana, alcoholism has increased and greatly influences youth, in some cases causing them to lose jobs. Due to peer groups, youth are drawn into smoking cannabis (*bhang*) and chewing khat (*miraa*), which it is linked to individuals becoming homeless. In Kainuk, focus group participants report new types of drugs and alcohol being consumed, in some cases incapacitating people for up to three days. Social Maladies in West Pokot County are similar to those in Turkana. Child Labour is prominent due to livelihoods which entail young boys to herd livestock and young girls employed as house girls.

6.11.9 Social Capital and Conflict

A total number of 106 security incidents have been registered in Turkana and West Pokot during the reporting period August 2018 to July 2019. These are differentiated as banditry, cattle raids, civil disorder and intercommunal violence incidents. Turkana accounts for 85.8% of the total number of incidents. The security reports reveal that the number of incidents related to cattle raiding have increased during the first quarter of 2019. West Pokot has fewer reported incidents over the same reporting period with two cattle raids registered during October 2018 and June 2019.

6.12 Cultural Heritage

The cultural heritage baseline was defined through a mix of desk-based research, field survey and community consultation between 2016 and 2019. This work was undertaken by Golder, with support from specialists from the National Museums of Kenya (NMK).

Data was captured from across the South Lokichar Basin, with a total of 2,123 cultural heritage assets identified. These included large volumes of archaeological remains, such as pottery and stone tools, as well as living cultural heritage sites, such as elder/sacred trees, churches and graves. Elements of intangible cultural heritage were also identified, including distinct Turkana and West Pokot cultures (including belief systems, societal structures and traditional practices), nomadic pastoralism and environmental subsistence.

7.0 POTENTIAL IMPACTS AND MITIGATION

The following presents a summary of the main potential impacts (only) and key commitments to manage or mitigate potential impacts.

7.1 Air Quality

Dust generated by construction activities are identified as having the potential to impact on people and ecological receptors within 250 m of the Project footprint. During operation, impacts are expected within a defined area near the CPF, and on people travelling through that same area, as a result of small particulate emissions.

Key commitments to mitigate and manage impacts include:

- Communication to local communities of the construction schedule, the potential duration of construction activities and the risks of exposure for extended periods;
- Effective signage to explain risks associated with staying in affected areas for extended periods;
- Pre-construction surveys to map sensitive species distribution. Once surveys are completed, suitable mitigation will be developed where appropriate; and
- Homesteads within affected areas will be considered under the Land Acquisition and Resettlement Framework (LARF).

With mitigation in place, impacts during construction and operations are all expected to be of **Minor** or **Negligible** significance.

7.2 Noise and Vibration

The impacts of vibration are considered to be **Negligible**.

Construction noise from building the Project and drilling wells is expected to impact people who are both permanently based within close proximity of the Project footprint and those who use the area temporarily. These impacts will not be throughout the entire construction period but will be linked to specific construction activities. It is expected that noise during operation has the potential to impact upon people who temporarily use land in close proximity to the Project footprint.

Key commitments to mitigate and manage impacts include:

- Communication to local communities of the construction schedule, the potential duration of construction activities, the noise levels during construction (including well drilling) and the risks of exposure for extended periods;
- Communication to local communities of potential change to noise levels during operation to encourage avoidance or minimal exposure;
- Signage should be put in place around operational areas, to further communicate the risks;
- TKBV will exert influence over the owners of the airstrip to consider a communication plan to encourage avoidance or minimal exposure during the Kapese airstrip upgrade work.

With these mitigation in place, impacts during construction and operation are all expected to be of **Minor** or **Negligible** significance.

7.3 Water Quantity

During construction, it is expected that the abstraction of water from the abstraction wells for the Project, discharge of water from the Project and activities near or within watercourse have the potential to impact upon water quantity in the Kalabata River, seasonal rivers/ streams and drainage luggas, and the Turkwel Reservoir.

Key commitments to mitigate and manage impacts include:

- Communication and provision of alternative water supplies where shallow groundwater could be affected during construction;

- Monitoring of shallow groundwater adjacent to sensitive habitats to establish baseline groundwater levels and to monitoring groundwater abstraction during construction along the Kalabata River (see Section 7.7).
- An action plan to avoid long term stress of potential critical habitat along the Kalabata River relating to groundwater abstraction during construction;
- Adoption of the water management philosophy to promote efficient water use, reuse and disposal;
- Site specific assessments to identify any local water users dependent on access to local water supplies prior to construction;
- Climate change management plan (including supply security assessment to account for climate change scenarios) will be developed to make sure an adequate supply from the reservoir, or alternative, can be maintained for the Project; and
- Determination of a reservoir water level, below which Project abstraction would impact other reservoir water users and an action plan should unprecedented changes in reservoir level occur.

With these mitigation measures in place, impacts during construction and operation are all expected to be of **Minor** or **Negligible** significance.

7.4 Water Quality

There is potential that water quality may be impacted during construction as a result of activity in or near watercourses and discharges/releases to watercourses from waste storage and disposal activities. These impacts (without mitigation) have the potential to affect water quality in either the Kalabata, Turkwel and Malmalte Rivers, seasonal rivers/ streams and drainage luggas, the Turkwel Reservoir and groundwater. It is predicted that, during operation, water quality may be impacted by discharges/releases to watercourses from waste storage and disposal activities.

Key commitments to mitigate and manage impacts include:

- Managing construction works in the rainy season and periods of extreme rainfall with temporary erosion control measures, water quality monitoring programmes and minimising work in seasonal watercourses when there is flow to reduce the generation of sediment mobilisation;
- Where necessary, during construction, temporarily redirecting the flow to re-join the watercourse further downstream;
- Monitoring of shallow groundwater quality in the Kalabata River prior to and during construction;
- Monitoring of water quality in sensitive environments in the Turkwel River prior to and during construction;
- Production and implementation of a construction waste management plan;
- Site drainage systems that are isolated from surface and groundwater;
- Landfill leachate monitoring and management and surface water management system at the engineered landfill; and
- Groundwater monitoring will be installed around the engineered landfill and CFA.

With this mitigation in place, impacts during construction and operation are all expected to be of **Minor** or **Negligible** significance.

7.5 Soils, Terrain, Geology and Seismicity

During construction, it is predicted that soils with agricultural potential will be impacted by ground disturbance and the handling of topsoil.

Key commitments to mitigate and manage impacts include:

- Implementation of a soil management procedure, erosion control plans and rehabilitation plans to revegetate areas of agricultural potential and reduce soil erosion;
- An erosion control plan outlining soil conservation tactics for works during extreme rainfall events and extreme dry, windy events during construction;
- Storage of topsoil for no more than 6 months along the water pipeline;
- Salvage topsoil in areas where it occurs in the direct soil disturbance footprint of the CFA, wellpads, engineered landfill, roads and camps; and
- The make-up water pipeline will be inspected within the first two years following construction to identify areas of erosion and subsidence.

With this mitigation in place, impacts during construction and operation are all expected to be of **Minor** or **Negligible** significance.

7.6 Landscape and Visual

It is expected that construction works will impact on the landscape within the Nasolot Nature Reserve and the Pellow Community Conservancy. Construction activities are expected to have visual impacts upon people and visual impacts from Project infrastructure and site activities are expected to impact people during operation.

Key commitments to mitigate and manage impacts include:

- During construction, night-time working (dusk until dawn) is avoided, in areas within 100 m of the Nasolot National Reserve (NR) or Pellow Community Conservancy unless agreed by TKBV and supervised by the Project Biodiversity Clerk of Works (BCoW);
- Communication of the construction schedule to the administrators and users of protected areas;
- Where possible, natural screening will be maintained as well as vegetating stockpiles, dust suppression and minimising light spill;
- A Grievance Management Procedure will be implemented, to enable the recording and follow up of complaints related to Project activities that could contribute to visual impacts; and
- During operations, where practical, landscaping (including earth bunds and vegetation) will be maintained to act as screening.

With this mitigation in place, impacts during construction and operation are all expected to be of **Minor** or **Negligible** significance.

7.7 Biodiversity, Ecology and Protected Areas

A range of important biodiversity receptors, including habitats, species of conservation concern, and protected areas, are expected to be impacted upon during construction and operation. These include: forest vegetation along the Malmalte River; range-restricted plant species; elephants; vultures; the Turkana toad; a ground beetle; fish; the Nasolot NR and South Turkana NR; and the Pellow Community Conservancy.

These biodiversity receptors trigger critical habitat (CH)[2], as defined by the IFC's PS6 (2012), within the AoI. Critical habitat potentially impacted by the construction and operation of the Project include: *Euphorbia turkanensis* identified along the water pipeline route; the African elephant populations, which extend from the Kerio Valley in the south, to the South Turkana NR and Nasolot NR in the north; leopard and striped hyaena populations in the peripheral rocky ridges and densely vegetated habitats along the Malmalte and Turkwel Rivers; a ground beetle species new to science recorded and collected near Loperot in the east of the AoI; the Turkana toad, recorded in the vicinity of the Kalabata River; and vulture and steppe eagle populations in the AoI with the CH restricted to those areas where vultures are likely to encounter carrion, preferred flights paths and areas where they are likely to find large trees for nesting and roosting

Impacts on biodiversity receptors are predicted from a number of construction and operation-related activities, including direct disturbance and land take, disruption of ecological connectivity, sensory disturbance, introduction of alien invasive species, and increased mortality/persecution as a result of interactions between animals and humans (particularly traffic), and between animals and project infrastructure (particularly OHTL).

Impacts on habitats and species are also expected to occur specifically during operation due to increased access along the RoW resulting in increased human interaction, direct mortality (e.g. from traffic, OHTLs or flares), persecution, sensory disturbance, and 'edge' impacts. Edge impacts are those that occur in transitional habitats (e.g. the habitat between woodland and the desert), and, with regard to the Project, are particularly associated with the establishment of invasive plants species.

Key commitments to mitigate and manage impacts include:

- Monitoring to establish baseline physiological stress levels in riparian trees, humidity levels, and shallow water level data adjacent to potentially affected habitats for the Turkana toad and undescribed beetle, which trigger critical habitat and potential nesting habitat for vultures. Plus, continuation of this monitoring during construction when groundwater abstraction will occur;
- Turkana toad and beetle surveys will be completed during a rainy season ideally May/June prior to construction (the season when data was originally collected in 2016), to establish likely baseline presence in the Kalabata and areas likely affected by groundwater drawdown during construction;
- Should evidence of the Turkana toad be collected, the survey will be repeated on a yearly basis in May/June during the period of groundwater abstraction during construction;
- A Biodiversity Management Plan (BMP) is proposed, which will include a range of management plans for rehabilitation after ground disturbance, a wildlife rescue plan, and a range of species-specific management plans (e.g. Turkana toad, undescribed beetle, elephant, leopard, striped hyaena, vultures, *E. turkanensis*, as well as invasive species);
- Demarcation of sensitive areas during construction, including critical habitats;
- Avoiding night-time driving, where possible;
- Including bird-friendly design measures in the OHTL design;
- Exerting influence over the relevant Kenyan electricity company to implement an OHTL mitigation and monitoring programme to assess effectiveness of bird impact mitigation measures;

2 Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

- Staff environmental inductions;
- Development and Implementation of an Influx Management Plan;
- Development and Implementation of an Invasive Species Management Plan (ISMP), vegetation and wildlife monitoring programmes;
- Development and implementation of a Rehabilitation plan;
- Effective communication with, and logistical support for, Kenya Wildlife Service (KWS);
- Implementation of a start-up routine for flares that includes checking for the presence or proximity of birds; and
- During detailed design, a review of off-site light spillage will be undertaken and any identified mitigation measures will be implemented.

With these mitigation measures in place, the majority of the impacts are expected to be of **Minor** or **Negligible** significance. **Moderate** significance impacts during construction are expected on elephants, leopards and striped hyaena, the Turkana toad and the ground beetle species. Mitigated impacts on vultures are expected to be **Moderate** during both construction and operations.

7.8 Ecosystem Services

During construction, it is expected that there will be impacts on cultivated and wild food, grazing for livestock, medicinal plants, freshwater, cultural sites (such as sacred trees) and spiritual values. These impacts will occur primarily as a result of direct disturbance and changes to land cover reducing the availability of certain resources, but also due to increased demand as population increases. Water abstraction and changes to the air, noise and visual environment will also have an impact. During Project construction, micro-alignment of the route within the RoW will be used to avoid direct impacts on sacred trees, however, one sacred tree (CH-046 near Twiga) is located in close proximity to the RoW. The tree could be directly impacted by construction dust and users of the tree could be impacted by visual disturbance.

During operation, it is expected that, as a result of influx and the presence of the Project within the landscape, there will be impacts on wild food, grazing for livestock, medicinal plants, biomass fuel, wood and fibre, spiritual values, and educational and inspirational values.

Key commitments to mitigate and manage impacts include:

- Adoption of biodiversity and ecosystem services (BES) management practises to address impacts, dependencies, risks and opportunities on ecosystem services, in line with GIIP;
- Influence all third-party contractors to ensure the avoidance of impacts on cultural heritage features (such as sacred trees) that are essential to the identity and/or cultural, ceremonial, or spiritual aspects of beneficiaries' lives;
- Sacred sites close to construction/operation areas should be protected through demarcation of no-go areas for vehicles and Project personnel;
- Avoid beekeeping enterprises and farms where possible;
- Pre-construction survey to identify any cultivation areas likely to be impacted and rehabilitation plan immediately post-construction where necessary;
- Consultation with the local community will be undertaken and a communication plan will be produced and implemented involving relevant traditional leaders in relation to the affected sacred tree;

- A cultural heritage management plan;
- Encourage sustainable use of water points to discourage overgrazing, and record issues as part of the grievance mechanism;
- Economic displacement (e.g. loss of grazing/browsing resources) experienced by affected pastoralists will be addressed via the Livelihood Restoration Plan (LRP);
- Community development planning that will support developing sustainable herding practises, crafts, ecotourism or other activities that provide alternative livelihoods and income;
- Enforcement of a ban on purchasing locally produced charcoal for sale outside camps for Project personnel;
- Rehabilitation of affected cultivation areas;
- Further studies into the economic and importance of livestock to pastoralists, use of wild foods and medicinal plants; and
- Develop and share an influx management plan with Turkana and West Pokot County governments.

With these mitigation measures in place, the majority of these impacts are expected to be of **Minor** or **Negligible** significance. **Moderate** residual impacts are expected on the one sacred tree (CH-046) near Twiga and associated spiritual values.

7.9 Social

Social impacts are a mix of both positive and negatives impacts for both construction and operation and are linked to:

- Project-induced influx and in-migration;
- Infrastructure;
- Economics, employment and livelihoods (including taxes and payments; contractor employment; business opportunities and local content; and inflation);
- Land use and ownership (including long term loss of community land; temporary restriction on land use - particularly in relation to pastoral use); long term restriction on settlement along the water pipeline route; loss of occupied homesteads, other household structures and business structures; temporary loss of access to TKBV supplied community water points; increased travel distance to community assets or TKBV supplied community water points; impacts on livelihoods due to loss of communal land; impacts on graves; and impacts on vulnerable people);
- Community Health (including sexually transmitted infections; vector related diseases; communicable diseases; diseases that can transfer from animals to humans (‘zoonotic’); and accidents and injuries);
- Changes in access to education;
- Social maladies (including crime and commercial sex work); and
- Social capital and conflict (including inter-ethnic conflict and community cohesion within Turkana and West Pokot.

Key commitments to mitigate and manage impacts include:

- Implementation and maintenance of Policies including Human Resources Contractor Standard, Code of Ethical Conduct, Human Rights, Safe and Sustainable Operations and HIV Policy;
- Implementation and maintenance of Management Plans including Influx, Community Health, Safety and Security, Transport, Malaria and TB;
- Develop and Implement Community Development Plans (CDPs) and LRP, which will be created with authorities in Turkana and West Pokot Counties and will deliver livelihood restoration and community benefits;
- Develop and approve a strategy for educational support, which will be created in partnership with authorities in Turkana and West Pokot Counties, NGO/development agencies;
- Agree to a revised and updated National Content planning approach;
- Maintenance of the SEP and Grievance mechanisms;
- TKBV will also continue to adhere to Accounting Directive and disclose taxes in company-wide Annual Reports;
- Maintain all construction accommodation and worker accommodation during operations as "*closed camps*";
- Work with County Governments to encourage sustainable use of community offtake water points on the water pipeline to discourage overgrazing at water off take points, and record issues as part of the grievance mechanism;
- Land impact mitigations are guided by two key commitments. First, compensation, as determined under the Kenyan Law, will be provided as part of the Government-led statutory land acquisition process. Any gaps between government-led land acquisition and IFC PS 5 will be addressed as part of the LRP.;
- Compensation, as provided under Kenyan Law which recognises graves and the costs of rituals required to relocate graves, to be provided as part of the Government-led statutory land acquisition process;
- Human Resources processes will restrict informal hiring, establish clear procedures for hiring unskilled and low skilled workers, establish explicit definitions for "*local*" or "*local-local*" hiring criteria; and revise all recruitment procedures in line with external engagement practice outlined in the SEP;
- Adoption of a "*95-95-95*" strategy, which sets targets for awareness, treatment and demonstrating performance in viral suppression to combat HIV/AIDs;
- Implement TB Management Programme, linked to the HIV Programme, in collaboration with authorities in Turkana and West Pokot Counties;
- Develop and implement Pest Control Plan for landfill and other Project facilities;
- Engage with the community to agree procedures for demarcation of 'no go' sensitive locations and mapping and communication of cultural heritage 'constraints', including graves and sacred trees; and
- Maintain regular community engagement outreach to address rumour and other misunderstandings identified through regular engagement.

With these mitigation measures in place, residual negative impacts during construction and operation are all expected to be of **Minor** to **Negligible** significance, except for one **Moderate** negative residual impact relating to accidents and injuries. Many impacts are expected to be positive, with **Moderate** or **Major** positive impacts relating to transparent tax payments, infrastructure, employment and business opportunities.

7.10 Cultural Heritage

During construction, it is expected that ground disturbance, changes to environmental setting (e.g. changes to air quality, the landscape, or noise levels), and changes to socio-economic conditions have the potential to impact upon archaeology, living cultural heritage and intangible cultural heritage. During operation, there will be visual impacts on sacred trees, and socio-economic changes will continue to impact upon intangible cultural heritage.

Key commitments to mitigate and manage impacts include:

- Continued community consultation in accordance with the SEP;
- Staff induction and training to include information on the different cultural heritage receptors and the proposed mitigation strategy;
- Implementation of a Cultural Heritage Management Plan (including a Chance Finds Procedure);
- Pre-construction targeted archaeological investigation, survey and mapping of living cultural heritage receptors along the water pipeline;
- Development and implementation of communication plans to engage traditional leaders and local administrative leaders to inform local communities of the Project construction schedule;
- Consultation with communities along the make-up water pipeline and mapping of sacred trees in this area. If sacred trees are identified, then measures such as micro-alignment and consultation regarding the possible translocation of sites and associated cultural practices will be applied to reduce impacts;
- Consultation with communities along the make-up water pipeline and mapping of living cultural heritage receptors in this area. If receptors are identified, then measures such as micro-alignment and exhumation of burials will be applied to reduce impacts; and
- Influx Management Plan, LRP and CDPs.

With this mitigation in place, most impacts are expected to be of **Minor** significance. **Moderate** significance impacts are expected as a result of visual impacts on users of the identified sacred tree and on graves that have to be relocated.

7.11 Environmental Risks and Accidents

Emergency, accidental and non-routine events risk assessment were assessed, including an evaluation of natural and industrial hazards and the probability of their occurrence during the lifetime of the project (including the construction and operational stages).

Hazards identified (and the assessed risk) include:

- Natural seismicity on built structures, flowlines, vibration-sensitive built structures or equipment (low risk);
- Failure or rupture of a storage tank (low risk);
- Perforation or rupture of a flowline or spillage due to poor working practices (low risk);
- Road traffic accidents on access roads (medium risk);
- Road traffic accidents on public roads (high risk);
- Induced seismicity due to well testing/oil production (low risk); and
- Well casing/cement integrity failure and down hole collisions during drilling and production (low risk).

The following management plans are required to respond to the identified unplanned events:

- Emergency Preparedness Response Plan;
- Construction Environmental Management Plan, including Waste Management, Traffic Management, Water Management and Hazardous Materials Management; and
- Operational Environment Management Plan, including Waste Management, Traffic Management, Water Management and Hazardous Materials Management.

8.0 CUMULATIVE IMPACTS

Cumulative impacts, as defined by IFC (2013), are those that may result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined planned developments, at the time the risks and impact identification process is undertaken. While a standalone activity may itself result in an impact that is not significant, when combined with other impacts (significant or not significant) in the same geographical area and occurring simultaneously, it may result in a significant cumulative impact.

Combined impacts associated with the LLCOP project present the greatest potential cumulative impacts. Cumulative impacts are largely expected to occur during the construction phase of the Project relating to the concurrent construction schedules and the operational phase relating to community health and safety. The project proponents will work together to identify additional measures and controls to limit the significance and duration of activities.

TKBV are committed to engage with other associated and third-party projects to encourage implementation of specific mitigation measures including OHTL routing and bird-friendly design, consideration of receptors close to the proposed Kapese airstrip upgrade works and to discourage the development of borrow pits in areas of sensitive biodiversity and to ensure that site-specific Project reports are developed and submitted to NEMA.

9.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

In accordance with the Environmental Impact Assessment Guidelines for the Energy Sector in Kenya, an Environmental and Social Management Plan (ESMP) is included as part of the ESIA. An ESMP compiles a set of management, mitigation and monitoring measures to be taken during construction and operation of the Project to manage key potential environmental and social impacts identified in this ESIA. The ESMP contained within this ESIA therefore:

- Describes the Environmental and Social Management System (ESMS) that will be developed to implement the requirements of the approved ESMP and to meet Kenyan regulatory requirements; and
- Sets out the key impacts and mitigations defined in the ESIA and allocates responsibilities for implementation and performance monitoring in an ESMP format.

The ESMP addresses each of the topics assessed as part of this ESIA and considers a framework for decommissioning.

The commitments, mitigations and management controls set out will be used by TKBV, the Project Management Company (PMC) and the EPC Contractor to develop detailed implementing procedures for construction and operations.

ESIA REPORT

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ESIA Report

Signature Page

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15 June 2020

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ACRONYMS AND UNITS OF MEASUREMENT

"	Inch
%	Percentage
~	circa
<	Less Than
>	Greater Than
≤	Less Than or Equal to
≥	Greater Than or Equal to
º	Degrees
ºC	Degrees Celsius
µg	Microgram
AADT	Annual Average Daily Traffic
AAH	Action Against Hunger
ABA	Athi Basin Area
AD	Anaerobic digestion
A.D.	After Christ
ADCP	Acoustic Doppler Current Profiler
ADM	Air Dispersion Model
ADP	Annual Development Plan
AFDB	Africa Development Bank
AGI	Above Ground Installation
AIDS	Acquired Immune Deficiency Syndrome
Al	Aluminium
ANC	Antenatal care
AOC	Africa Oil Corporation
AoI	Area of Influence
AoO	Area of Occupancy
APC	Air Pollution Control

AQS	Air Quality Standard
AR	Archaeology
ARI	Acute respiratory infections
ASAL	Arid and Semi-Arid Lands
ASL	Above Sea Level
Ba	Barium
BAT	Best Available Technology
bbls	Barrels
BBOP	Business and Biodiversity Offsets
BC	Before Christ
BCE	Before Common Era
BCoW	Biodiversity Clerk of Works
BES	Biodiversity and Ecosystem Services
bilharzia	Schistosomiasis
BMP	Biodiversity Management Plan
BOP	Blow Out Preventor
BP	Before Present
BrO3	Bromate
BSI PAS	British Standards Institution Publicly Available Specification
BTEX	Benzene, toluene, ethylbenzene and xylene
bwpd	barrels of water per day
Ca	Calcium
CadnaA	Computer Aided Noise Attenuation
CAPEX	Capital Expenditure
CBD	Convention on Biological Diversity
CDP	Community Development Plan
CEC	County Environmental Committees
CEMP	Construction Environmental Management Plan
CFA	Central Facilities Area
CFP	Chance Finds Procedure
CGMW	Commission for the Geological Map of the World

CH	Living Cultural heritage
CHIS	Community Health Information System
CHMP	Cultural Heritage Management Plan
CHMT	County Health Management Team
CHSSMP	Community Health, Safety and Security Management Plan
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLTS	Community Led Total Sanitation
cm	Centimetre
cm/min	Centimetres per Minute
CMS	Convention on Migratory Species
CO2	Carbon Dioxide
CPF	Central Processing Facility
CR	Critically Endangered
CS	Carbon Steel
CSM	Corrugated Sheet Metal
CSOs	Civil Society Organisations
CWP	Community Water Points
CWRUA	Community Water Resource Users Associations
DALYs	Disability Adjusted Life Years
d	Day
dB	Decibels
dBA	A-weighted decibels
dBL	Decibels Linear
DD	Data Deficient
DDP	Delivery duty paid
DEFRA	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DHIS	District Health Information System
DHIS2	District Health Information Software 2
DICL	Ductile Iron Cement Lined

DMRB	Design Manual for Roads and Bridges
DNA	Deoxyribonucleic Acid
DOSHS	Directorate of Occupational Safety and Health Services
dS/m	deci siemens per meter
DSM	Digital Surface Model
DTM	Digital terrain model
E&A	Exploration and Appraisal
EA	Environment Agency
EAC	East African Community
EAC	East African Community
EARS	East African Rift System
EBA	Endemic Bird Area
EBRD	European Bank for Reconstruction and Development
ECD	Early Childhood Development
ECoW	Environmental Clerk of Works
EDC	Enterprise Development Centres
EHA	Environmental Health Areas
EHS	Environmental Health and Safety
EITI	Extractive Industry Transparency Initiative
ELC	Environment and Land Court
EMCA	Environmental Management and Co-ordination Act
EN	Endangered
ENNBA	Ewaso Ng'iro North Catchment Area
ENSO	El Niño-Southern Oscillation
EoO	Extent of Occurrence
EOPS	Early Oil Pilot Scheme
EPC	Engineering, Procurement and Construction
EPF	Early Production Facility
EPRA	Energy and Petroleum Regulatory Authority
ESD	Emergency Shutdown System
ESIA	Environmental and Social Impact Assessment

ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESP	Electrical Submersible Pumps
ETP	Effluent treatment plant
EWB	Elephants Without Borders
F&G	Fire & Gas System
FAO	Food and Agriculture Organisation
FBOs	Faith Based Organisations
FDPs	Final Distribution Points
FEED	Front End Engineering Design
FGM	Female Genital Mutilation
FGT	Flue gas treatment
FID	Final Investment Decision
FPIC	Free Prior and Informed Consent
g	Gram
GBIF	Global Biodiversity Information Facility
GBV	Gender-based violence
GDP	Gross Domestic Product
GIIP	Good International Industry Practice
GIS	Geographical Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit
GNI	Gross National Income
GoK	Government of Kenya
GPS	Global Positioning System
GTG	Gas Turbine Generator
GTI	GeoTerra Image
GTZ	German Agency for Technical Cooperation
H2S	Hydrogen Sulphide
H2SO4	Sulphuric acid
ha	Hectare

HBV	Hepatitis B virus
HDD	Horizontal Directional Drilling
HDI	Human Development Index
HDPE	High- Density Polyethylene
HECRAS	Hydraulic Engineering Center River Analysis System’
HGV	Heavy Good Vehicles
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
hr or h	Hour
HR	Human Resources
HV	High Voltage
HWC	Human Wildlife Conflict
IBA	Important Bird Area
IBAT	Integrated Biodiversity Assessment Tool
ICSS	Integrated Control and Safety System
IDP	internally displaced person
IEBC	Independent Electoral and Boundaries Commission
IEC	International Electrotechnical Commission
IF	Incineration facility
IFC	International Finance Corporation
IHME	Institute for Health Metrics and Evaluation
ILO	International Labour Organisation
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
IRPA	Individual Risk Per Annum
ISMP	Invasive Species Management Plan
ISO	International Organization for Standardization
ITCZ	inter-tropical convergence zone
IUCN	International Union for Conservation of Nature
IWMF	Integrated Waste Management Facility

K	Potassium
KBA	Key Biodiversity Area
kbd	1000 barrels per day
kbwpd	1000 barrels water per day
KCl	Potassium Chloride
KDHS	Kenya Demographic and Health Survey
KEMRI	Kenya Medical Research Institute
KenGen	Kenya Electricity Generating Company
KeNHA	Kenya National Highways Authority
KEPH	Kenya Essential Package for Health
KES	Kenyan Shilling
KETRACO	Kenya Electricity Transmission Company
KFS	Kenya Forest Service
kg	Kilogram
KII	Key Information Interview
KJV	Kenyan Joint Venture
km	Kilometre
KMIS	Kenya Malaria Indicator Survey
KNBS	Kenyan National Bureau of Statistics
KPC	Kenya Pipeline Company
KPHC	Kenya Population and Housing Census
KPR	Kenyan Police Reserve
kV	Kilovolts
KVDA	Kerio Valley Development Authority
KWCMA	Kenyan Wildlife Conservation and Management Act
KWRUA	Kochodin Water Resources Users Association
KWS	Kenya Wildlife Services
l or ltr	Litre
LA90	Ambient Noise
LAeq	A-weighted Equivalent Continuous Sound Level in Decibels
LAPSSET	Lamu Port- South Sudan- Ethiopia Transport

LARF	Land Acquisition and Resettlement Framework
LC	Least Concern
LCAA	The Landcover Assessment Area
LCAs	Landscape Character Areas
LCDA	LAPSSET Corridor Development Authority
LCIDP	LAPSSET Corridor Infrastructure Development Project
LEF	Lokichar Export Facility
LGV	Light Good Vehicles
LiDAR	Light Detection and Ranging
LLCOP	Lokichar to Lamu Crude Oil Pipeline
LLINs	Long-lasting Insecticidal Nets
LoD	Limit of Detection
LOWASCO	Lodwar Water and Sewerage Company
LPG	Liquified Petroleum Gas
LV	Low Voltage
LVAA	Landscape and Visual Assessment Area
LVNBA	Lake Victoria North Basin Area
LWHIV	Living with HIV
m	Metre
m/s	Meters Per Second
m2	Metres squared
m3	Metres cubed
masl	Metres Above Sea Level
mbar	Millibar
MDBRT	Measured Depth Below Rotary Table
mbgl	Metres Below Ground Level
MCA	Member of County Assembly
Mg	Magnesium
mg	Milligram
MJ	Megajoules
mm	Millimetre

MMbbls	Million Barrels
MMIF	Mesoscale Model Interface Program
MMscfd	Million standard cubic feet per day
Mg	Magnesium
Mn	Manganese
MoH	Ministry of Health
MoPM	Ministry of Petroleum and Mining
MSAVI	Modified Soil Adjusted Vegetation Index
MTRH	Moi Teaching and Referral Hospital
mS	Millisiemen
mV	millivolts
MW	Megawatt
MWSI	Ministry of Water, Sanitation and Irrigation
Na	Sodium
NACC	National AIDS Control Council
NASA	National Aeronautics and Space Administration
NASCOP	National AIDS and STI Control Programme
NBI	Nile Basin Initiative
NBSAP	National Biodiversity Strategy and Action Plan
NCD	Non-Communicable Diseases
NDMA	National Drought Management Authority
NEAP	National Environmental Action Plan
NEC	National Environmental Council
NECC	National Environmental Complaints Committee
NET	National Environment Tribunal
NGOs	Non-governmental Organisations
NLC	National Land Council
NMK	National Museums of Kenya
NO	Nitric oxide
NO2	Nitrogen dioxide
NO3	Nitrate

NPV	Net present value
NRT	Northern Rangelands Trust
NRT	National Reserve
NT	Near Threatened
NTLD	National TB, Leprosy and Lung Disease
NTR	Non-Technical Risk
NTS	Non-Technical Summary
O2	Oxygen
O3	Ozone
O&M	Operations and Maintenance
OEMP	Operations Environmental Management Plan
OHTL	Overhead Transmission Lines
ORP	Oxygen Redox Potential
OSHA	Occupational Safety and Health Act
Osiris	Optical Scattering Instantaneous Respirable Indication Sensor
OVCs	Orphans and Vulnerable Children
PaHs	Polycyclic aromatic hydrocarbons
PAP	Project Affected People
PARs	Pre- assembled racks
PAUs	Pre-assembled units
Pb	Lead
PC	Process Contribution
PCP	Progressing Cavity Pump
PCS	Process control system
PEC	Predicted Environmental Concentrations
PGA	Peak Ground Acceleration
pH	Acidity or Basicity of a Water-Based Solution
PIIM	Project induced in-migration
PLL	Potential Loss of Life
PM10	Particulate matter less than or equal to 10 micrograms
PM2.5	Particulate matter less than or equal to 2.5 micrograms

PMC	Project Management Company
ppm	Parts Per Million
PoI	Points of Interest
polio	Poliomyelitis
PPP	Purchasing Power Parity
PPV	Peak Particle Velocity
PS	Performance Standard
PS	Performance Standard
PSC	Production Sharing Contracts
PSD	Particle Size Distribution
PSPL	Peak Sound Pressure Level
QA	Quality Assurance
RAP	Resettlement Action Plan
RF	Recycling facility
RoW	Right of Way
RUSLE	Revised Universal Soil Loss Equation
RVBA	Rift Valley Basin Area
RWs	Reformed Warriors
s	Second
SBM	Synthetic-Based Mud
SD	Scaled Distance
SEA	Strategic Environmental Assessment
SEP	Stakeholder Engagement Plan
SGR	Standard Gauge Railway
Si	Silicon
SL	Standard Length
SLMs	Sound Level Metres
SMART	Standardised Monitoring Assessment on Relief and Transition
SNCR	Selective Non-Catalytic Reduction
SO2	Sulphur dioxide
SoCC	Species of Conservation Concern

SPT	Social Performance Team
sq km	Square Kilometre
SRES	Special Report on Emissions Scenarios
SRTM	Shuttle Radar Topography Mission
SSAs	Specific Site Assessments
STP	Sewage treatment plant
TAN	Twiga, Amosing and Ngamia
TB	Tuberculosis
TBA	Tana Basin Area
TBP	Turkana border pastoral
TCFD	Task Force on Climate- related Financial Disclosures
TCG	Turkana County Government
TCP	Turkana central pastoral
TDS	Total dissolved solids
TKBV	Tullow Kenya Business Venture
TMP	Transport Management Plan
ToT	Terms of Trade
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particles
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations International Children's Emergency Fund
UPS	Uninterruptible Power Supply
US	United States
USD or $	United States Dollar
UTM	Universal Trans Mercator
V	Volts
VDS	Vision 2030 Delivery Secretariat
VECs	Valued Environmental and Social Components

VIP	ventilated improved pit
VOCs	Volatile Organic Compounds
VPSHR	Voluntary Principles for Security and Human Rights
VU	Vulnerable
W/m2	Watts per metre squared
w/w	Weight by Weight
w/w %	percent by weight
WaSH	Water-Sanitation-Hygiene
WAT	Wax Appearance Temperature
WBG	World Bank Group
WBG EHS	World Bank Group Environmental, Health and Safety General Guidelines
WBM	Water-Based Mud
WCRP CMIP3	World Climate Research Programme Coupled Model Intercomparison Experiment, Phase 3
WHO	World Health Organisation
WHRU	Waste Heat Recovery Units
WRA	Water Resources Authority
WRF	Weather Research and Forecasting
WWF	World Wildlife Fund
yr	Year
ZTV	Zone of Theoretic Visibility

SIGNATURE PAGE

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1.0 INTRODUCTION

This report presents the Environmental and Social Impact Assessment (ESIA) for the proposed Foundation Stage of the South Lokichar Development (the Project) for Upstream oil production in South Lokichar. This has been prepared by Golder Associates (UK) Ltd and Ecologics Consulting Ltd (NEMA Expert Registration No: 9709) based on the Terms of Reference (144936.517.A0[1], March 2016, presented in Annex I), which was approved by the National Environment Management Authority (NEMA), in a letter sent on 16 March 2016, also in Annex I.

The ESIA assesses potential impacts of the Project based on the Project description presented in Section 5 and covers all activities and infrastructure associated with the construction, operation and decommissioning of the Project.

The objective of the ESIA is to identify and quantify impacts that the Project may have on the biophysical and socio-economic environments by comparison to the ESIA baseline and Project standards. Where identified as necessary, the ESIA will define potential mitigation and management processes to prevent unacceptable deterioration of environmental and social conditions, minimise negative impacts and enhance benefits to Kenya, local communities and other stakeholders.

1.1 Background

In 2010, Tullow signed agreements with Africa Oil and Centric Energy to gain a 50% operated interest in five Kenyan licences; Blocks 10BA, 10BB, 10A, 12A and 13T covering over 67,000 km^2. The first onshore well in the South Lokichar Basin, Ngamia-1, in Block 10BB, commenced drilling in January 2012 and since then several discoveries have been made in the South Lokichar Basin during the exploration phase.

In 2011 Africa Oil Kenya B.V and Tullow Kenyan Business Venture (TKBV) agreed a farm-in deal whereby TKBV acquired a 50% interest and Operatorship in block 10BB and 13T, which is where the Project is located. At the end of 2015 Africa Oil Corporation (AOC) entered into a farmout agreement with Maersk Oil & Gas A/S, whereby Maersk acquired 50% of Africa Oil's interests in block 10BB. Thereafter in 2017, Maersk Oil & Gas A/S was acquired by Total S.A. At the time of writing, AOC and Total S.A. each have a 25% and TKBV a 50% working interest in the block. These three companies form the Kenyan Joint Venture (KJV) that will execute the Project.

The Project has been preceded by the Early Oil Pilot Scheme (EOPS) Phase II, for which a separate ESIA was produced in 2018 (Golder, 2018, ref. 1654017.718). Existing facilities used during EOPS Phase II, including the Kapese airstrip, Kapese Base (camp), wellpads, wells, water supply boreholes and production facilities will be adopted by the Project.

For the Project, oil will be produced from production wells located on multiple wellpads across the Twiga, Amosing and Ngamia (TAN) fields. The wellpads are connected to the Central Processing Facility (CPF) via a buried gathering network. The Project will use water injection to maintain reservoir pressure. Water will be taken from the Turkwel dam reservoir, located in West Pokot (to the south west of the facility), and supplied to the CPF via an approximate 90 km buried pipeline.

The CPF will be located within a central hub, the Central Facilities Area (CFA), which will be located adjacent to the Ngamia oil field. The CFA will contain accommodation, waste management facilities (excluding a planned engineered landfill facility), offices, laydown areas and warehouses as well as facilities required for production, and to support construction and operating activities.

[1] Initially developed with the Kenyan-based consultancy firm EMC in March 2016. See Annex I for reference.

Oil export facilities for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) project are also located within the CFA. However, a separate ESIA has been prepared for this component.

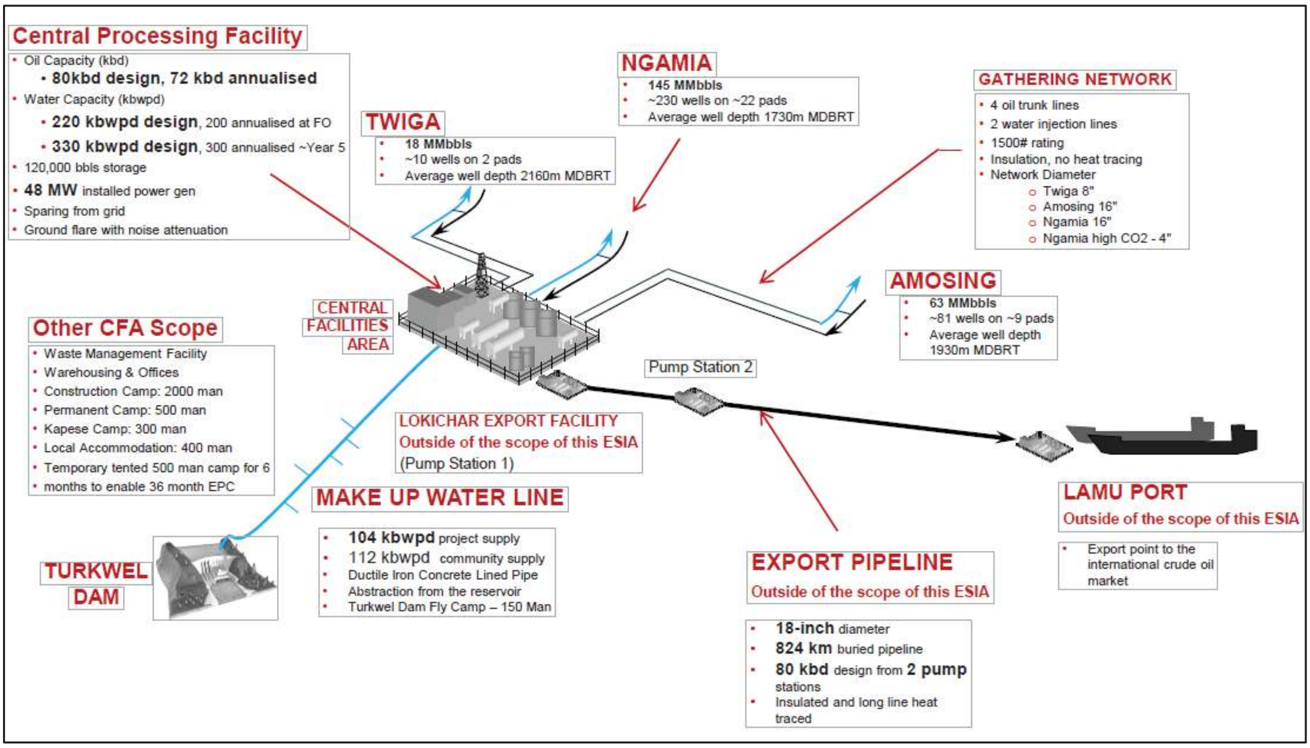


Figure 1.1-1: Project Overview

1.2 Project Proponent

TKBV, AOC and Total S.A. form the KJV that is responsible for the development of the Project. TKBV as main operator of the Project will be responsible for the effective implementation of the commitments presented in this ESIA, the NEMA approved Environmental and Social Management Plan (ESMP) and environmental license conditions.

Land will be acquired by the Government of Kenya (GoK) and leased back to the KJV for the execution of the Project. The National Land Commission (NLC) will be responsible for all regulatory land acquisition associated to the Project with TKBV retaining responsibility for ensuring that land acquisition also meets non-regulatory requirements defined in applicable Project and International Finance Corporation (IFC) standards.

1.3 This Report

The structure of this ESIA is as follows:

- ESIA Report:
  - Non-Technical Summary (NTS);
  - 1.0 Introduction (this section);
  - 2.0 Policy, Legal and Administrative Framework;
  - 3.0 Impact Assessment Methodology;
  - 4.0 Stakeholder Engagement;
  - 5.0 Project Description and Analysis of Alternatives (including zero project option);

- 6.0 Baseline Reports;
- 7.0 Potential Impacts and Mitigation;
- 8.0 Cumulative Impacts;
- 9.0 Environmental and Social Management Plans;
- 10.0 Conclusions; and
- 11.0 References.

- Annex I – Supplementary Information:
  - Terms of Reference and Scoping Report (as approved by NEMA);
  - Project Standards;
  - Baseline Annexes; and
  - ESIA supporting information.
- Annex II – Stakeholder Engagement:
  - Stakeholder Engagement Plan;
  - Stakeholder Engagement Consultation Materials (pending); and
  - Stakeholder Engagement Consultation Report (pending).

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Background and Context

The Project ESIA complies with the Kenyan legislative, regulatory and policy requirements. Throughout this document, reference is made to relevant international standards as part of Good International Industry Practice (GIIP) (i.e. IFC Performance Standards on Environmental and Social Sustainability (2012) and WBG EHS (Environmental, Health and Safety) Guidelines (2007a, 2007b)). This subsection of the ESIA provides an overview of the relevant policy, legal and institutional framework governing the Project ESIA. Other relevant regulatory and legal framework specific to each Physical, Biodiversity or Social discipline is provided within each section of the ESIA.

2.1.1 Devolution in Kenya

The Constitution of Kenya 2010 has given mandate to devolve certain powers from the National Government to the 47 County Governments, including responsibility for the agriculture sector, health services, early childhood development, public amenities, County trade development and regulations, County planning and development. The National Government continue managing issues related to security, education, and other national interests.

The operation *per se* made effectively after March 2013, where County Governors were elected by voters registered in the County. County Executive Committees are proposed by the County Governor and these implement County and national legislation, manage and coordinate the functions of the County administration and its departments, and implement any other functions conferred by the Kenyan Constitution. The County Assembly is formed by members elected from different wards in the County and by several nominated members representing specific interests.

With this new devolved governance system, the administrative governance decentralised into 47 counties receives a share of the national revenues and it is responsible for managing revenues from different sources within their counties (e.g. taxes on property).

2.1.2 Governance and Administrative Structure

The following table presents a list of administrative agencies and government institutions that regulate the development of the oil and gas sector in Kenya which have a key role in the Project ESIA authorisation process.

Table 2.1-1: Administrative Regulation Agencies

Institution	Description	Project Relationship
County Environmental Committees (CEC)	The County Environmental Committees (CEC) are responsible for the proper management of the environment within the County for which it is appointed. The Committee also develops the county Strategic Environmental Action Plan for five years.	Key stakeholder at County level that monitors project activities.
Directorate of Occupational Safety and Health Services (DOSHS)	The Directorate of Occupational Safety and Health Services (DOSHS) draws its functions from the Occupational Safety and Health Act (OSHA), 2007 and the Work Injury Benefit Act, 2007. It promotes the development of a safe and healthy workplace by implementing effective systems for the prevention of occupational diseases. As part of its responsibilities, it inspects internal and external working environments and ensures the prevailing environmental conditions are favourable to human health.	Issues workspace permits for any premises used as workplace areas. Receives reports of Occupational Health and Safety audits which are undertaken every 12 months in relation to each workplace.

Institution	Description	Project Relationship
Energy and Petroleum Regulatory Authority (EPRA)	The Energy and Petroleum Regulatory Authority (EPRA) was established under the Energy Act, 2019 and is also the selected regulator under the Petroleum Act, 2019 (regulation of upstream petroleum and coal). All responsibilities relating to Energy Regulatory Commission (established under the now repealed Energy Act of 2006) now fall under the remit of EPRA. EPRA's functions in relation to the Environment include: ■ Regulate, monitor, and supervise upstream petroleum operations in Kenya in accordance with the law relating to petroleum. ■ Inform the Cabinet Secretary regarding Upstream petroleum operations in Kenya. ■ Collect, maintain and manage Upstream Petroleum data.	EPRA is mandated by law to take such action as is necessary to enforce the requirements in a petroleum agreement or any regulations and to protect the environment, the health and safety of workers and the public. It is also required to investigate complaints or disputes arising from petroleum operations as well as enforce local content requirements. The Project contractor is required to take all reasonable actions to secure the safety, health and welfare of all persons engaged in its operations, furnish EPRA with details of petroleum reservoirs and water sources discovered and seek approval for flaring and venting.
Environment and Land Court (ELC)	The Environment and Land Court (ELC) is established under Section 4 of the Environment and Land Court Act No. 19 of 2011. It has original and appellate jurisdiction to hear and determine all disputes in accordance with Article 162(2)(b) of the Constitution and with the provisions of the Act or any other written law relating to environment and land.	ELC would adjudicate any disputes on environment and land matters.
Kenya Forest Service (KFS)	The Kenya Forest Service (KFS) is established under the Forest Conservation and Management Act (2016) to conserve, protect and manage all public forests and also to manage water catchment areas in relation to soil and water conservation, carbon sequestration and other environmental services in collaboration with the relevant stakeholders. According to the Environmental Management and Co-ordination Act (EMCA), the Cabinet Secretary has the authority to (in consultation with the relevant lead agencies and national and international treaties) declare any area of land, sea, lake, forests, or river to be a protected natural environment.	Issues conservation (orders) and ensures enforcement.
Kenya Pipeline Company (KPC) Limited	The Kenya Pipeline Company (KPC) is a state corporation established in September 1973 under the Companies Act Cap 486 (now repealed). It is 100% owned by the government and is responsible for providing an effective, reliable, safe and cost-effective means of transporting petroleum products from Upstream to Downstream.	Key stakeholder to ESIA process and management of oil/ petroleum resources.
Kenya Wildlife Services (KWS)	The Kenya Wildlife Service (KWS) is responsible for the conservation and management of Kenya's Wildlife and its habitats.	Key stakeholder for wildlife conservation and management of human – wildlife conflicts.

Institution	Description	Project Relationship
Kerio Valley Development Authority (KVDA)	The Kerio Valley Development Authority (KVDA) is responsible for the planning, monitoring and implementation of transboundary programmes and projects making use of the best technical, financial, human and natural resources.	Key stakeholder to ESIA process
Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) Corridor Development Authority (LCDA)	The Lamu Port- South Sudan- Ethiopia Transport (LAPSSET) Corridor Development Authority (LCDA) was established in March 2013 (Presidential Order Kenya Gazette Supplement No. 51, Legal Notice No. 58). It is mandated to plan, coordinate and manage the implementation of the LAPSSET Corridor. It is tasked with establishing an integrated implementation plan and oversee the implementation of the proposed projects, especially the LLCOP, railway and highways.	Key stakeholder, LAPSSET is involved in the midstream LLCOP development).
Ministry of Agriculture, Livestock and Fisheries.	The Ministry of Agriculture, Livestock and Fisheries is responsible for the implementation and monitoring of agricultural legislations, regulations and policies, facilitating and representing agricultural state corporations in the government, and implementing programmes in the agriculture sector. It is also responsible for the management and control of pests and disease.	Key stakeholder in the management of agriculture and livestock.
Ministry of Energy	The Ministry of Energy is responsible for facilitating the provision of clean, sustainable, affordable, reliable, and secure energy services for national development while protecting the environment. On behalf of the National Government, The Ministry of Energy is in charge of promoting energy policies and regulation of electricity and gas reticulation. Relevant departments include the EPRA (previously named Energy Regulatory Commission) and the Energy and Petroleum Tribunal (previously named the Energy Tribunal).	Key stakeholder mandated in permitting of energy generation and distribution.
Ministry of Environment and Forestry	The Ministry of Environment and Forestry mission statement and key objective is to facilitate good governance in the protection, restoration, conservation, development and management of the environment and forestry resources for equitable and sustainable development. Responsible for several administrative structures under EMCA 1999 as amended by EMCA (amendment) 2015, these include the National Environmental Council (NEC), NEMA, National Environment Tribunal (NET) and the National Environmental Complaints Committee (NECC)	Key stakeholder to the Project, mandated to undertake national environment policy and management, forestry development policy and management, development of re-afforestation and agro-forestry, among others.
Ministry of Interior and Coordination of National Government	The mission of the Ministry of Interior and Coordination of National Government is to create an enabling environment for Kenya's growth and prosperity via the provision of security and safety to people and property, maintain a credible national population registration system, promotion of national cohesion, facilitate administration of justice, provision of correctional services and coordination of national government	Key stakeholder in mobilisation of communities at the County, sub-County and locational levels. Control of registration of expatriate workers at the national level and coordination of emergency responses.

Institution	Description	Project Relationship
	functions. The ministry is composed of two state departments: State Department for interior and Citizen Services; and Correctional Services. The ministry has the following responsibilities: ■ National government coordination at counties; ■ Disasters and Emergency Response Coordination; ■ Internal Security Affairs; and ■ Citizenship and Immigration Policy and Service.	
Ministry of Petroleum and Mining (MoPM)	The Ministry of Petroleum and Mining (MoPM) oversees the management of the extractive sector in Kenya by developing Petroleum and Mining policies and creating and overseeing a favourable legal and regulatory framework. It is responsible for managing programs and projects within the Petroleum and Mining sector. The MoPM includes the State Department for Mining and the State Department for Petroleum.	Government Institution leading land acquisition process via NLC.
Ministry of Sports, Culture and Heritage	The mission of the Ministry of Sports, Culture and Heritage is to develop, promote, preserve and disseminate Kenya's diverse cultural, artistic and sports heritage, through formulation and implementation of policies on sports, culture and the arts industry that enhance national pride and improve the livelihood of the Kenyan people. Of relevance to the Project are the Ministry's responsibilities for: ■ National Heritage Policy and Management; ■ National Archives/Public Records Management; ■ Management of National Museums and Monuments; and ■ Historical Sites Management. Following the passage of the National Museum and Heritage Act 2006, the National Museums of Kenya (NMK) was established under the Ministry, which has the following function: ■ Heritage promotion, collection and documentation; ■ Research; ■ Preservation and conservation; and ■ Information dissemination.	The NMK is the key stakeholder that permits the movement of heritage items.
Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works	The Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works is responsible for granting permits for the transportation of wide loads, bulk carriers and abnormal loads as described under Traffic Act Cap 403 part (V) and (VI); Kenya Roads Act No.2 of 2007. It is composed of the following state departments: ■ State Department of Transport; ■ State Department of Infrastructure; ■ State Department for Maritime and Shipping Affairs;	Key stakeholder responsible for permit approvals within the transport sector as well as safety management on classified roads.

Institution	Description	Project Relationship
	■ State Department for Public Works; and ■ State Department for Housing & Urban Development. The Ministry is mandated to perform several functions, including (amongst others): ■ National Roads Development Policy Management; ■ Transport Policy Management; ■ National Road Safety Management; ■ Development and Maintenance of Airstrips; and ■ National Transport and Safety Policy.	
Ministry of Water, Sanitation and Irrigation (MWSI)	The Ministry of Water, Sanitation and Irrigation (MWSI) mission statement is to contribute to national development by promoting and supporting integrated water resource management to enhance water availability and accessibility. The MWSI has the following subsectors: Water Supply Services; Sewer & Non-Sewer Sanitation Services; Water Harvesting & Storage; Water Resource Management; Water Sector Investment Planning; and Transboundary Waters.	Key stakeholder responsible for water management and catchment conservation.
National Land Commission (NLC)	The National Land Commission (NLC) is the main government institution responsible for managing public land on behalf of the National and County governments. It is responsible for advising the national government on a comprehensive program for the registration of title in and throughout Kenya and recommends National Land Policy to the National government. The NLC also initiates investigations into present or historical land injustices and have oversight responsibilities over land use planning throughout the country.	Responsible for Land acquisition process and compensation to persons affected by the Project.
National Environment Management Authority	The National Environment Management Authority (NEMA) was established under the EMCA 1999 (CAP387, Laws of Kenya). NEMA is the main institution of the Government responsible for the coordination and supervision of the various environmental management activities in Kenya and implementation of policies relating to the environment in country development projects. As part of its mandate in the regulation and management of the petroleum sector, NEMA is responsible for granting ESIAs, Environmental Audit reports, licensing under different Environmental Management and coordination regulations.	Main institution responsible for granting of ESIA approvals in Kenya and monitoring and assessing project activities according to relevant environmental regulations and laws in the country. The Project ESIA document will be submitted to NEMA for approval and permitting.
National Environment Council	The National Environment Council was established under the EMCA 1999 (Section 4(1), Act no 8). It's key function is to formulate and set national policy and direction for the protection of the environment as prescribed in the EMCA.	Stakeholder responsible for formulation of environmental policies.

Institution	Description	Project Relationship
National Environmental Complaints Committee	The National Environmental Complaints Committee is responsible for investigating complaints and allegations related to the condition of the environment and suspected cases of environmental degradation.	Key stakeholder in environmental complaints and dispute resolution
The National Environment Tribunal (NET)	The National Environment Tribunal (NET) has several functions, including: to hear and determine appeals from NEMA's decisions; to adjudicate over actions relating to the issuance, revocation or denial of Environmental Impact Assessment (EIA) licences; to determine the amount of money to be paid under the Act; to decide upon the imposition of restoration orders; to give direction to NEMA on any matter of complex nature referred to it by the Director General; and in accordance with the Forest Conservation and Management Act, No. 34 of 2016, NET is mandated to make determination on any matter that remains unresolved after reference to the lowest structure of devolved system set out in the County Government Act under section 70.	Key stakeholder in environmental dispute resolution
National Oil Corporation of Kenya	The National Oil Corporation of Kenya is a fully integrated State Corporation involved in all aspects of the petroleum supply chain covering the upstream oil and gas exploration, midstream petroleum infrastructure development and downstream marketing of petroleum products. It was incorporated in April 1981 with a mandate to participate in all aspects of the petroleum industry and it became operational in 1984. The Corporation is wholly owned by the Government of Kenya through a joint ownership by the Ministry of Petroleum and Mining and the National Treasury.	Key stakeholder to ESIA process and management of oil/ petroleum resources.
Turkana County Government	The Turkana County Government was formed as part of the devolved government provided by the 2010 Constitution of Kenya. The Turkana County Government consists of the County Assembly and the County Executive made up of several County Ministries. The Turkana County Government functions include agriculture, health and sanitation, control of air and noise pollution, cultural activities, County transport, planning and development, implementation of national government policies on natural resources and environmental conservation, land, energy and housing, trade, gender and youth affairs, etc. Further, planning for development of all nationally significant projects in County require participation in each of the affected counties.	Key stakeholder for the Project.
West Pokot County Government	The West Pokot County Government was formed as part of the devolved government provided by the 2010 Constitution of Kenya. The West Pokot County Government consists of the County Assembly and the County Executive made up of several County Ministries. The West Pokot County Government functions include agriculture, health and sanitation, control of air and noise pollution, cultural activities, County transport, planning and development, implementation of national	Key stakeholder for the Project.

Institution	Description	Project Relationship
	government policies on natural resources and environmental conservation, land, energy and housing, trade, gender and youth affairs etc. Further, planning for development of all nationally significant projects in County require participation in each of the affected counties.	
Vision 2030 Delivery Secretariat (VDS)	Vision 2030 Delivery Secretariat (VDS) is the leading institution to implement the Vision 2030 as the country's blueprint and strategy towards making Kenya a newly industrialising middle-income country. The LAPSSET and its constituent projects including the LLCOP form a key pillar to the Vision 2030.	VDS and LAPSSET responsible to implement Vision 2030.
Water Resources Authority (WRA)	The Water Resource Authority (WRA) is a state corporation established under the Water Act 2016 (Section 11) (formerly called Water Resource Management Authority - WRMA, established under Water Act 2002). The WRA is the lead agency in water resources management and use of water sources. Its responsible for granting permits of water use.	National authority responsible for granting water permits for water abstraction from surface and ground sources. Any application for water permits will be conducted in accordance with the requirement of the EMCA 2015 and Water Act, 2016.
Other Government Agencies	Relevant government agencies at the national level include: ■ Ministry of Lands and Physical Planning; ■ Radiation Protection Board (RPB); ■ Kenya Electricity Generating Company (KENGEN); ■ Kenya Revenue Authority (KRA); ■ Kenya Bureau of Standards (KBS); ■ National Construction Authority (NCA); ■ Kenya Petroleum Refineries Limited (KPRL) ■ National Disaster Operation Centre; ■ National Drought Management Authority (NDMA); ■ Kenya National Highways Authority (KeNHA); ■ Kenya Urban Roads Authority (KURA) ■ Kenya Rural Roads Authority (KeRRA); ■ National Transport Safety Authority (NTSA); ■ Kenya Civil Aviation Authority (KCAA); and ■ Ministry of Health	

2.2 Kenyan Policy and Legislative Requirements

This section includes a list of Kenyan policy and national legislation applicable to the Project ESIA as well as draft policies, legislation and guidelines relevant to the ESIA.

Table 2.2-1: Key Kenyan National Policy

Policy	Description
Environment and Development (Sessional Paper No.6) (1999)	The Kenya's policy paper on the Environment and Development was formulated in 1999. The policy defined approaches that will be pursued by the Government in mainstreaming environment into development. The policy harmonised environmental and developmental objectives with the broad goal of achieving sustainable development. The policy paper also provided guidelines and strategies for government action regarding environment and development. About wildlife, the policy reemphasised government's commitment towards involving local communities and other stakeholders in wildlife conservation and management, as well as developing mechanisms that allow them to benefit from the natural resources occurring in their areas. The policy also advocated for the establishment of zones that allow for the multiple use and management of wildlife.
The National Biodiversity Strategy and Action Plan (NBSAP) (2000)	The National Biodiversity Strategy and Action Plan (NBSAP) was formulated in order to enable Kenya address national and international commitments defined in Article 6 of the Convention on Biological Diversity (CBD). The strategy is a national framework of action for ensuring that the present rate of biodiversity loss is reversed, and present levels of biological resources are maintained at sustainable levels for posterity. The general objectives of the strategy are to conserve Kenya's biodiversity; to sustainably use its components; to fairly and equitably share the benefits arising from the utilisation of biological resources among the stakeholders; and to enhance technical and scientific cooperation nationally and internationally, including the exchange of information in support of biological conservation.
The National Environmental Action Plan (NEAP) (1994 revised in 2007).	First published in 1994 and later revised in 2009, The National Environment Action Plan (NEAP) provides a framework for the implementation of the Environment Policy and realisation of the National Millennium Sustainable Goals and Vision 2030. The NEAP proposes a series of measure to address climate change including mitigation and adaptation, improving inter-sectoral coordination, mainstreaming sustainable land management into national planning, policy and legal frameworks and undertake research on impact of climate change on environmental, social and economic sector. It is also part of NEAP scope to increase the country's forest cover and adopt economic incentives for the management of forest products and community participation in conservation strategy The NEAP has been also responsible for the formulation of An Environmental Action Plan for Arid and Semi-Arid Lands (ASAL) and County-specific Environmental Action Plans which will form a baseline for reference during the development of the ESIA process.
National Land Policy (2009)	The National Land Policy aims to guide the country towards efficient, sustainable and equitable use of land for prosperity and provides legal, administrative, institutional and technological framework for optimal utilisation and productivity of land related resources in a sustainable and desirable manner at national, County and community levels. It addresses critical issues of land administration, access to land, land use planning, restitution of historical injustices, environmental degradation, conflicts, unplanned proliferation of informal urban settlements outdated legal framework, institutional framework and information management.

Policy	Description
	This policy addresses the following topics: ■ Constitutional issues, such as compulsory acquisition and development control as well as tenure. It recognises the need for security of tenure for all Kenyans (all socioeconomic groups, women, pastoral communities, informal settlement residents and other marginalised groups); ■ This policy recognises and protects private land rights and provides for derivative rights from all categories of land rights holding; ■ Through the Policy the government will ensure that all land is put into productive use on a sustainable basis by facilitating the implementation of key principles on land use, productivity targets and guidelines as well as conservation; and ■ Policy promotes Environmental Management and Audit as land management tools and encourages public participation in the process. It will encourage a multi-sectoral approach to land use, provide social, economic and other incentives and put in place an enabling environment for investment, agriculture, livestock development and the exploitation of natural resources.
Kenya Vision 2030 (2010)	Kenya Vision 2030 involved the participation of a wide range of stakeholders for its preparation and with the process carried out between 2006 and 2007. Kenya Vision 2030 is a national long-term development blue-print to create a globally competitive and prosperous nation with a high quality of life by 2030. The vision is anchored on three key pillars; economic, social and political governance. It aims to transform Kenya into a newly industrialising, middle high-income country and to provide a high quality of life to all its citizens by 2030 in a clean and secure environment.
The National Water Policy (2012)	The National Water Policy includes details of the national government's policies and plans for the mobilisation, enhancement and deployment of financial, administrative and technical resources for the management and use of water resources.
The Wildlife Policy (2012)	The Wildlife Policy makes provision for an overarching framework for the prudent and sustainable conservation, protection and management of wildlife and wildlife resources in Kenya, with incidental provision on access and the fair and equitable distribution of benefits accruing there-from, and its alignment with other sector-specific laws and the environment policy.
The National Environment Policy (2013)	The goal of The National Environment Policy is to provide a better quality of life for present and future generations through the sustainable management and use of the environment and natural resources. The National Environment Policy has the following objectives: ■ Provide a framework for an integrated approach to planning and sustainable management of the environment and natural resources; ■ Strengthen the legal and institutional framework for effective coordination and management of the environment and natural resources; ■ Promote sustainable management of the environment and natural resources; and ■ Promote collaboration and cooperation in the protection, conservation and sustainable management of the environment.

Policy	Description
The Wetland Policy (2013)	The Wetland Policy aims to provide an effective and efficient institutional and legal framework for the management and conservation of wetlands and mitigating the diverse challenges that affect wetlands conservation and use in Kenya. This policy also fulfils Kenya's obligations under the Ramsar Convention.
National Water Masterplan 2030 (2014)	The National Water Master Plan 2030 was launched in 2014 and includes information about Kenya's water resources and meteorological conditions to facilitate planning for development and management of the same. The objectives of this plan are: ■ Assess the availability, reliability, quality, and vulnerability of Kenya's water resources up to 2050; ■ Include climate change into the assessment of availability of water resources in the country; ■ Improve water and sanitation access to all Kenyans by 2030; ■ Promote a clean, secure and sustainable environment by 2030; and ■ Generate more energy and increase efficiency in energy sector.
The National Forestry Policy (2014)	The Policy provides a framework for improved forest governance; resource allocation, partnerships and collaboration with the state and non-state actors to enable the sector to contribute in meeting the country's growth and poverty alleviation goals within a sustainable environment. Among other objectives the policy includes: ■ Mainstreaming of forest conservation and management into national land use systems; ■ Preparation of a national strategy to increase and maintain forest and tree cover to at least 10% of the total land area and for the rehabilitation and restoration of degraded forest ecosystems, and the establishment of a national forest resource monitoring system; ■ Adoption of an ecosystem approach for the management of forests, and recognition of customary rights and user rights to support sustainable forest management and conservation; ■ Establishment of national programmes to support community forest management and afforestation/reforestation on community and private land; and ■ Preparation of national standards for forest management and utilisation, and the development of codes of conduct for professional forestry associations.
The National Land Use Policy (2017)	The Policy provides a legal, administrative, institutional and technological framework for optimal utilisation and productivity of land related resources in a sustainable and desirable manner at national, county and community levels. The Policy is premised on the philosophy of economic productivity, social responsibility, environmental sustainability and cultural conservation. Key principles informing it include efficiency, access to land use information, equity, elimination of discrimination and public benefit sharing. The Policy offers a framework to ensure efficient, productive and sustainable use of land system that provides for: ■ Land use planning, resource allocation and resource management for sustainable development to promote public good and general welfare; ■ Environmental management and sustainable production in the utilisation of land resources;

Policy	Description
	■ Equitable utilisation of land resources to meet governance, social, economic and cultural obligations of the people of Kenya; and ■ Mitigating problems associated with poor land use
The National Energy Policy (2018)	The Policy provides for sustainable, adequate, affordable, competitive, secure and reliable supply of energy at the least cost geared to meet national and county needs while protecting and conserving the environment.
Strategic Environmental and Social Assessment of the Petroleum Sector in Kenya (2016)	Presents a unique opportunity for the country to systematically address environmental and socio-economic management issues pertaining to oil and gas activities in the context of sustainable development.

Table 2.2-2: Relevant National Legislation

Name of Legislation	Description
Food, Drugs and Chemical Substances (Food Hygiene) Regulations (1978)	These regulations provide that no person shall use any premises or being the owner or occupier thereof permit or allow the premises to be used for the purposes of selling, preparing, packaging, storing, or displaying for sale any food unless that person is in possession of a licence issued under the Regulations.
Subsidiary Legislation of Petroleum (exploration and Production) Regulations (1984)	These Regulations provide for access to land. A petroleum agreement or exploration permit cannot authorise a contractor to occupy or exercise any rights in any burial ground or land near a place of worship, any area situated within 50 m of any building, any public road, any area situated within a municipality or township and any area of land declared to be a national park.
Physical and Land Use Planning Act (2019)	An Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purposes. It empowers County governments to adopt Physical Development Plans in accordance with this Act and to control development through issuance of development plan permits, prohibition/control of land and buildings, and subdivision of land. It also provides for approval by the Cabinet Secretary of projects of strategic national importance.
National Environmental Tribunal Procedure Rules (2003) (L.N. No. 191)	The rules provide the procedure for appeals and referrals to the tribunal for determination. The Tribunal hears appeals and complaints from the decisions of NEMA.
Occupational Health and Safety Act (2007), and subsidiary legislations and rules.	An Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. This Act includes requirements for the control of air pollution, noise and vibration in every workplace where the level of sound energy or vibration emitted can result in hearing impairment, be harmful to health or otherwise dangerous. This Act, through medical examination rules, requires workers exposed to various occupational health hazards to undergo regular medical examination

Name of Legislation	Description
Factories and Other Places of Work (Noise Prevention and Control) Rules (2005)	These rules require that where the noise level is above 90 dB(A), the employer shall put in place a noise conservation program that includes posting conspicuous signs reminding employees that hearing protection must be worn, supply hearing protection and ensure all employees wear hearing protection.
The Factories and Other Places of Work (Hazardous substances) Rules 2007	These Rules are prepared to: ■ Mitigate against workplace exposure of persons to potentially hazardous substances; ■ Put in place safety standards against hazardous exposure; and ■ Lower performance of work in hazardous conditions or circumstances.
The Factories and Other Places of Work (Fire Risk Reduction) Rules L.N. 59/2007	These Rules seek to promote fire safety measures at every workplace, process and operations by, among others: ■ Vesting some responsibilities to the occupier; ■ Recommendations on flammable substances on storage, marking and labelling, handling, monitoring (flammable substances), ventilation; ■ Housekeeping as well as removal of products and waste; ■ Machinery/equipment layout as well as Fire escape exits; ■ Control of the spread of smoke; ■ Means of evacuation; ■ Formation and functions of fighting teams; ■ Training in fire safety; ■ Fire detection system; ■ Maintenance inspection & testing of cylinders.
The Factories and other places of work (Safety and health committees) Rules L.N. 31/2004	Make provisions in support of formation of Safety and Health Committees at all factories and other workplaces which regularly employ 20 or more employees. These committees are tasked with the responsibility for overseeing occupational safety and health implementation, and performing safety audits.
The Factories (First-Aid) Order, L.N. 666/1963.	Makes provisions for first aid boxes/cupboards and trained first aiders in workplaces with the respective level first aid kit stocking and numbers of trained first aiders required depending on the number of workers.
Waste Management Regulations (2006)	A licence is required to transport waste in a vehicle approved by the Authority upon the recommendation of the relevant lead agency.
Water Quality Regulations (2006)	A permit is required to discharge a waste/ effluent disposal into the environment in a sound manner.
The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006)	These regulations ensure that activities do not have an adverse impact on any ecosystem.

<table>
<tr><th>Name of Legislation</th><th>Description</th></tr>
<tr><td>The Environmental Management and Coordination (Water Quality) Regulations (2006)</td><td>These Regulations outline the water quality standards that should be met for different uses including effluent discharge. The following schedules in the Water Quality Regulation set out the relevant standards and monitoring requirements:
▪ First Schedule: Quality Standards for Sources of Domestic Water;
▪ Second Schedule: Quality Monitoring for Sources of Domestic Water;
▪ Third Schedule: Standards for Effluent Discharge into the Environment;
▪ Fourth Schedule: Monitoring Guide for Discharge into the Environment;
▪ Fifth Schedule: Standards for Effluent Discharge into Public Sewers; and
▪ Sixth Schedule: Monitoring for Discharge of Treated Effluent into the Environment.
The WRA and NEMA are key administering authorities.</td></tr>
<tr><td>The Environmental Management and Coordination (Waste Management) Regulations (2006), Cap. 387</td><td>These regulations set rules for general waste management and for the management of solid waste, industrial waste, hazardous waste, biomedical waste, radioactive waste, pesticides and toxic waste. These regulations prohibit the pollution of public places, provide for the granting of licences for waste transportation and waste disposal facilities, and require an EIA to be undertaken on any site disposing of or generating biomedical waste.</td></tr>
<tr><td>The National Museums and Heritage Act (2006)</td><td>An Act of Parliament to consolidate the law relating to national museums and heritage; to provide for the establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya. The Act also establishes a notification of discovery requirement and sets restrictions on moving objects of archaeological or palaeontological interest.</td></tr>
<tr><td>Kenya Roads Act (2007)</td><td>An Act of Parliament to provide for the establishment of the Kenya National Highways Authority, the Kenya Urban Roads Authority and the Kenya Rural Roads Authority, to provide for the powers and functions of the authorities and for connected purposes.</td></tr>
<tr><td>Employment Act (2007)</td><td>This is an Act of parliament that applies to all employees employed by any employer under a contract of service. The Act came in operation in June 2008. The Act regulates employment relations between the employer and the employee. It provides fundamental rights of employees, to provide basic conditions of employment of employees, to regulate employment of children, and to provide for matters connected with the foregoing.
This law prohibits employment of children in any activity which constitutes worst form of child labour. No person shall employ a child who has not attained the age of thirteen years whether gainfully or otherwise in any undertaking. However, a child of between thirteen years of age and sixteen years of age may be employed to perform light work which is:
a) Not likely to be harmful to the child’s health or development; and
b) Not such as to prejudice the child’s attendance at school, his participation in vocational orientation or training programmes approved by Minister for labour or his capacity to benefit from the instructions received.</td></tr>
</table>

Name of Legislation	Description
Children Act (2001)	Protects children from economic exploitation and any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development.
Work Injury Benefits Act (2007)	The Act of Parliament seeks to provide framework for compensation to employees for work related injuries and occupational diseases contracted in the course of their employment. The Act provides for, among other provisions, the right for compensation in case of injury related to work, or in case of death due to an accident at work.
Environmental Management and Coordination Act (1999) as amended in 2015 and the subsidiary Regulations	The EMCA as amended in 2015 and its subsidiary regulations set out requirements and procedures for conducting EIAs, auditing and environmental monitoring in Kenya. This Act addresses issues related to duties of NEMA, constitution of CEC at County level as well as its composition and functions, the National Environmental Complaints Committee, the adoption of a NEAP. The Act also establish environmental standards for water quality, noise, fossil fuel emission, and waste management and regulates activities impacting wetlands, riverbanks, lake/seashores, and the conservation of biological diversity.
The Environmental Management and Coordination (Impact Assessment and Audit) Regulations (EIAAR) (2003) The Environmental Management and Coordination (Impact Assessment and Audit) Regulations (EIAAR) (Amendment) (2016) The Environmental Management and Coordination (Impact Assessment and Audit) Regulations (EIAAR) (Amendment) (2019)	These regulations contain rules relative to the content and procedures of an EIA, to environmental audit and to monitoring and strategic environmental assessment. These rules regulate other matters such as the appeal for, and registration of, information regarding EIA. A holder of an EIA licence may, on payment of the prescribed fee, transfer the licence to another person only in respect of the project to which such licence was issued. The EIA/EA amendments revises and replaces the second schedule of projects required to undergo EIA by categorising projects into low, medium and high risk. Petroleum exploration, development and production are categorised as high risk. The draft ESIA and EA Guidelines for the Downstream Petroleum Sub-sector (2012) issued by ERC (now the responsibility of EPRA) provide advice on their interpretation to that sector.
Environmental Management and Co-ordination (Controlled Substances) Regulations (2007), Cap. 387	The regulations provide a framework for controlled substances management including classification and controls in disposal, movement, export and import of controlled substances listed in the schedule. The regulations also provide for licensing, and also for packing and labelling control. A valid license is required to import controlled substances into Kenya.
The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management Plan) Regulations (2009)	These regulations require the protection of wetlands, riverbanks, lake shore and seashore areas which provide ecological habitats.

Name of Legislation	Description
The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations (2009)	This regulation establishes environmental standards that should be met for noise. NEMA is a key administering authority. The following schedules in the Noise and Excessive Vibration Pollution Control Regulation set out the relevant standards and monitoring requirements: ■ First Schedule – Maximum Permissible Intrusive Noise Levels; ■ Second Schedule – Maximum Permissible Noise Levels for Construction Sites; ■ Third Schedule – Maximum Permissible Noise Levels for Mines and Quarries; ■ Fourth Schedule– Application for a License to Emit Noise/Vibrations in Excess of Permissible Levels; ■ Fifth Schedule–License to Emit Noise/Vibrations in Excess of Permissible Levels; ■ Sixth Schedule – Application for a Permit to Carry out Activities; ■ Seventh Schedule – Permit to Emit Noise in Excess; ■ Eighth Schedule – Minimum Requirements for Strategic Noise and Excessive Vibrations Mapping; ■ Ninth Schedule – Minimum Requirements for Action Plans; and ■ Tenth Schedule – Improvement Notice. For an activity that will exceed the noise and/ or vibration limits stipulated in the Regulations ensure that a licence is secured before the undertaking of such activity (fireworks, demolitions, firing ranges or specific heavy industry).
The Constitution of Kenya (2010)	The Constitution of Kenya has taken on board various issues that are related to environmental management. Article 42 of the Constitution provides that every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures. In terms of land and environmental, chapter 5 (Part 1 and Part 2) of The Constitution of Kenya is dedicated to both issues; Part 1 of this chapter provides a list of principles of land policy (article 60), defines different types of land (public, community and private land) (articles 61 to 64) and describes regulation of land use and property (article 66 and 67). The constitution requires that land be used and managed in a manner that is equitable, efficient, productive and sustainable. Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources. Article 69 in Part 2 provides that the state shall provide encourages efforts towards sustainable of natural resources, increasing of the national forest cover public participation in the management, protection and conservation of the environment, protection of genetic resources and biodiversity. This article also mandates that the State shall establish systems of environmental impact assessment, environmental audit and monitoring of the environment. It also mandates that the State should eliminate processes and activities that are likely to endanger the environment.

Name of Legislation	Description
Environment and Land Court Act (2012)	The Environment and Land Court Act establishes the Environment and Land Court pursuant to Article 162 of the Kenya Constitution which provides for the creation of specialised courts to handle all matters on land and the environment. Such a court will have the status and powers of a High Court in every respect. Article 159 on the principles of judicial authority, indicates that courts will endeavour to encourage application of alternative dispute resolution mechanisms, including traditional ones, so long as they are consistent with the constitution.
County Government Act (2012)	The County Governments Act expounds on the functions of County Governments in Kenya and to clarify on the functions of County governments in Kenya. It also designates any other functions not assigned to the counties by the Constitution, or any other written law, as a national government function. It led to the constitution of the department of Environment, Water and natural resources responsible for environmental conservation in the County level.
Prevention, Protection and Assistance to Internal Displaced Persons and Affected Community Acts (2012)	An Act of Parliament on internal displacement in Kenya that makes provision for the prevention, protection and provision of assistance to internally displaced persons and affected communities.
Public Health Act (2012)	The Act provides for the prevention of the occurrence of nuisance or conditions dangerous/injurious to humans. It also provides that the relevant local authority (now County governments) shall take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its jurisdiction has a right to use and does use for drinking or domestic purposes (whether such supply is derived from sources within or beyond its jurisdiction). Chapter 242 makes provision for securing and maintaining public health. Section 115 of this Act prohibits causing nuisance or other condition liable to be injurious or dangerous to health. Section 118 provides a list of nuisances which includes any noxious matter or waste water, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any watercourse, irrigation channel or bed thereof not approved for the reception of such discharge.
The Kenya Wildlife Conservation and Management Act (KWCMA) (2013)	An Act of Parliament to provide for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes. The Act covers wildlife resources in all public, private and community land and Kenyan territorial waters. The Act provides that wildlife should be conserved to yield optimum returns in terms of cultural, aesthetic, scientific and economic benefits. The Act requires that full account be taken of the inter-relationship between wildlife conservation and land use. The Act controls activities within the national parks, which may lead to the disturbance of wild animals. Unauthorised entry, residence, burning, damage to objects of scientific interest, introduction of plants and animals and damage to structure are prohibited under this law. It also regulates wildlife conservation and management in Kenya, through the protection of endangered and threatened ecosystems. Specifically, it prohibits the disturbance or harm of flora and fauna within public places,

Name of Legislation	Description
	community and private land, and Kenyan territorial waters. The Act also establishes KWS as the implementing agency. The act lists nationally protected wildlife conservation areas, species under varying conservation threat levels as well as those nationally considered invasive. The following schedules will form key reference for the impact analysis and ESMP formulation: ■ Sixth Schedule- Nationally listed Critically Endangered, Vulnerable, Nearly Threatened and Protected Species; ■ Seventh schedule- National list of Invasive Species; ■ Ninth Schedule- Wildlife categories in relation to offences and penalties in sport and recreational hunting; and ■ Eleventh Schedule- National Parks, Marine Protected Areas and Sanctuaries
Agriculture, Fisheries and Food Authority Act (2013)	The Agriculture, Fisheries and Food Authority Act consolidates the laws on the regulation and promotion of agriculture and makes provision for the respective roles of the national and County governments in agriculture and related matters.
The Environmental Management and Coordination (Air Quality Standards) Regulations (2014)	This regulation's objective is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries). The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas. Schedules 1 to 3 of the regulations prescribe the ambient air quality tolerance limits, priority air pollutants and emission limits. These will be relevant in monitoring any project impacts on the air environment.
The Water Act (2016) and subsidiary legislation	This is an Act of Parliament with the purpose to provide for the regulation, management and development of water resources and water and sewerage services in line with the Constitution. Part III of the Act provides for the Regulation of the Management and use of water Resources through the WRA which is in charge of implementation of the policy. Part of this act, Section 22 provides for protection of catchment areas to conserve vulnerable water resource and Section 23 provides for the conservation of ground water resource, including i) protection of public water or water supplies for different uses (industrial, agriculture and other private purposes), ii) conservation of the water resources of the aquifer of the ground water resources, and iii) declaration of conservation areas for ecological reasons (published in Gazette). Section 36 of the Act requires that a permit is obtained for: any use of water from a water resource, except as provided by section 37; the drainage of any swamp or other land; and the discharge of a pollutant into any water resource. The policy requires that an application for such a permit shall be subject to public consultation as well as an EIA as per the EMCA, 1999. Section 63 of the Act entitles every person in Kenya the right to clean and safe water in adequate quantities and reasonable standards of sanitation as stipulated in Article 43 of the Constitution.

Name of Legislation	Description
Land Act (2012) as amended by the Land Laws (Amendment) Act (2016)	It is the substantive law governing land in Kenya and provides the legal regime over the administration of public and private lands. It also provides for the acquisition of land for public benefit. The government has the powers under this Act to acquire land for projects, which are intended to benefit the general public. The projects requiring resettlement are under the provision of this Act.
The Forest Conservation and Management Act (2016)	An Act of Parliament to give effect to Article 69 of the Constitution about forest resources; to provide for the development and sustainable management, including conservation and rational utilisation of all forest resources for the socio-economic development of the country and for connected purpose.
Community Land Act (2016)	The Act provides for the recognition, protection and registration of community land rights; management and administration of community land; to provide for the establishment of and the powers of community land management committees; and County governments in relation to unregistered community land and for connected purposes. Part V to VIII of the Act are key to Oil and Gas Operations on Community Land. These parts give provisions on guidelines on: ▪ Conversion of community land for public use; ▪ Special rights and entitlements in the community land; ▪ Environment and natural resources management (natural resources on community land, benefit sharing, rules by-laws and regulation of community land use planning); and ▪ Settlement of disputes relating to community land such as dispute resolution mechanisms, mediation and arbitration.
Land Registration Act (2012) as amended by the Land Laws (Amendment) Act (2016)	This is a procedural law and provides for revision, consolidation and rationalisation of the registration of titles to land, to give effect to the principles and objects of devolved government in land registration. It also provides for the registration of interests over land.
National Land Commission Act (2012) as amended by the Land Laws (Amendment) Act (2016)	The Act establishes the National Land Commission with the purpose of managing public land and carrying out compulsory acquisition of land for specified public purposes.
Climate Change Act (2016)	The objective is the development, management, implementation and regulation of mechanisms to enhance climate change resilience, and low carbon development for sustainable development and connected purposes. It provides the regulatory framework for enhanced response to climate change.
Access to Information Act (2016)	The Act upholds the right to information and enables citizens to access information from the state and private companies.
Health Act (2017)	Private entities shall be permitted to operate hospitals, clinics, laboratories and other institutions in the health sector, subject to licensing by the appropriate regulatory bodies.

Name of Legislation	Description
The Public Health (Drainage and Latrine) Rules	This subsidiary legislation, to Public Health Act, regulates drainage and sewerage provisions and provides technical standards that have to be met in the construction, laying or maintenance of any sewerage system. Provides that every owner or occupier of every workshop, workplace or other premises where persons are employed shall provide proper and sufficient latrines for use by employees. Also requires every contractor, builder or other person employing workmen for the demolition, construction, reconstruction or alteration of any building or other work in any way connected with building to provide in approved position sufficient and convenient temporary latrines for use by such workmen.
The Petroleum Act (2019)	This Act applies in the regulation of upstream, midstream and downstream petroleum operations being developed in Kenya. It provides a framework for the contracting, exploration, development and production of petroleum and provides information on the establishment and functions of the National Upstream Petroleum Advisory Committee. Part VIII of the Petroleum Act (2019) provides for environment, health and safety, which covers environmental compliance, waste management, maintenance of property, venting and flaring of oil and natural gas, reporting of accidents and incidents, safety precautions, emergency preparedness measures, safety zones and liability of contractor for damage due to pollution.
The Traffic (Amendment) Act (2019)	The Traffic Act relates to traffic on all roads. This amendment makes provision for the standardisation of the use of all roads classified as superhighways.
Energy Act (2019)	The Act provides for the establishment, functions and powers of the EPRA under Part III. The Energy Act also provides that a person engaged in any undertaking or activity pursuant to a licence under this Act shall notify the respective licensing authority and EPRA of any accident or incident causing loss of life, personal injury, explosion, oil spill, fire or any other accident or incident causing harm or damage to the environment or property which has arisen in Kenya, within 48 hours in writing, in the form and manner prescribed by EPRA.
The Turkana County Water Act (2019)	Enacted by the County Assembly of Turkana, this Act provides for: the regulation and management of water and sewerage services in Turkana County; the development, regulation and management of County public works in relation to water and sewerage systems; and the implementation of National Government Policies on water conservation in Turkana County and for connected purposes
Human Immunodeficiency Virus (HIV)/ Acquired Immune Deficiency Syndrome (AIDS) Control & Prevention Act (2006)	Provides measures for the prevention, management and control of HIV and AIDS, and for the protection and promotion of public health and for the appropriate treatment, counselling, support and care of persons infected or at risk of HIV and AIDS infection, and for connected purposes. The act requires HIV and AIDS education in the workplace for employees of private and informal sector.

Name of Legislation	Description
The Penal Code, Cap 63 (2009)	Makes it an offence for any person or institution that voluntarily corrupts, or fouls water for public springs or reservoirs rendering it less fit for its ordinary use. Similarly, it prohibits making the atmosphere in any place noxious to health of persons/institution in dwellings or business premises in the neighbourhood or those passing along a public way. In addition, any person who makes loud noises or offensive or unwholesome smells in a place so as to annoy any considerable number of persons in the exercise of their common rights commits an offence and is liable to be punished as for a common nuisance.
Labour Relations Act (2007 Revised 2012)	Consolidates the laws relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratisation of trade unions and employers organisations and to promote sound labour relations through the protection and promotion of freedom of association. It addresses employee's freedom of association, establishment and registration of trade unions and organisations, officials and members of trade unions and employers' organisations, trade union dues and agency fees, among many others.
Mining Act (2016)	Addresses the key areas that will regulate and facilitate the development of the mining and mineral industry including health, safety and environment issues related to mining, including mining of construction materials.
Explosives Act, Chapter 115 (2017)	Regulates the manufacture, storage, sale, transport, importation, exportation and use of explosives, as deployed in construction materials extraction and related construction activities
Land Value (Amendment) Act (2019)	The Act amends the Land Act, Land Registration Act and the Prevention, Protection and Assistance to Internally Displaced Persons and Affected Communities Act; to provide for the assessment of land value index in respect of compulsory acquisition of land.
The Protection of Traditional Knowledge and Cultural Expressions Act (2016)	The Act provides a unified and comprehensive framework for the protection and promotion of traditional knowledge and traditional cultural expressions.
Natural Resources (Classes of Transactions Subject to Ratification) Act (2016)	The Act provides for ratification process by parliament prior to extraction of natural resources. The extraction of underground steam within a water conservation or other water resource protected area, extraction of crude oil or natural gas and excision or change of boundaries of gazetted public forests or nature reserves are listed as transactions requiring parliamentary ratification.

Table 2.2-3: Draft Policies, Legislation and Guidelines

Name of Legislation	Description
The Draft Environmental Management and Co-ordination (E-Waste) Regulations (2013)	The regulations provide an appropriate legal and institutional framework and mechanisms for the management of E-waste handling, collection, transportation, recycling and safe disposal of E-waste. It also provides for improved legal and administrative co-ordination of the diverse sectoral initiatives in management of E- waste as a waste stream, in order, to improve the national capacity for the management of the E-waste.
Draft Environmental Management and Coordination (Waste Tyre Management) Regulations (2013)	The regulations stipulate that no person shall be engaged in the collection, transportation, storage or disposal of waste tyres without a valid licence from the Authority.
The Environment Management and Co-ordination (Deposit Bonds) Regulations (2015)	The regulations are applicable to the activities, industrial plants and undertakings which have or more likely to have adverse effects on the environment. This is to ensure, among other things, good environmental practices, adequate remediation is achieved without adversely affecting economic viability. Any person operating or proposing to operate an industrial plant and undertaking an activity as stipulated in the Deposit Bonds. Register shall be required to prepare a Deposit Bond Assessment Report.
Draft Environmental Management and Coordination (Conservation and Management of Wetlands) Amendment Regulations (2017)	The overall objective of the draft Amendment Regulations, 2017 is to align it to the Constitution of Kenya, 2010, Environmental Management and Coordination Act, 1999 and the National Wetlands Conservation and Management Policy, 2015. The Regulations also seek to address emerging issues such as climate change and invasive species.
The Draft Environmental Management and Coordination (Strategic Assessment, Integrated Impact Assessment and Audit) Regulations (2018)	The draft regulations provide for the need to register environmental assessment experts and the requirement for an environmental assessment expert licence. The regulation spells out requirements for a project report as well as the submission comment and authorisation process. The regulations define the requirements for the integrated environmental impact assessment, environmental audit and monitoring, and strategic environmental assessment processes in some detail.
Draft Plastic Bags Control and Management Regulations (2018)	The Authority may authorise the manufacture, import, export or use of plastic flat bags for industrial packaging. An application for authorisation to manufacture, import, export or use plastic flat bags shall be made in accordance with the first schedule.
Public Participation Bill (2019)	This Bill seeks to provide a framework for effective public participation. The Constitution of Kenya 2010, introduced a new system of governance that places the people at the centre of governance.
Draft Environmental Management & Coordination (Toxic & Hazardous Industrial Chemicals & Materials Management) Regulations (2018)	The regulations will provide for the sustainable management of chemicals in Kenya, specifically, labelling, classification, registration, manufacture, storage, transport (road, air and sea), distribution, handling, import, export, chemical use in mining, substances in articles/chemicals in products, polluter release and transfer register, restrictions and banning, incidents, liabilities, waste disposal and offences of toxic and hazardous chemicals and materials.

Name of Legislation	Description
Local Content Bill (2018)	The Bill seeks to provide for a framework to facilitate the local ownership, control and financing of activities connected with the exploitation of gas, oil and other mineral resources; and further to provide framework to increase the local value capture along the value chain in the exploration of gas, oil and other mineral resources.
Draft Petroleum (Local Content) Regulations (2019)	These regulations are made pursuant to the Petroleum Act, 2019. The regulations will apply to local content with respect to the upstream, midstream and downstream petroleum activities. The purpose of these regulations includes: a) To maximise value addition through local content development and local participation in the petroleum industry operations; b) To promote participation of Kenyan people and indigenous Kenyan companies in provision of goods and services in the petroleum industry value chain; c) To provide for a robust, transparent monitoring and reporting for local content obligations, among others
Strategic Environmental and Social Assessment of the Petroleum Sector in Kenya (2016)	Presents a unique opportunity for the country to systematically address environmental and socio-economic management issues pertaining to oil and gas activities in the context of sustainable development.
The Draft Kenya National Petroleum Master Plan (2015)	Purpose of this is to integrate all elements of the oil and gas value chain, from exploration, production, transportation, processing, storage and distribution, and usage in domestic and export markets.
The Draft Sovereign Wealth Fund Bill (2019)	The Bill establishes Kenya's Sovereign Wealth Fund to undertake diversified portfolio of medium and long-term local and foreign investment to build a savings base for purposes of national development, stabilisation the economy at all times, enhance intergenerational equity in Kenya. It provides institutional arrangements for effective administration and efficient management of minerals and petroleum revenues.
The Preservation of Human Dignity and Enforcement of Economic and Social Rights Bill (2018)	The Bill gives effect to Article 43 of the Constitution in order to ensure the preservation of human dignity as set out under Article 19 of the Constitution. Article 43 of the Constitution guarantees economic and social rights for all persons.

2.3 International Guidance and Standards

The following international standards and guidelines will be incorporated throughout the Project ESIA:

Table 2.3-1: List of WBG & IFC International Standards Applicable to Project ESIA

Source	International Standard
WBG (2007a)	■ EHS General Guidelines including key sections on the following: ▪ EHS Guidelines: Wastewater and Ambient Water Quality; ▪ EHS Guideline: Air Emissions and Ambient Air Quality; ▪ EHS Guideline: Occupational Health and Safety; ▪ EHS Guideline: Noise; and ▪ EHS Guidelines: Water and Sanitation.
WBG (2007b)	■ EHS Guidelines for Onshore Oil and Gas Development.
WBG (2007c)	■ EHS for Crude Oil and Petroleum Product Terminals.
WBG (2007d)	■ EHS Guidelines for Electric Power Transmission and Distribution
IFC (2012)	■ Performance Standards for Environmental and Social Sustainability and accompanying Guidance Notes.

Good Practice guidelines which will be also referred to throughout this document are presented as follow:

Table 2.3-2: List of Good Practice Guidelines Incorporated into Project ESIA

Source	International Guideline
Business and Biodiversity Offsets Programme (BBOP) (2012).	■ BBOP Standard on Biodiversity Offsets Guidance.
IFC (1998)	■ Doing Better Business Through Effective Public Consultation and Disclosure.
WBG (2007e)	■ Stakeholder Engagement: A Good Practice Guide for Companies Doing Business in Emerging Markets.
IFC GPN 7 (2009)	■ Good Practice Note 7: Addressing Grievances from Project-Affected Communities: Guidance for Projects and Companies on Designing Grievance Mechanisms.
WBG and European Bank for Reconstruction and Development (EBRD) (2009)	■ Workers' Accommodation: Processes and Standards.
IFC (2013)	■ Good Practice Handbook: Cumulative Impact Assessment and Management – Guidance for the Private Sector in Emerging Markets.
IFC (2014)	■ Environmental and Social Management System Implementation Handbook.

Source	International Guideline
WBG (2017)	■ Good Practice Note: Managing Contractors' Environmental and Social Performance.
International Petroleum Industry Environmental Conservation Association (IPIECA) (2007).	■ An ecosystem approach to oil and gas industry biodiversity conservation.
IPIECA (2010)	■ Alien invasive species and the oil and gas industry Guidance for prevention and management.
IPIECA (2014)	■ Cross Sector Biodiversity Initiative Guidance.
The Energy and Biodiversity Initiative (2006)	■ Integrating Biodiversity into Environmental and Social Impact Assessment Processes and associated guidance.
The Energy and Biodiversity Initiative (2006)	■ Negative Secondary Impacts from Oil and Gas Development: www.theebi.org.
The Energy and Biodiversity Initiative (2006)	■ Biodiversity Indicators for Monitoring Impacts and Conservation Actions: www.theebi.org.
The Energy and Biodiversity Initiative (2006)	■ Opportunities for Benefiting Biodiversity Conservation: www.theebi.org.
The Energy and Biodiversity Initiative (2006)	■ Good Practice in the Prevention and Mitigation of Primary and Secondary Biodiversity Impacts: www.theebi.org.
The Energy and Biodiversity Initiative (2006)	■ Framework for Integrating Biodiversity into the Site Selection Process.
World Resources Institute (WRI) (Landsberg et al., 2013)	■ Weaving ecosystem services into impact assessment: A Step-By-Step Method.
WHO (1999)	■ Guidelines for Community Noise.
WHO (2005)	■ Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines.
WHO (2011)	■ Drinking Water Quality Guidelines – 4th edition.

2.4 International Conventions

This subsection presents a list of relevant international treaties, conventions and agreements to which Kenya is a signatory or has acceded to/ratified and that are related to the social and/or environmental aspects of the Project ESIA.

Table 2.4-1: International Conventions

Convention	Date Ratified/ Acceded to
African Convention on The Conservation of Nature and Natural Resources (Revised Edition) 2003	Ratified 1969
International Convention Relating to Intervention on the High Seas in Case of Oil Pollution Casualties (1969)	N/A
International Oil Pollution Compensation Supplementary Fund (2003)	N/A
International Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) (London Dumping Convention)	Acceded 1976
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973)	Acceded 1992
International Covenant on Economic, Social and Cultural Rights	Ratified 1972
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)	Acceded 1978
The African (Banjul) Charter on Human and Peoples" Rights (African Charter)	Ratified 1992
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the East African Region (1985)	N/A
Vienna Convention for the Protection of the Ozone Layer (1985)	Acceded 1988
Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	Accepted 1988
International Convention on Oil Pollution Preparedness, Response and Co-operation (1990)	Acceded 1999
Convention on Wetlands of International Importance (the Ramsar Convention) (1971)	Ratified 1990
UNESCO Convention for the Protection of the World Cultural and Natural Heritage	Acceded 1991
United Nations Framework Convention on Climate Change (1992)	Acceded 1994
Convention on Biological Diversity (1992)	Acceded 1994
Lusaka Agreement on the Cooperative Enforcement Operations Directed against Illegal trade in Fauna (1994)	Ratified 1997

Convention	Date Ratified/ Acceded to
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (1979): ■ The African-Eurasian Water-bird Agreement (AEWA); and ■ The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA).	Acceded 1999
Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (Basel Convention) (1989)	Acceded 2000
Bamako Convention on the Ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa (1991)	Signed 2003
Convention on Persistent Organic Pollutants (2001)	Ratified 2004
Convention on Climatic Change and the Kyoto Protocol (1997)	Ratified 2005
UNESCO Convention on Intangible Cultural Heritage	Ratified 2007
Framework Convention for Climate Change (The Paris Agreement)	Ratified 2016
United Nations Convention to Combat Desertification	Ratified 1997
International Convention on Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992	Acceded 2000
International Convention on Civil Liability for Oil Pollution Damage for Oil Pollution Damage, 1992	Acceded 2000

2.5 Project Standards

The Project Standards are presented in Annex I.

3.0 IMPACT ASSESSMENT METHODOLOGY

3.1 Overview

The objective of the ESIA is to identify and quantify impacts that the Project may have on the biophysical and socio-economic environments through comparison to the ESIA baseline. The ESIA sets out potential mitigation and management processes to prevent unacceptable deterioration of environmental and social conditions, minimise negative impacts and enhance benefits for stakeholders, affected communities and the environment. The ESIA methodology uses a staged approach presented in Table 3.1-1.

A stakeholder engagement process is incorporated in the ESIA methodology to ensure that legislative requirements are met; sources of information and expertise are identified; stakeholder concerns and expectations are registered and addressed in the ESIA. Project Affected People (PAP) have the opportunity to discuss the Project risks, impacts, proposed mitigation and monitoring. The Stakeholder Engagement Plan (SEP) and consultation materials are presented in Annex II.

Table 3.1-1: Approach to Impact Assessment

Stage	Activity
1	Establish baseline conditions – determine baseline conditions through review of existing published and available site-specific information.
2	Establish the key receptors and their importance.
3	Characterise the magnitude of the impact to the receptor Bio-physical: determine the potential changes to receptors brought about by the Project (including incorporated environmental measures) and assign a magnitude of impact. Social: determine the potential changes to PAP brought about by the Project (including incorporated environmental measures) and assign a consequence.
4	Assess the impact significance Bio-physical: determined by the nature and magnitude of impact, combined with the importance of receptor. Social: Evaluation of social significance impacts through a narrative evaluating direction, consequence, geographic extent and duration of impact
5	Consider the need for monitoring and management – used where there is a need to support the implementation of or monitor the success of any mitigation.

The ESIA will be undertaken in accordance with the applicable requirements of:

- Kenyan EIA legislation and policy;
- IFC PSs;
- Tullow internal policies and standards; and
- GIIP.

3.2 Scoping Stage

The aim of scoping is to identify potential impacts on environmental and social receptors arising from Project activities that will need to be further considered in baseline data collection and the impact assessment. Scoping is also used to determine how the ESIA will be undertaken.

The primary output of the scoping stage was the Terms of Reference (ToR) and the Scoping report. Both documents were produced based on what was at that time the "*Full Field Development*", the name of the Project has subsequently changed, but the ToR (1433956.517_A.0) and Scoping report (1433956.516_A.2) remain valid and are presented in Annex I of this ESIA.

3.3 Establishment of Baseline Conditions

Baseline data collection is undertaken to characterise the existing environmental and social receptors and conditions in the Area of Influence (AoI), and trends in such conditions. Baseline data determination largely comprises:

- Review of existing published sources; and other available secondary information, including those held by government agencies, Non-governmental Organisations (NGOs) and research agencies;
- Site reconnaissance visit and field surveys; and
- The subsequent analysis and interpretation of data.

Baseline data is presented in Section 6.0 of this ESIA.

Baseline data collection was undertaken both prior to and during the operation of EOPS. Although EOPS is outside of the scope of this ESIA, the impact and inclusion of EOPS on the current baseline has been considered in this assessment.

3.4 Impact Assessment

The impact assessment process has been based on a standard methodology, widely used nationally and internationally.

The term 'impact' will be used to describe a change to the receiving physical, biological or social environment, which may require mitigation or management to be considered. The types of impacts that will be considered in the ESIA include:

- Direct – an impact that arises directly from activities that form an integral part of the Project (e.g. new infrastructure) and is within the control of the Project proponent;
- Indirect – an impact that arises from activities not explicitly forming part of the Project but as a "*knock on effect*" of it, that may not be within the control of the Project proponent (e.g. changes to water availability due to increased influx of people); and
- Combined – the combination of other direct or indirect impacts of the Project on any one or group of receptors.

The impact assessment process will comprise the following main steps:

- Identification of the impacts of the Project on receptors taking into account incorporated environmental measures (see Section 3.8);
- Evaluation of the significance of the impact;
- Development of mitigation measures; and
- Where necessary, prediction of the significance of residual impacts.

The details of the methodology will however be developed for each topic based on professional judgement; comparison with topic-specific regulations or standards; comparison with experience on other similar projects; and consultation with stakeholders.

In addition to the standard ESIA methodology the impact analysis for each environmental and social topic will be accompanied with an assessment of emergency, accidental and non- routine events, which will be reported in a separate Section (7.11) and will feed into an emergency preparedness response plan.

3.5 Receptor Importance

The term ‘receptors’ is used to describe features of the environment such as water resources, habitats and species which are valued by society for their intrinsic worth and/or their social or economic contribution; and social groups or PAP such as individuals and communities that may be impacted by the Project.

The importance of a receptor is determined by the consideration of a range of criteria depending on the topic under consideration, including: the economic, social and cultural value of the receptor, locally, nationally and internationally; any local, national or international designations; the rarity of the receiving environment; and the benefits or services provided.

Receptor importance is determined by the consideration of a receptors’ ability to resist or adapt to changes and its resilience to change. The category of the importance of a receptor is determined based on professional judgement of technical topic leads and is presented in each technical sub section of Section 7. Table 3.5-1 provides an example of categories of importance.

Table 3.5-1: Example for Determining Receptor Importance

Importance of Receptor	Example of importance of receptors
Very high	An attribute with a high quality and/ or rarity on an international, regional or national scale with little or no potential for substitution. Sensitive Receiving environment or receptor with little resilience or adaptability to imposed stresses.
High	An attribute with a high quality and/ or rarity on a local scale with little or no potential for local substitution, or with a medium quality or rarity on an international, regional or national scale with limited potential for substitution. Sensitive Receiving environment or receptor with little resilience or adaptability to imposed stresses.
Medium	An attribute with a medium quality and/ or rarity on a local scale with limited potential for substitution, or an attribute of low quality and rarity on an international, regional or national scale. Receiving environment or receptor with moderate resilience or adaptability to imposed stresses.
Low	An attribute of low quality and/ or rarity on a local scale with potential for substitution locally. Receiving environment or receptor with high resilience or adaptability to imposed stresses.

3.6 Identifying the Magnitude and Significance of Environmental Impacts

The magnitude of the impact will be determined by taking into account several factors. This will vary per topic but may include one or several of the following:

- Intensity of change;

- Geographic extent of change;
- Duration of change; and
- Frequency.

Table 3.6-1: Determination of Significance of Environmental Impact

		Magnitude of Impact			
		Negligible	Low	Medium	High
Receptor importance	Very High	Minor	Moderate	Major	Major
	High	Negligible	Minor	Moderate	Major
	Medium	Negligible	Minor	Minor	Moderate
	Low	Negligible	Negligible	Minor	Minor

Impact significance will be determined by consideration of the importance of the receptor in combination with the magnitude of the impact. Receptor importance and magnitude are specific to each environmental topic and are defined in the impact assessment using a combination of environmental standards, guidance and professional judgement. Table 3.6-1 demonstrates how these parameters are considered in the assessment of significance.

3.7 Evaluating the Significance of Social Impacts

The evaluation of social impacts will differ from the evaluation of environmental impacts. Evaluation of social impacts will rely on a narrative, which will bring together the evaluation of the following four criteria to reach an impact significance for the overall social impact:

- Direction, i.e.:
- Positive direction– impact provides a net benefit to the affected person(s);
- Negative direction – impact results in a net loss to the affected persons(s); and
- Mixed direction – mixed directions or no net benefit or loss to the affect person(s).
- Consequence, i.e.:
  - Negligible consequence – no noticeable change anticipated;
  - Low consequence – predicted to be different from baseline conditions, but not to change quality of life of the affected person(s);
  - Moderate consequence – predicted to change the quality of life of the affected person(s); and
  - High consequence – predicted to seriously change quality of life.
- Geographic extent of change; and
- Duration.

Each impact will be considered in relation to other impact topics and sub-topics. The objective of the narrative in the evaluation of social impacts is to show the relative importance of social impacts.

3.8 Incorporated Environmental and Social Measures

Incorporated environmental and social measures are those measures that have been incorporated into the design of the Project. These design changes are already incorporated into the Project and are therefore not considered to be mitigation in terms of ESIA.

The impact assessment will be undertaken assuming that the above incorporated design measures are applied alongside GIIP as an integral element of the Project design.

3.9 Mitigation of Impacts

Additional measures will be committed to if, as a result of the ESIA, mitigation is required. Mitigation will be identified in accordance with a hierarchy of options in accordance with good practice and comply with IFC PSs.

- Avoid - making changes to the Project's design or location to avoid adverse effects on an environmental feature or adverse social impacts;
- Minimise - reduction of adverse effects through sensitive environmental treatments/design, or different Project design to reduce adverse social impacts;
- Restore - measures taken during or after construction to repair/reinstate and return a site to the situation prior to occurrence of impacts;
- Compensate/offset - where avoidance or reduction measures are not available, it may be appropriate to provide compensatory/offsetting measures. Compensatory measures do not eliminate the original adverse effect; they merely seek to offset it with a comparable positive one; and
- Improvement measures - projects can have positive effects as well as negative ones, and the Project preparation stage presents an opportunity to enhance these positive features through innovative design.

3.10 Identification of Residual Impacts

Residual impacts are those that remain following the implementation of the proposed mitigation. These will be identified for each of the specialist topics by reviewing the predicted impacts against the mitigation measure proposed and then identifying any residual impacts. Residual impacts will be defined based on the same process applied to the evaluation of impacts.

3.11 Consideration of Climate Change

According to the Task Force on Climate- related Financial Disclosures (TCFD) it is increasingly essential to understand the risks posed by a changing climate on business and to realise that climate has a material impact on operations. As recommended by the TCFD, the first step in increasing sustainability and climate resilience is to assess the risks posed by climate change, and to account for its physical impacts.

The Project will have an operational life of approximately 25 years, during which time the Project will need to be resilient to the risks of climate change. The Project will be designed taking into account the physical impacts of climate change over this timeframe, as well as during construction. The weather and climate baseline (Section 6.4) presents the results of a desktop study of Kenyan specific climate change indicators.

To understand the potential impacts on the Project posed by future climate change, prior to construction a risk assessment will be undertaken to identify how climate change should be accounted for in the Project design. In accordance with the TCFD recommendations, this assessment will allow for climate change resilience to be integrated into the Project. In addition, a climate change management plan will be produced to guide adaptation throughout its life.

Likely physical climate risks are identified in each relevant technical section of the ESIA and where a risk associated to climate change is identified, e.g. temperature change, water scarcity, extreme events, there will be a commitment to mitigation or management relating to climate change resilience.

3.12 Area of Influence

The AoI is defined in the IFC PS1 as the area likely to be affected by: (i) the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.

For the Project, the AoI has been defined incorporating the Biophysical AoI and the Social AoI. The Biophysical AoI is constrained to the administrative unit boundaries (Locations) in which project infrastructure is located. It is more constrained than the Social AoI, so the land use and habitat analysis is not overly conservative.

The social AoI remains constrained by administrative boundaries but extends further than the Biophysical AoI into surrounding Locations that could be indirectly affected by the Project. The larger Social AoI reflects the dynamic of pastoralism in which people move across administrative boundaries in search of natural resources. In this context, the Project and any associate movement of people and influence on their livelihoods extends beyond the administrative units which contain the Project physical infrastructure. The Social AoI includes Locations where movement of PAP is understood to occur based on baseline data gathering.

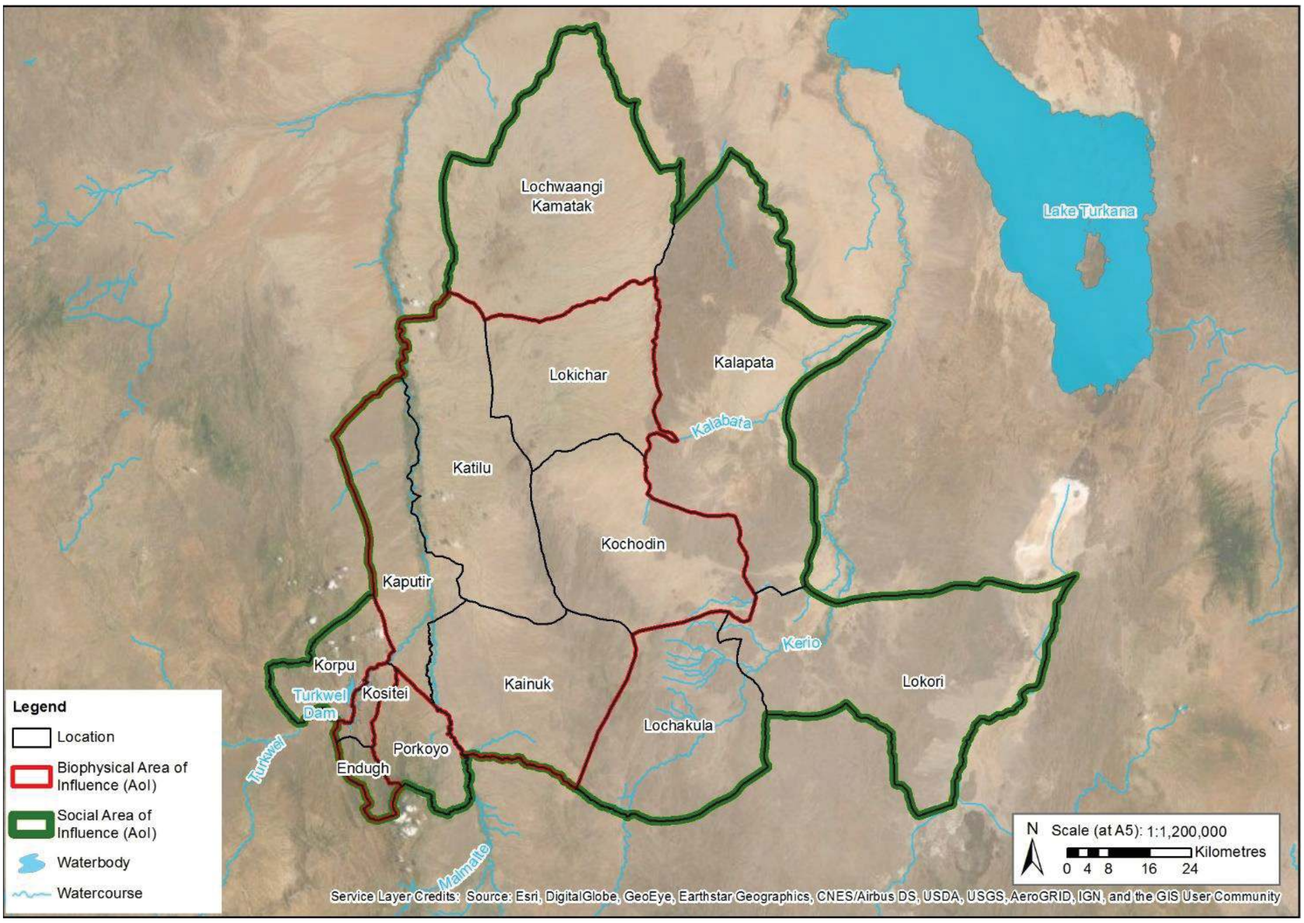


Figure 3.12-1: Project Area of Influence

4.0 STAKEHOLDER ENGAGEMENT

Stakeholder Engagement will be completed in line with the Stakeholder Engagement Plan (SEP) which is already publicly available on the Tullow website:

https://www.tullowoil.com/Media/docs/default-source/operations/kenya-eia/esia-stakeholder-engagement-plan_september-2019.pdf?sfvrsn=2

Stakeholder engagement relating to this ESIA will include extensive consultation with Stakeholders on this draft ESIA. Consultation is planned at the earliest convenient time (dependent on restrictions relating to Covid-19) in 2020.

The primary objective of this consultation is to ensure that stakeholder issues are registered and addressed in the final ESIA and PAP have the opportunity to discuss Project impacts, and proposed mitigation and monitoring measures. Stakeholders including local communities, government, civil society organisations and NGOs will be invited to participate in consultation on draft ESIA.

5.0 PROJECT DESCRIPTION

5.1 Introduction

This Section of the ESIA report presents the technical components of the Project and details construction and operational processes, including the following phases:

- Site Preparation;
- Construction;
- Commissioning;
- Operations; and
- Decommissioning.

This Section also outlines incorporated Project design measures which have been identified and incorporated within the Front-End Engineering and Design (FEED) phase for the Project. As presented in the ESIA Methodology section (Section 3.0), these measures are referred to as 'incorporated measures'.

The South Lokichar Basin is located in Turkana County, north-west Kenya between Lake Turkana and the Turkwel River valley, approximately 450 km north of Nairobi. The Project will focus on developing the most mature areas of the TAN fields. Oil will be produced from production wells located on multiple wellpads across the three fields enabled by water injection supplied to injection wells located on the same pads.

The Ngamia oil field is centrally located in the site, with the Amosing field located approximately 3 km to the south and Twiga approximately 18 km north. The CFA is located to the north-east of the Ngamia oil field and within the CFA is the CPF.

Early production of oil from the Ngamia and Amosing fields, as part of EOPS Phase II uses an Early Production Facility (EPF). Production from the EPF will continue until the Final Investment Decision (FID) on the Project, when the EOPS facility will be decommissioned. The construction stage of the Project will therefore occur post-decommissioning of the EOPS facility.

The Early Oil Pilot Scheme Phase II operations and decommissioning are permitted under a separate ESIA (Golder, 2018, ref. 1654017.718).

5.2 Project Overview

The Project consists of the following key facilities (Figure 5.3-1):

- Use of the existing facilities developed as part of EOPS Phase II, including wellpads, wells, production facilities and water supply boreholes;
- Use of existing wellpads which do not form part of EOPS;
- New wellpads and 321 new wells;
- Use of the existing airstrip and basecamp which is leased by TKBV;
- Infield flowlines;
- The CFA which includes a CPF, the Lokichar Export Facility (LEF), an ancillary area, the Integrated Waste Management Facility (IWMF), a permanent accommodation camp, a temporary accommodation camp, a drilling area and a construction laydown area;

- Additional temporary accommodation camps (water pipeline construction camp, rig camp and drilling minicamp);
- Make-up water facilities;
- An engineered landfill facility (not located within the IWMF);
- Infrastructure, including roads, power supply network and communications network; and
- Community water offtake points from the make-up water pipeline which terminate at an isolation valve local to the pipeline.

The ESIA scope will encompass the following Project components:

- All drilling and associated well construction activities;
- Expansion of existing wellpads and creation of new wellpads;
- All infield flowlines, trunklines, fibre optic network and electrical distribution;
- All facilities located within the CFA perimeter fence including the LEF which is separately permitted and operated as part of LLCOP;
- Expansion of facilities to 330 Thousand barrels of water per day (bwpd) in year 5;
- All telecommunications network and equipment;
- Use of the upgraded Kapese Airstrip (upgrade to be permitted elsewhere as a leased facility);
- Accommodation camps (temporary and permanent);
- Addition of a new landfill site;
- Infield roads (except the existing Kenyan national roads, e.g. C46);
- Make-up water pipeline from the Turkwel Dam (headrace) to the CFA;
- Electrical connection from a new 220 kV Transformer adjacent to CFA; and
- Electrical connection from a new 66kV/11.4 kV Transformer local to make-up water abstraction pumps.

Existing facilities, including the Kapese airstrip, Kapese Base (camp), existing wellpads, wells and production facilities, and water supply boreholes do not form part of the Project covered by the scope of this ESIA.

The following items do not form part of the Project scope and may require separate permitting/approval activities:

- Construction of contingent wellpads, which may potentially be developed in the future based on the performance of the planned firm wellpads;
- Removal of supply route pinch points (e.g. lifting of existing Overhead Transmission Lines (OHTL)) will be subject to a separate approval procedure;
- CPF connection to grid at the South Lokichar location;
- Borrow pits;
- The water reticulation system will be owned and managed by the County Governments; and
- The Turkwel Dam water pipeline will improve access to 112,000 bwpd for communities along the proposed water pipeline route in West Pokot and Turkana. Along the route (approximately 90 km), the Project will

make provisions for six community offtake points (two in West Pokot and four in Turkana) allowing County water services providers to access the water. These providers will be responsible for the treatment of the water to ensure it meets drinking water standards and its distribution. Community Water Resource Users Associations (CWRUA) will be formed in collaboration with the County Government's Department of Water Services, and Water Resource Authority (WRA). The CWRUA's will be responsible for the management and operation of the supply schemes.

5.3 Foundation Phase Development

Oil will be produced from production wells located on multiple wellpads across the three TAN fields. Due to the reservoir properties, artificial lift is required to transfer the fluid from the reservoir to the surface. The wellpads are connected into a system of buried trunklines and flowlines (gathering network) to transfer fluids to the CPF for treatment and stabilisation.

The Project will use water injection to sustain and improve the rate of recovery from the reservoirs which make up the TAN fields. Water for the Project will be taken from the Turkwel Dam reservoir, located in West Pokot, to south-west of the facility, and supplied to the CPF via a buried pipeline, approximately 90 km in length. The abstraction point at the Turkwel Dam reservoir will require a small facility to pump water.

The water conveyed by the water pipeline will be treated at the CPF to meet the injection specification before offtake for other water needs for the Project and distribution at pressure via the water injection network to wellpads for injection. Once production has started and the CFA is operational, produced water will eventually replace the need for make- up water.

There will be a network of pipelines to convey the water received at the CPF to the wellpads for water injection. Service water for other activities at the wellpads will also come from the CPF but will be treated prior to distribution. Service water will be distributed via a network running parallel to the water injection network through the Amosing and Ngamia fields. Twiga will not be connected to the service water system but will be supplied by truck.

The CPF will be located within a central hub, the CFA, which will be located adjacent to the Ngamia oil field. The CFA will contain accommodation, waste management facilities (excluding landfill), offices, laydown areas and warehouses as well as facilities required for production, and to support construction and operating activities. The CPF will process the oil from the low CO_2 production wells, including the following stages of treatment:

- Degassing of the oil;
- Separation of oil and water;
- Stabilisation of the oil; and
- Heated storage, prior to export to the pipeline.

Flow from high CO_2 wells will be degassed at a lower pressure in a separate vessel (to release low CO_2 from the well fluids), prior to co-mingling with main oil treatment process.

Within the CFA is the LEF which is included in the scope of the separately permitted and operated LLCOP. A plot area of 80 m x 80 m is allocated within the boundaries of the CFA layout to support the pump station and required utilities including power and service water (not within the ESIA scope). The first export of crude from the Lamu Marine Terminal is expected within two months of start-up.

Project components located outside of the CFA will include the airstrip at Kapese (currently under a leasing arrangement but will be used by the Project), infield access roads and an engineered landfill site for waste disposal.

The main power supply to production wells shall be provided using 33 kV overhead lines from the substation located in the CPF.

Treated crude from the CPF will be exported via the midstream pipeline (not included in the scope of this assessment), with the custody transfer point between upstream facilities and midstream facilities being the custody metering package, located within the CPF. An underground export pipeline will take processed oil from the CPF to a terminal in Lamu, where oil will be stored for transport to international markets (not within the scope of the Project). The battery limit for the oil pipeline is at the connection to the CPF.

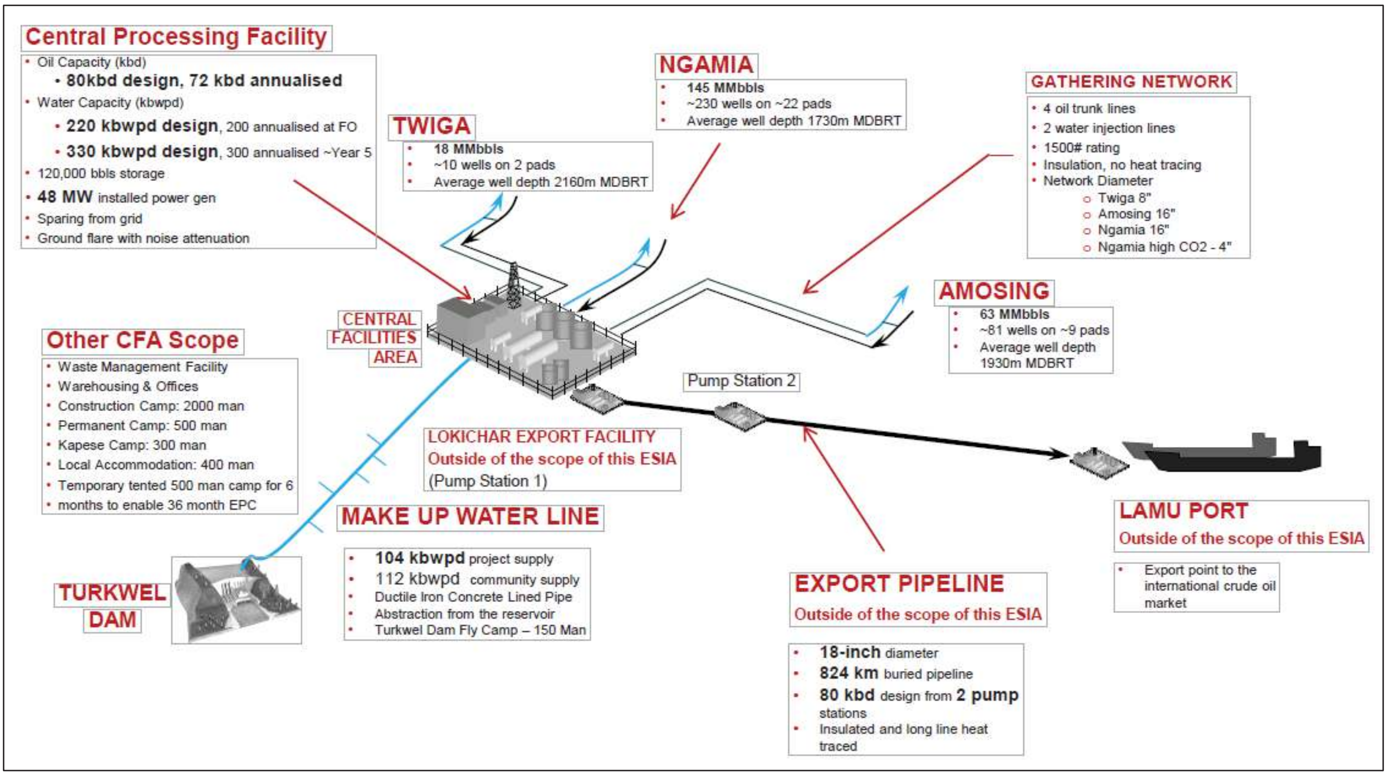
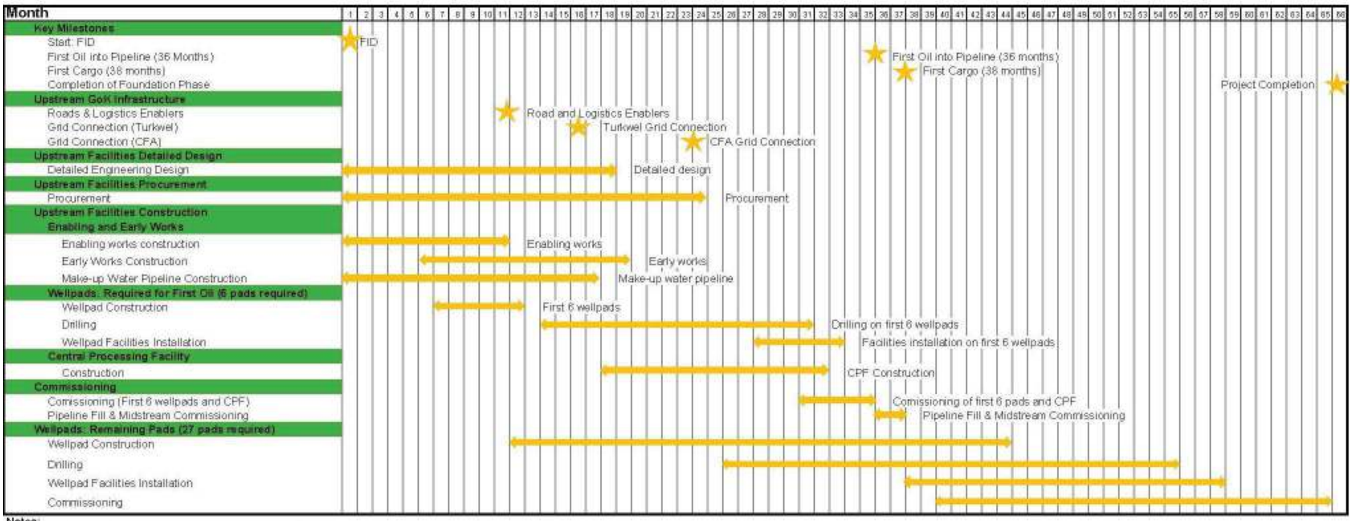


Figure 5.3-1: Foundation Phase Development Overview Including Selected Existing Facilities

5.3.1 Project Schedule

The construction period for the first 6 wellpads will be completed 15 months from the start of construction, when drilling of the wells required for First Oil (FO) will commence. The CFA, CPF and wells required for FO will be constructed by month 36. The remaining 27 wellpads will be constructed with wells drilled up to Month 66. Operations are assumed to last approximately 25 years. The schedule is summarised in Figure 5.3-2 below.



Notes:

1. Overall Project duration based on upstream FEED schedule, subject to further optimisation as part of EPC tendering and alignment with well tendering

Figure 5.3-2: Project Schedule Showing Critical Items

5.3.2 Production Profile

The production profiles for oil, gas, produced water, injection water and make-up water are shown below in Figure 5.3-3.

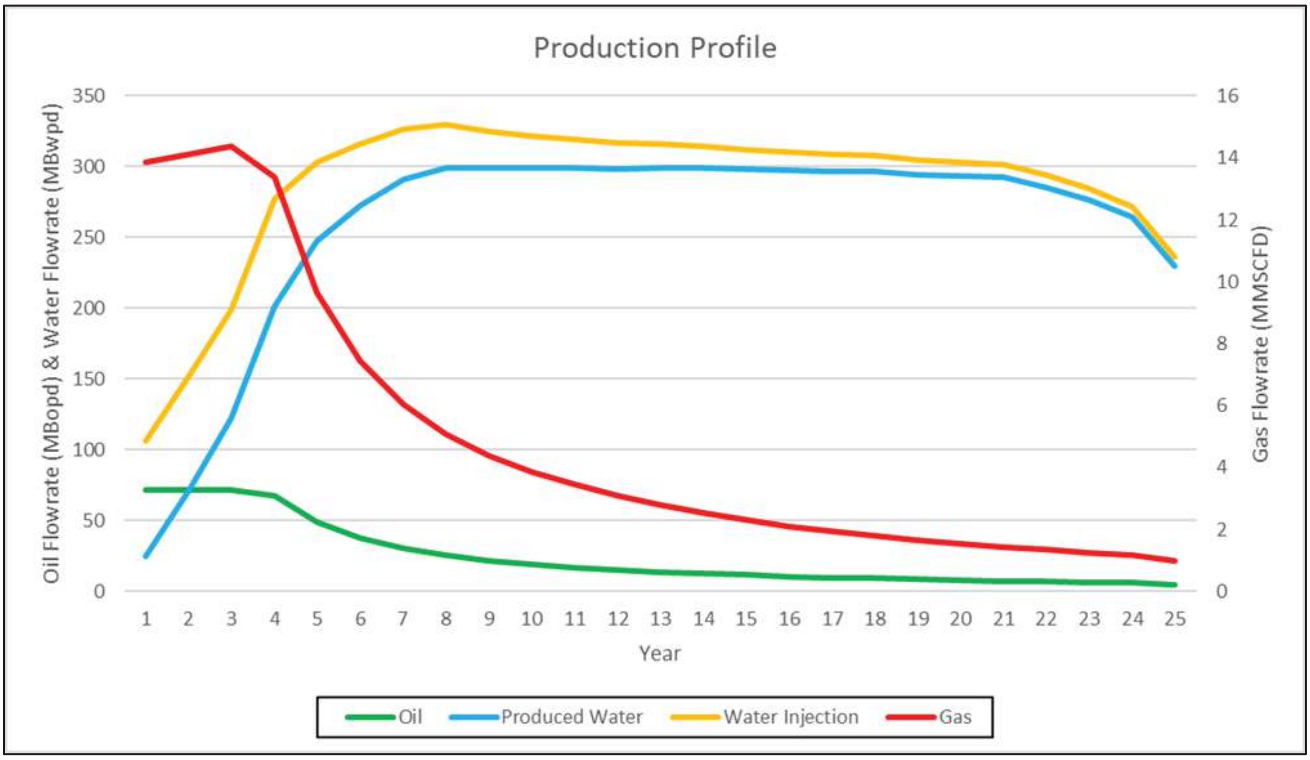


Figure 5.3-3: Production Profile, Case 1 - 2C June 2019

5.3.3 Oil Characteristics

Samples have been taken from the reservoir and analysed to determine the fluid composition and properties. The analysis has shown that the oil will be difficult to deal with when cold, due to the high wax appearance temperature (WAT) (62 to 67°C) and the high pour point (39 to 48°C). From this perspective, the Project operating philosophy is to keep the oil above the WAT in the facility, flowlines and export pipeline.

No H_2S has been identified to date in the produced reservoir fluids. The produced fluids are expected to have a low sulphur content.

A section of the Ngamia reservoir has been identified as having a higher CO_2 content as confirmed by samples during the exploration and appraisal (E&A) phase when compared to the rest of Ngamia. The high CO_2 wellpads have been identified as NG-02, NG-04, NG-10, NG-20, NG-23 and NG-24 and will have a separate treatment and disposal system at the CPF.

5.3.4 Land Requirements

The Project requires access to approximately 1,085 ha of land to develop the facilities required to construct and operate the Project as a prerequisite to FID. The MoPM has gazetted polygon areas measuring approximately 6,500 ha. The polygons will be classified as land for dual use i.e. for the Project and community but it is only the specific land requirements (defined footprint) which are to be restricted for the Project only use and thereby leased by TKBV. Land acquisition for the Project will be managed by the NLC.

The Project footprint is shown in Figure 5.3-4.

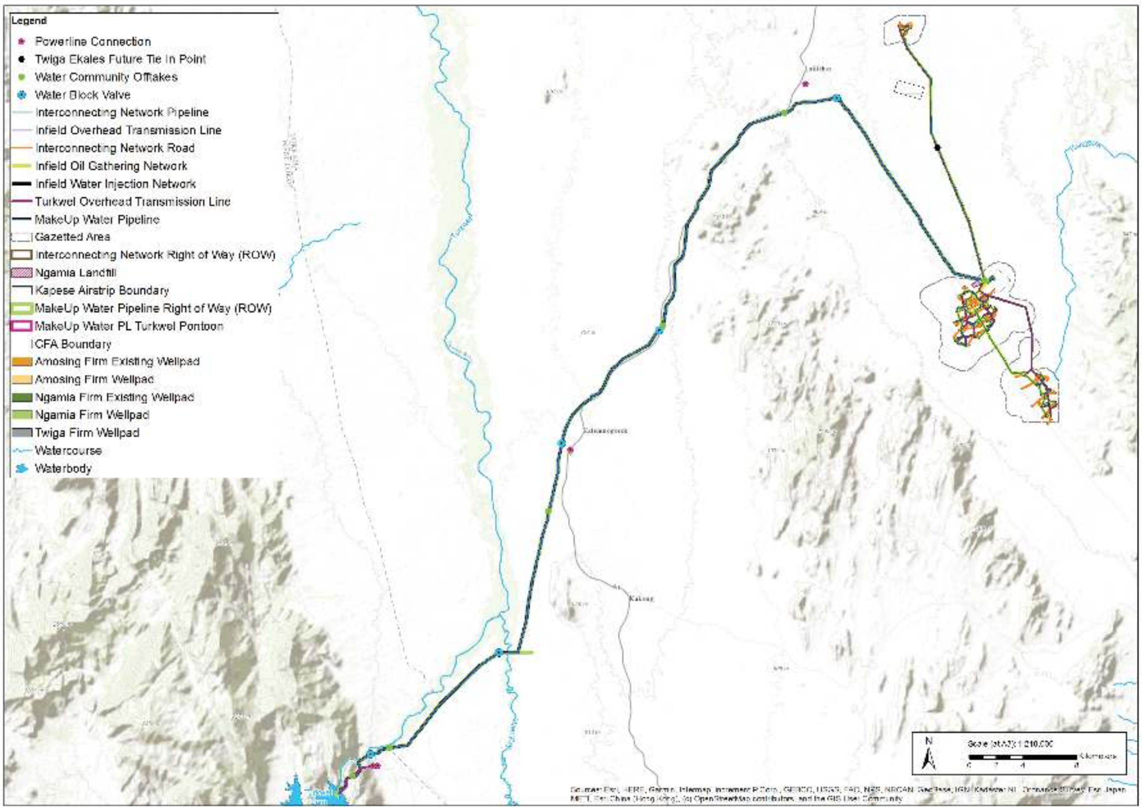


Figure 5.3-4: Project Footprint

Water will be sourced from Turkwel Dam, therefore land access for the water pipeline will involve temporary access to a 27 m corridor during construction and a long-term permanent easement (an easement is a right to access or otherwise use someone else's land for a specified purpose) for a 6 m corridor, with the pipeline located on the centreline.

The Government will make land required for the Project available to the contractor. A Government led approach to securing land access is therefore being followed, in compliance with Kenyan legislation. Land will be acquired to permit the installation of all facilities for the development as detailed in Table 5.3-1.

Table 5.3-1: Upstream Facilities Land Requirements

Land component	Specific land	Final Land Allocation Area (ha)
Make-Up Water Pipeline	Make-Up Water Pipeline	260
CFA	CFA Outer	244
	CFA Permanent	175
	Wellpads (Firm) [1]	256
Landfill	Landfill Ngamia	16
Interconnecting Network	Pipeline, infield- OHTL and Road network	309
	Total[2]	**1,085**

1 Scope of ESIA is firm wellpads only (i.e. 33 wellpads in TAN).
2 The total does not include the CFA permanent area as this is already accounted for in the CFA outer area (used for construction).

5.3.5 Water Demand and Supply

Water will be required for both the construction and operational phases of the Project. The demand and source of water is detailed for each phase.

5.3.5.1 Construction Water Demand and Supply

During the construction phase the estimated water demand will peak at 13,116 bwpd (~2,085 m^3/day). The current estimated water demand will exceed the rate currently permitted for groundwater abstraction (see black line on Figure 5.3-4) of 7,925 bwpd (~1,260 m^3/day) from month 17 of construction. Hence water from an alternative source will be required to meet the Project water demand.

Once installed, water abstraction from the Turkwel reservoir will have the potential to provide water to the CPF via the water pipeline of up to 104,000 bwpd (16,534 m^3/day).

The source water supply for construction will be from a network of existing borehole wells connected by a temporary water pipeline to water storage tanks.

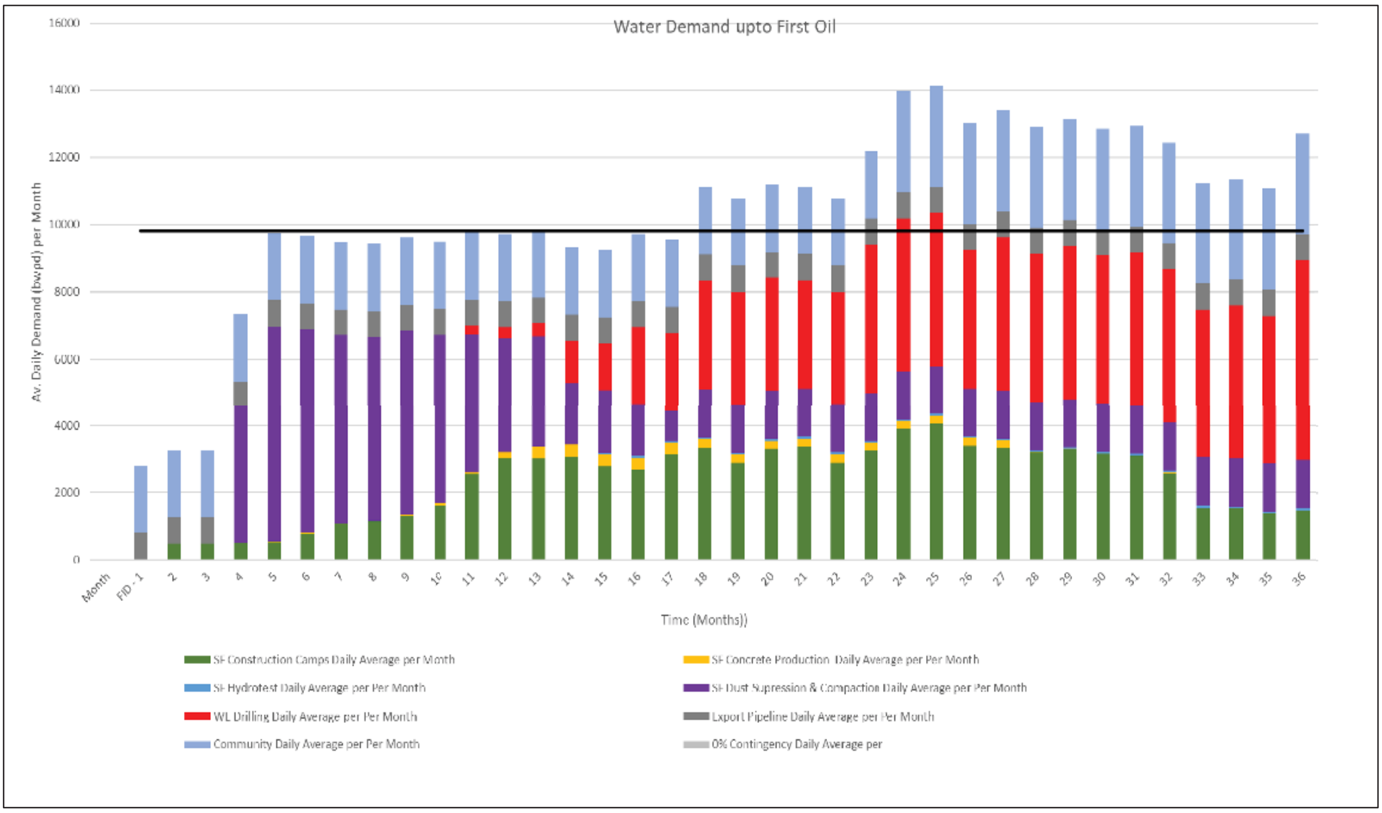


Figure 5.3-5: Estimated Water Demand - FID to FO

5.3.5.2 Operations Water Demand and Supply

During operation of the facility there will be a demand of 104,000 bwpd (Figure 5.3-6). The demand will reduce through the Project phase, linked to the oil production rate.

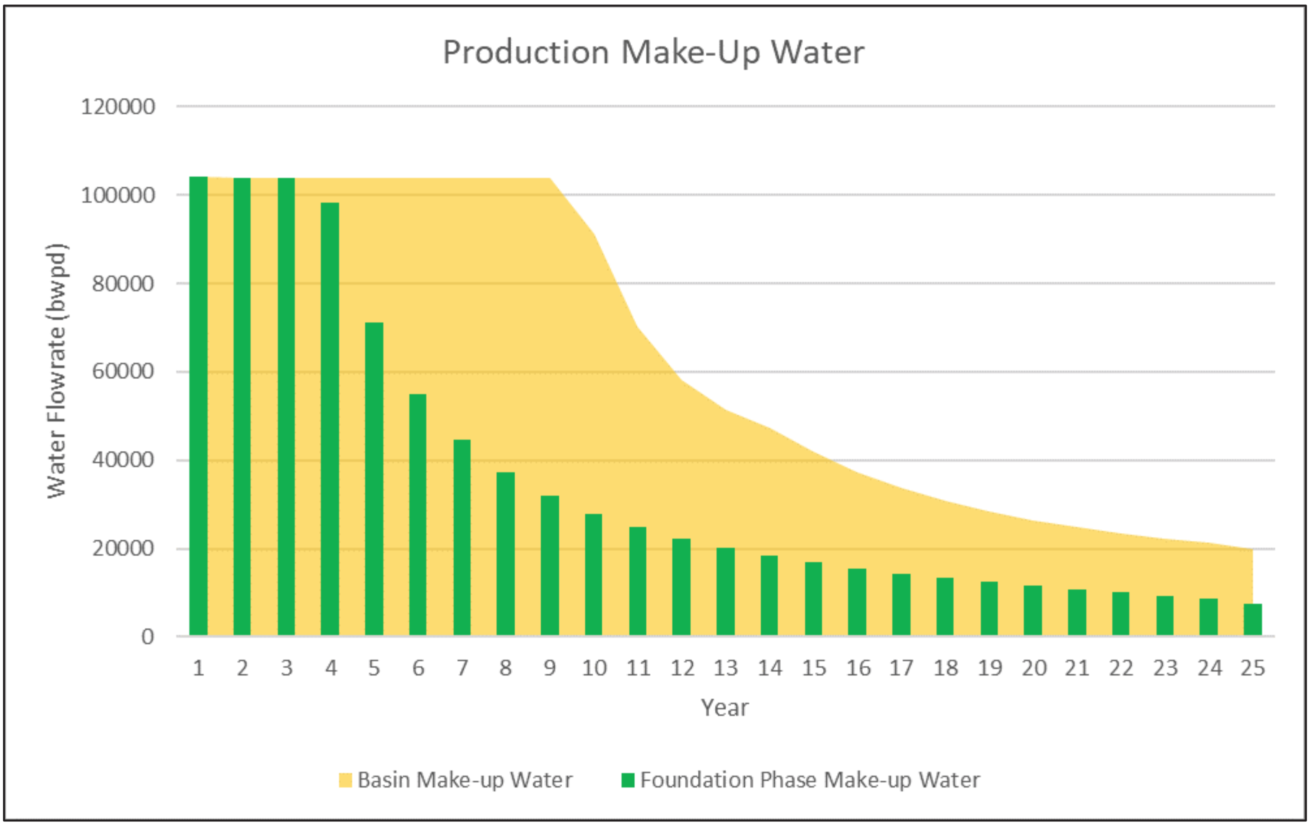


Figure 5.3-6: Operational Water Demand - Post FO

5.3.6 Power and Heat

5.3.6.1 Construction Power Supply

Power supply to construction camps, work areas and warehouses shall be provided by standalone diesel generators. Power demand for the drill rigs will be 3 MW per rig (9 MW total). Initial power to drilling will be by diesel generator and not from the CPF.

5.3.6.2 Operations Power Supply

Power generation for the CPF is provided, by 2 Gas Turbine Generator (GTG) with a rating of 24 MW each to meet the facilities power demand. The gas required is supplied from the fuel gas system. A connection to the local power grid is required to allow for power import in the initial years to cover GTG unavailability, and in later years when the facility is fuel gas deficient. Waste Heat Recovery Units (WHRUs) will installed with each of the GTGs, each rated for 50 MW. They will recover heat from the GTG exhaust and two cross exchangers on the oil rundown line and use the excess heat from the treated oil to heat the make-up water and produced water streams.

The substation located in the CPF will form the main source of the power distribution system meeting the total peak power demand for the following areas.

1) CPF;

2) CFA;

3) IWMF;

4) Production wells; and

5) Midstream facilities.

A new 33 kV, double circuit OHTL shall be routed from CPF substation to power up wellpads in the TAN fields.

For the permanent camp, a new 11 kV power supply shall be routed from the CPF substation to the ancillary area substation/electrical room.

Supplementary Power Source – Grid Connection to CPF

The design is based on connection to the grid at the Project location. The interface with the grid tie in point and the CPF shall be by a high voltage (HV) substation. The grid connection will provide power supply to cover GTG unavailability and any outages (planned or unplanned maintenance) of the GTGs, meeting peak demand and providing continuous power once fuel gas is deficient (Figure 5.3-7). It is therefore planned that the grid connection is available during early field life (required from Year 1).

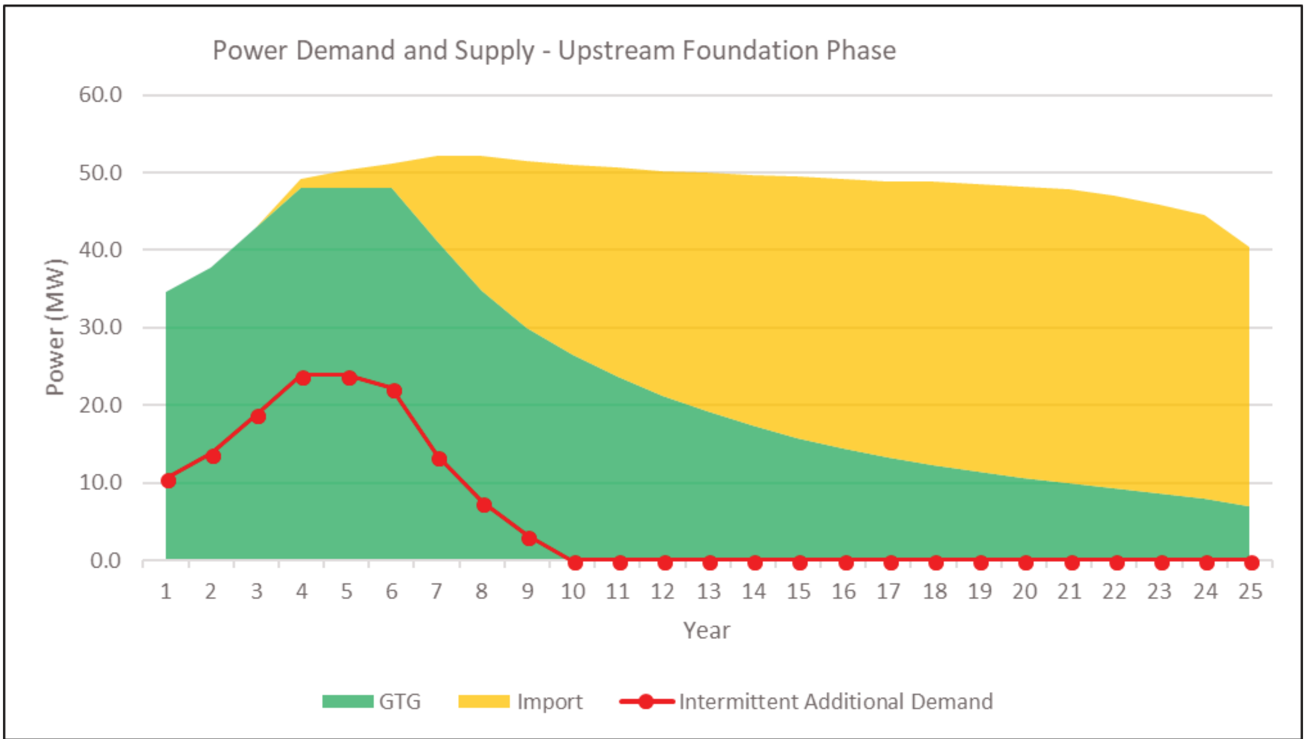


Figure 5.3-7: Case 1 Power Demand Profile and Import Requirement

Back-up Power Generation

The GTG (dual fuel: gas and diesel) will form an independent package and consist of engine, alternator, control panel, batteries and other auxiliary systems required for normal operation or self-starting under test or main grid supply failure and black start. Separate 400 V diesel generators will be connected to plant low voltage (LV) essential loads during power generation failure.

5.3.6.3 Excess Gas Management

Produced gas from the reservoir will primarily be used for power and heat generation. In the initial years of operation, the predicted produced gas flowrate is in excess of the required demand for fuel gas. The remaining gas (excess gas) declines over the first 6 years, until the facility becomes gas deficient from year 6.

The excess gas management strategy (for years 1 to 6) has been reviewed in detail throughout the FEED. An independent assessment of alternatives solution for associated gas utilisation was completed[1] by io consulting. The study reviewed the conclusions of previous options considered (in third party studies) and tested these against the IFC requirements. In addition, io Consulting identified new and hybrid solutions (partial solutions) resulting in a full and comprehensive options catalogue to demonstrate the intent of the IFC requirements were being met by the Project. The gap assessment tested the viability of the base case against alternative solutions from an economic basis, which resulted in two alternative solutions demonstrating a positive Net Present Value (NPV) (when compared with the base case option costs when considering a shadow carbon price for flaring). The base case was considered as full utilisation of gas in process (where possible) with a remainder of 7.6 Million standard cubic feet per day (MMscfd) (peak) excess gas sent to flare.

The alternative solutions included:

- Gas to Liquified Petroleum Gas (LPG) extraction (to Kenyan specifications), full utilisation of gas in process with ~4 MMscfd excess gas remaining (at peak) after LPG extraction directed to flare (as reinjection is screened out); and
- Gas to Power (to market/grid), where all excess gas is consumed, and power exported to the grid. There was a potential identified to integrate power management between upstream and midstream projects; potential to select between purchase or leased options were also assessed.

The two alternative options to continuous flaring were screened in detail to assess their potential as full or partial solutions in excess gas utilisation. The study concluded that further investigation with respect to market demand for LPG or power, uncertainty around contractual short duration agreements, discussions with third party suppliers (outside of the Project Proponents control) is required. Some assumptions made in previous reports also required strengthening before the alternative options can be fully discounted so during subsequent design phases, work will continue to firm up some of the gaps with respect to the options for excess gas utilisation, specifically around gas to power options.

This means the Project will continue to carry short term flaring as its base case, providing a flanged connection at the CPF boundary to allow for 3rd party users to take untreated gas should the alternative options be realised. If no feasible, economic alternative use is identified, the excess gas will be flared.

After the phase of excess gas production, only the gas produced from the high CO_2 region of the reservoir will be flared, as demonstrated in Figure 5.3-8. No other continuous flaring is intended.

[1] io Consulting, Excess gas management strategy gap assessment. Ref. J-00390-EN-REP-0001, 2019

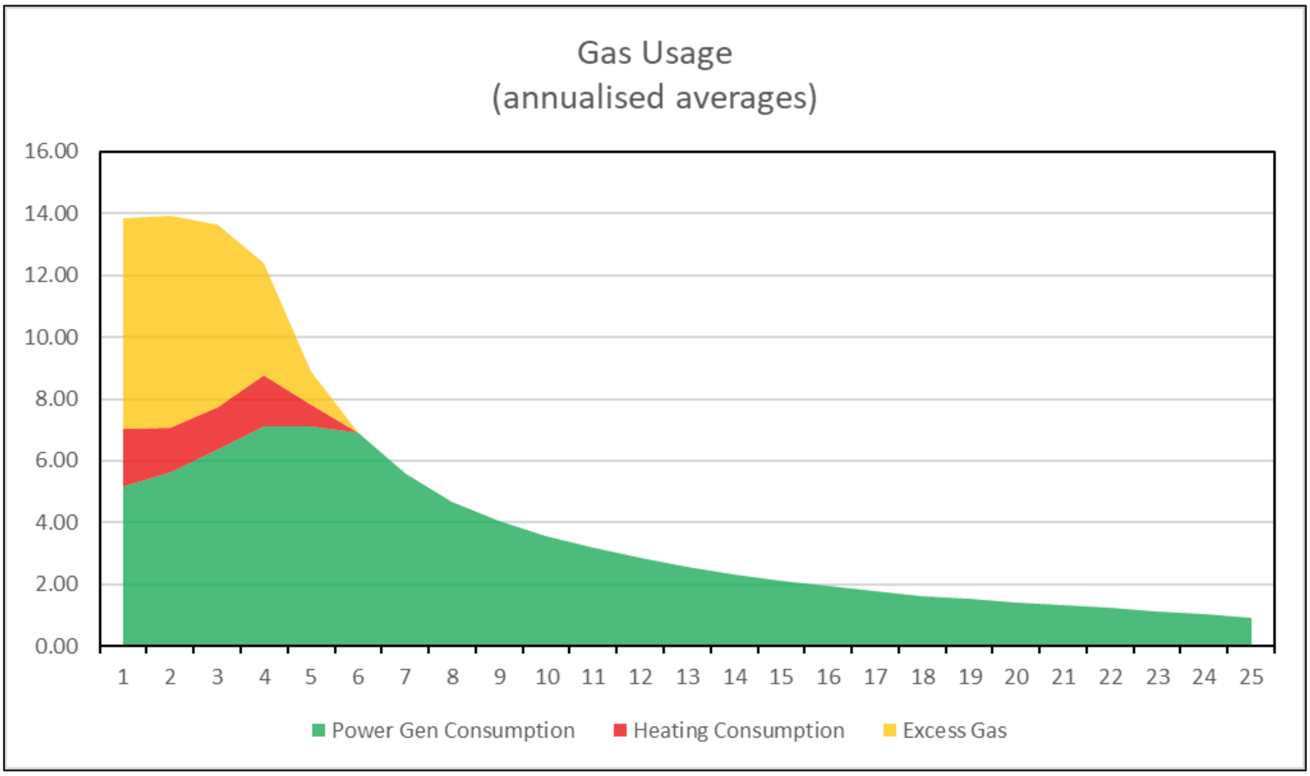


Figure 5.3-8: Case 1 Gas Usage

5.3.6.4 Flaring

There are two flare systems within the CPF, the main plant flare and the acid gas flare. These are combined in one enclosed ground flare (30 m height and 9.8 m diameter). The main plant flare collects all pressure relief loads and emergency disposal of liquid and gaseous hydrocarbons from the CPF with the exception of connections from the Ngamia High CO_2 Separator. The acid gas flare takes the off gas and any relief from the Ngamia High CO_2 Separator.

5.3.7 Workforce and Manpower

5.3.7.1 Construction Workforce and Manpower

Construction manpower will be determined by the Contractor selected to execute the Project. Manpower will be suitably trained, qualified and experienced in oil and gas construction or related industrial construction projects. The jobs associated with the Project will require varying skill sets and will offer employment opportunities for unskilled, semi-skilled and skilled workers. The estimated breakdown into unskilled, semi-skilled and skilled is as follows:

- Unskilled – 15% of manpower requirements;
- Semi-skilled – 25% of manpower requirements; and
- Skilled – 60% of manpower requirements.

The Construction manpower will consist of the following workforce categories:

- Construction management (managers, deputy managers, superintendents and supervisors);
- Construction engineers (e.g. process engineers, mechanical engineers, quantity surveyors);
- Construction skilled craft (e.g. electricians, pipe fitters, plumbers, IT technicians, paramedics);

- Construction semi-skilled craft (e.g. crane operators, roofers, truck drivers, catering personnel, riggers); and
- General labour (e.g. labourers, cleaners, security).

The estimated site peak manpower for FO consisting of the CFA/CPF area, interconnection network, water abstraction facility/pipeline and FO wellpads is approximately 2,400 persons. The construction workforce could however peak between 2,700 and 3,400[2]. The final manpower requirements will be determined during detailed design and construction tendering prior to FID.

5.3.7.2 Operations Workforce and Manpower

Accommodation for around 350 personnel will be required including upstream operators, midstream operators, catering personnel and well engineer/servicing personnel. In addition to the personnel with accommodation on site, there will be up to an additional 200 people sourced from the local community to fill roles such as guards, and IWMF workers. Some local workers will not require in-camp accommodation. It is planned that some expat roles required initially will eventually transition to Kenyan nationals over the life of production.

The final manpower requirements will be determined during detailed design and pre-commissioning.

5.4 Project Components

5.4.1 Existing facilities

This section provides an overview of the existing facilities and describes how they will be integrated into the Project.

Existing facilities include:

- Kapese Airstrip;
- Kapese Base (Camp);
- Existing wellpads and wells;
- Early Oil Production Facilities; and
- Water abstraction boreholes.

5.4.1.1 Kapese Facilities

TKBV hold a leasing arrangement for the Kapese facilities where there is an existing airstrip. This airstrip will be upgraded, with a new surface on the runway and local buildings upgraded to support the Projects airstrip operations, however is considered an associated activity for the purpose of this ESIA.

Kapese Base, including the associated facilities and a 400-bed camp is currently located close to the Kapese airstrip. It is expected that TKBV will utilise this base during construction to support early and enabling works, as well as the construction of the water pipeline.

5.4.1.2 Wellpads and Wells

The appraisal drilling campaign required the drilling of wells across the TAN fields. To support this activity 21 wells across 17 wellpads have already been drilled. The size of the pad and the number of wells drilled

[2] Worker estimates are based on two scenarios, one being a base case with a peak workforce of 3,400 and the second based on an assumption that some components of the CPF will be modularised and arrive in Kenya partially constructed, thereby reducing the number of workers needed in-country. Lower end estimated with modularisation are at 2,700.

varies from pad to pad. Where existing pads are required as part of the Project, they will be adapted, and the facilities will be upgraded in line with the Project wellpad design.

5.4.1.3 Water Abstraction Boreholes

Ten existing water production boreholes have been drilled in the South Lokichar area. If they were all brought into service, the total yield would be 9,812 bwpd. The existing boreholes will be used to support early and enabling works, prior to the commissioning of the water pipeline.

5.4.1.4 Early Oil Production Facilities

The Early Oil Production Facilities required for EOPS will be shut down and decommissioned prior to the Project's main construction activities. It is envisaged that the decommissioning will take place during the enabling works for the Project.

5.4.2 Field Layout

In total, 33 wellpads will be developed as part of the Project; 12 of these are existing wellpads (from E&A activities or relating to EOPS Phase II), with a further 21 new locations. The Project will develop 321 wells, with each wellpad containing up to 24 wells (combination of producer and injector). The indicative breakdown of wellpads between the oil fields is detailed in Table 5.4-1 and presented in Figure 5.4-2.

Table 5.4-1: Project Wellpads and Production Wells

Ngamia				Amosing				Twiga			
#	Pad	Producers	Injectors	#	Pad	Producers	Injectors	#	Pad	Producers	Injectors
1	NG-03	9	5	1	AM-01	9	6	1	TW-04	3	2
2	NG-08	16	5	2	AM-03	13	6	2	TW-05	3	2
3	NG-01	10	6	3	AM-04	6	4		**TOTAL**	**6**	**4**
4	NG-11	11	6	4	AM-07	3	1				
5	NG-12	10	3	5	AM-08	7	4				
6	NG-07	12	8	6	AM-09	8	3				
7	NG-13	7	4	7	AM-10	4	1				
8	NG-14	7	2	8	AM-11	3	1				
9	NG-16	3	3	9	AM-19	1	1				
10	NG-09	12	5		**TOTAL**	**54**	**27**				
11	NG-15	7	4								
12	NG-17	4	3								
13	NG-18	5	1								
14	NG-02	4	2								
15	NG-04	4	2								
16	NG-19	5	5								
17	NG-20	6	3								
18	NG-22	4	1								
19	NG-23	4	2								
20	NG-10	4	2								
21	NG-21	6	2								
22	NG-24	4	2								
	TOTAL	**154**	**76**								

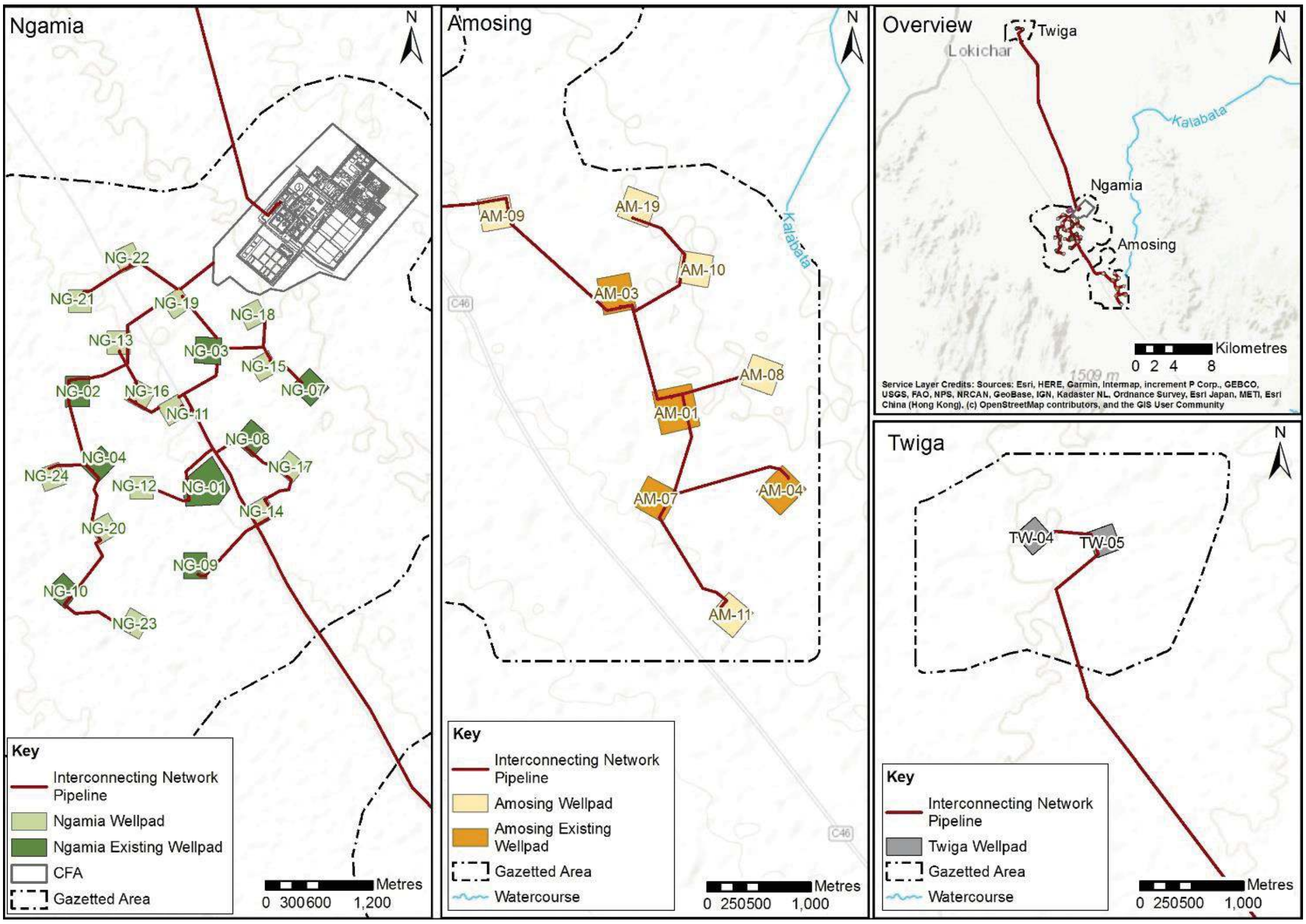


Figure 5.4-1: Project Field Layout

The wellpad area will be prepared based on the total number of wells expected per pad. New wellpads, with 12 or fewer planned wells will be approximately 200 m x 150 m. If 2 rows of wells are required (more than 12 wells) this will require an area of approximately 200 m x 200 m. A typical wellpad layout is presented in Figure 5.4-2.

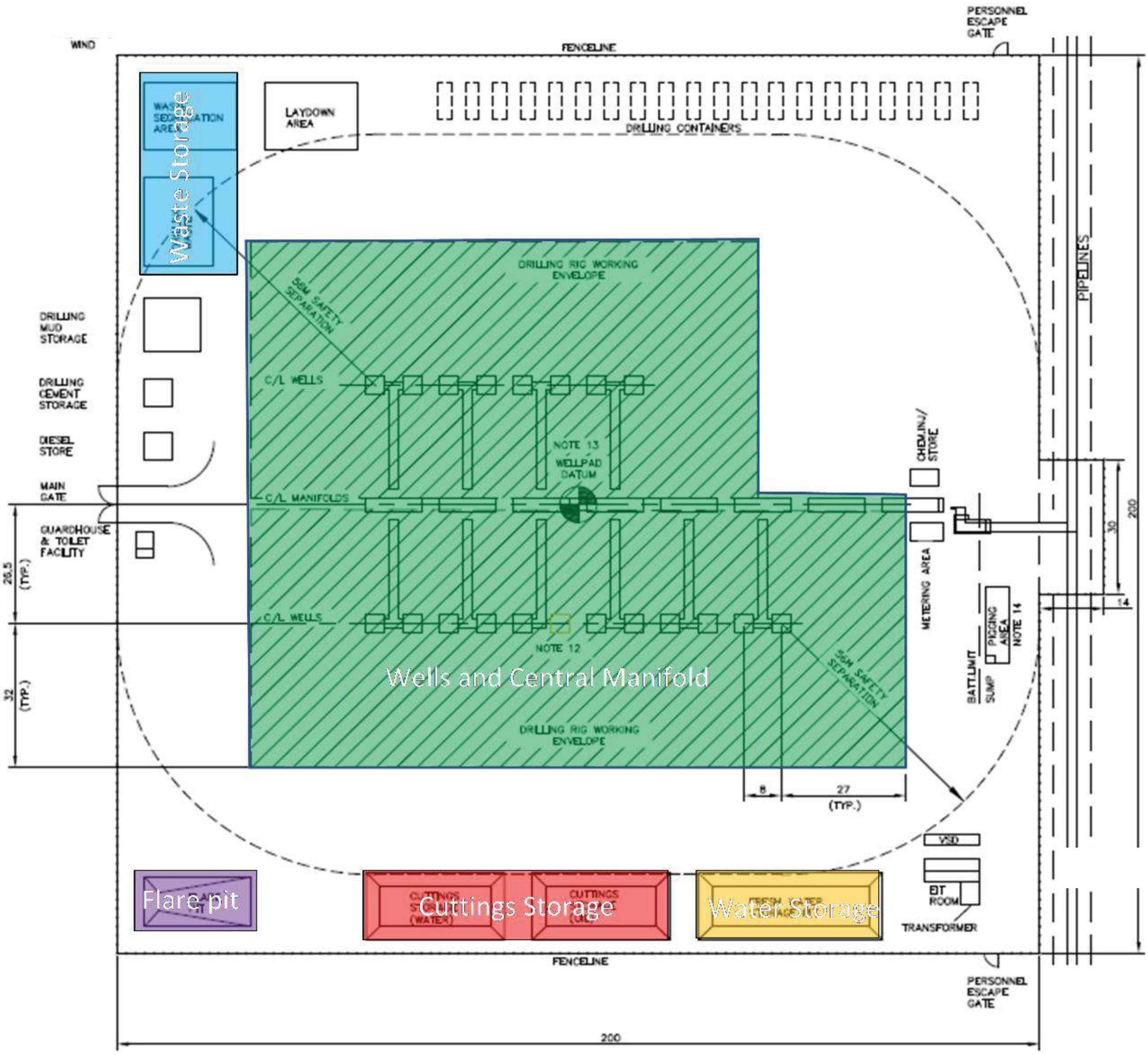


Figure 5.4-2: Typical Wellpad Layout

A buffer area of 15 m with cleared vegetation outside of the wellpad fenced perimeter will be maintained for mixing and burial of water-based mud (WBM) cuttings with native soil in line with previous practice from EOPS.

The following items are provided on the wellpad.

- Artificial Lift - each well will be provided with artificial lift pump. powered from the CPF, via the infield power distribution network;
- Chemical Storage - approximately 6 m³ of bunded storage at each wellpad for 30 days' supply of demulsifier;
- Diesel Storage - outdoor diesel/fuel storage area with bunding;
- Cement lined Flare Pit;
- HDPE lined pits - Fresh Water Storage Pit, Cuttings Storage Pit (Oil/synthetic), Cuttings Storage Pit (Water), Drilling Mud Pit, Drilling Waste Pit, Drilling Cement Pit;

- Multiphase flow meters;
- Drainage:
  - The wellpad is sloped such that all clean rainwater runs to the external ditch that runs around the perimeter. Discharge from the external drainage ditch can be controlled to prevent the discharge of oil contaminated water to the local environment. Any oil collected in the interceptor will be removed and disposed of; and
  - The cellars are provided with a sump to allow for collection of contaminated water. All cellars will be emptied by a gully suction truck and removed for treatment at the IWMF;
- The chemical storage or pigging areas are provided with a kerbed concrete area to contain any spillages;
- The septic tank will be periodically emptied with sewage treated at the IWMF;
- Security - the wellpads will be continuously manned by a security guard stationed in the guard house. CCTV is provided, monitored from the control room in the CPF;
- Pig Receivers/Launchers; and
- Service water supply and storage - for Well Services' activities on the wellpads throughout the life of the facility (piped supply to Amosing and Ngamia, trucked to Twiga).

5.4.3 Wells

The Project consists of 321 planned wells. Each wellpad will contain up to 24 wells (combination of production and water injection wells), with the specific number of wells drilled from each pad dependent on the location within the field and the reservoir performance.

The well design will adopt a three-casing policy. This will help reduce the potential risks associated with any uncontrolled hydrocarbon release. Each casing section is detailed below:

- Conductor casing - for structural support and isolation of shallow unconsolidated formations;
- Surface casing - for protection of shallow aquifers from contamination during drilling of the hydrocarbon zones; and
- Production casing - for controlled production of hydrocarbons as well as their long-term isolation from the surface for life of field.

The well head will be of a Christmas Tree design which will ensure they fit completely within the cellar (fully submerged). The Christmas tree design will provide all required connections for production and monitoring of the well performance.

5.4.4 CFA

The layout of the CFA is shown in Figure 5.4-3. The footprint is approximately 1,700 m x 800 m. It is designed to co-locate the following central facilities (shown as permanent or temporary):

- Central Processing Facility (CPF) - Permanent;
- Lokichar Export Facility (LEF) - Permanent (*not within the Project ESIA scope, covered in Midstream ESIA)*:
  - The LEF is located on the south-west perimeter of the CPF and within the CFA site, with the export pipeline running below ground from the LEF, through the CFA and beyond. The LEF and export

pipeline fall under the Midstream work scope and therefore the LEF introduces an interface between the Midstream Contractor and the CPF/CFA Contractor at the specified battery limit.

- Ancillary Area - Permanent:
  - The ancillary area is located to act as a buffer zone between the CPF and camps. The function of the ancillary area is to provide a safe area outside of the CPF to locate some utilities and provide a safe working environment for operators; and
  - The ancillary area contains utilities (make-up water storage tanks and treatment, firewater storage and pumps, emergency generators, diesel storage, potable water storage and pumps and service water pumps), training area (firefighting); paring; fenced laydown; and buildings (gatehouse, control and admin building, laboratory, emergency response facility, warehouse, workshop and vehicle service area).
- Integrated Waste Management Facility (IWMF) – Permanent;
- Permanent Accommodation Camp - Permanent:
  - Accommodation provided for approximately 500 personnel during operations.
- Temporary Camps - Temporary:
  - Construction camp (approximate 2,000 bed capacity);
  - Rig camp (approximate - 400 bed capacity); and
  - Drilling Mini-Camps - approximate 20 personnel moving with rig (from wellpad to wellpad).
- Drilling Area - Temporary:
  - The drilling area is provided with a dedicated road access from the C46 to minimise traffic disruption during construction/operations.
- Construction Laydown Area - Temporary.

The CFA shall have varying levels of security and internal access roads between the facilities.

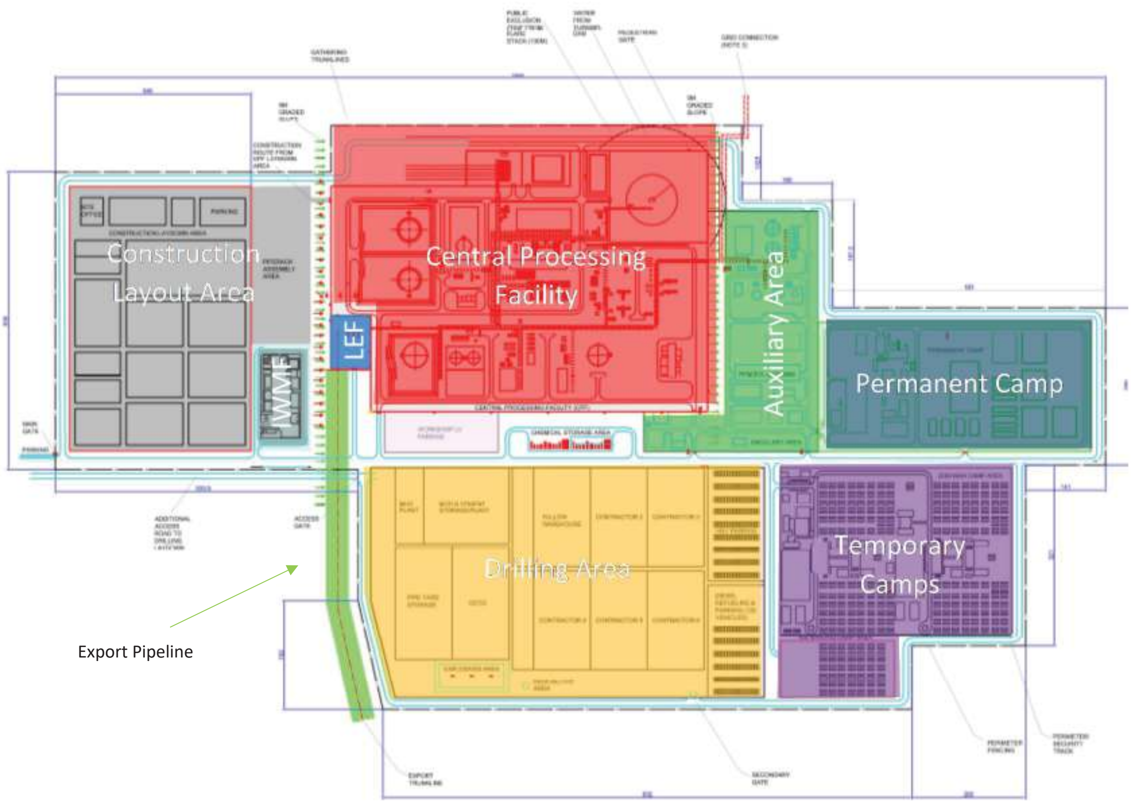


Figure 5.4-3: Central Facilities Area Layout

5.4.4.1 Temporary Waste Management

Construction wastes will be managed by the construction contractor. The construction phase will generate significant quantities of inert wastes and incidental quantities of hazardous materials. Wastes will be generated by the construction camps and from physical construction activities (unavoidable off-cuts and surplus materials, combined with any arisings from demolition, site clearance and preparatory groundwork).

Basic waste management facilities and protocols will be established at each camp with an objective of segregating and reducing waste and promoting recycling where possible. There may be some temporary storage of waste materials at the construction camps.

5.4.5 CPF

The CPF is a single, centrally located facility which will perform all the required processing to produce on-specification crude oil for export. The processing scheme will incorporate facilities to separate gas and water from the oil. The oil will be stabilised by successive flashes at elevated temperature in order to meet a true vapour pressure suitable for rundown into floating roof tanks. The oil will be routed from the tanks and metered via oil export metering before leaving the CPF via the LEF for export.

The CPF overview is illustrated in Figure 5.4-4, with layout presented in Figure 5.4-5.

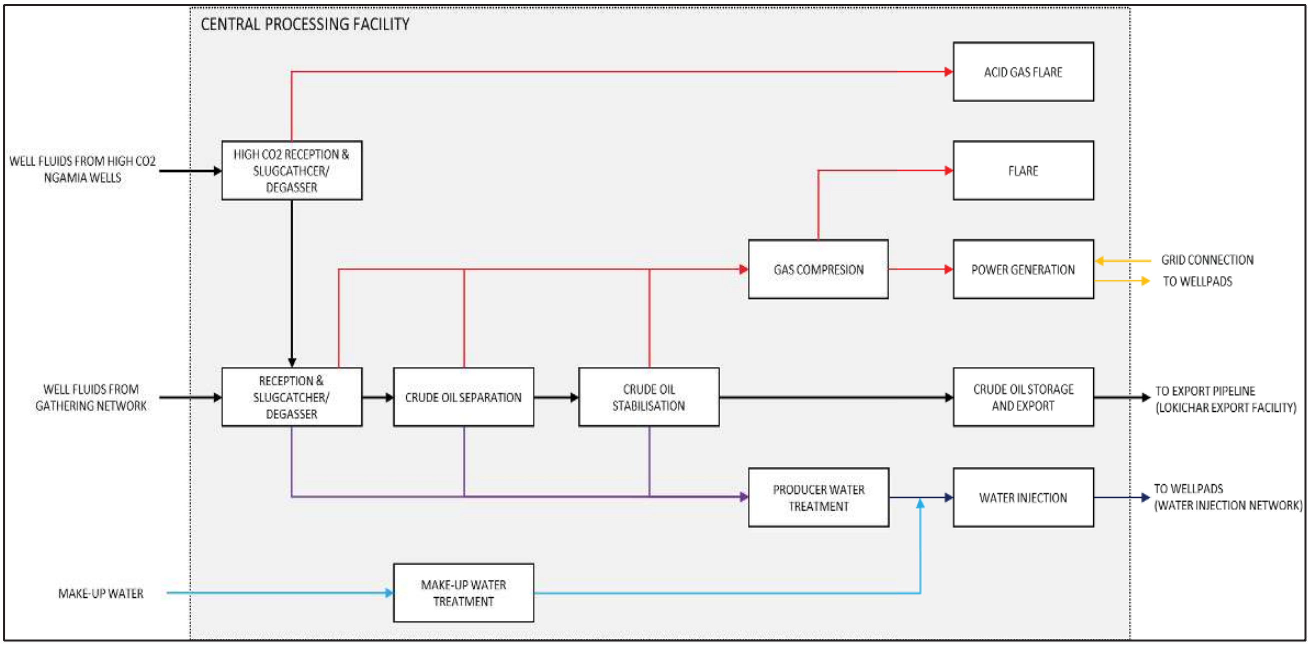


Figure 5.4-4: CPF Overview

Figure 5.4-5: CPF Layout

The CPF system features are shown in Table 5.4-2.

Table 5.4-2: CPF system features

Pig Receivers	Pigging is required to inspect the integrity of the main pipeline and to clean it periodically.
Oil Train	The oil train provides the required separation and stabilization of the oil to meet the export specifications.
Ngamia High CO_2 Production	An area of the Ngamia reservoir has been found to contain significant levels of CO_2. To allow the oil to be processed in the oil train, the fluid is degassed in a separate separator design for high CO_2 concentrations. Separated gas will be sent to the acid gas flare for disposal.
Oil Storage & Export	Stabilised oil is sent to on-spec (meeting export specifications) crude oil storage floating roof tanks which provide a total of 1.5 days storage at peak production rate. The storage tanks are insulated and heated to ensure product contents are maintained above 64°C. Oil from the storage tanks is pumped to the LEF for export. Off-spec oil is diverted to the off-spec (outside export specifications) crude oil storage fixed roof tank, from where it can be pumped back to the inlet production manifold for reprocessing.
Gas Compression	Three stages of gas compression are provided to compress all gas up to the GTG supply. Gas is then sent to the fuel gas system, with excess gas sent for 3rd party use or to flare.
Waste Heat Recovery Units (WHRU)	WHRUs recover heat from the GTG exhaust and two cross exchangers on the oil rundown line and use the excess heat from the treated oil to heat the make-up water and produced water streams. Once production has started, a heating medium will be required throughout the plant to achieve operational targets
Water Treatment and Injection	All produced water from the reservoir is treated and re-injected back into the reservoir (a small amount of water used for filter backwash is sent to the evaporation pond). Three stages of treatment (primary, secondary and tertiary) are required to ensure the water meets the injection specifications. Treated water and make-up water are combined before being pumped up to high pressure for distribution to the wellpads for injection.
Heating Medium	The heating medium system will be required for heating the water for both trunkline/system warm up and ultimately injection into the wells. The closed loop heating medium system will be circulated through the WHRUs with the turbine running on diesel.
Power Generation	Power generation is provided, in the base case, by 2 GTG units.
Flare	There are two flare systems within the CPF, the main plant flare and the acid gas flare.
Water Supply	Make-up water is delivered via a pipeline from the Turkwel Dam to the Ancillary Area and is stored with Firewater in two storage tanks. The water is treated to meet water injection specification.

Drains	The enclosed drain system will collect liquids from normally pressurized and hazardous equipment prior to their maintenance. Oil from the closed drain drum is returned to the main process drain. The hazardous open drain system collects liquids from areas potentially contaminated with oil which include spillages, overflow, wash down from equipment, kerbs/drip trays/piping, flooring and rain/deluge. Collected oil is held in the open drain drum (via vessel internals) to prevent release to the environment. All treated run-off will be sent to the evaporation pond. The uncontaminated water from surface run off will be discharged without further treatment via drainage ditches.
Evaporation pond	Contaminated runoff will be discharged to the evaporation pond. Once water has evaporated, the residue will be disposed of as hazardous waste.
Instrument Air and Nitrogen	Nitrogen and instrument air systems are provided to allow for the safe operation of the facility. Nitrogen is used to blanket fixed roof tanks to prevent the formation of explosive atmospheres.
Chemical storage and use	Provision for the injection of a variety of chemicals is allowed for within the CPF, some of which are continuous and others batch or intermittent when certain operating conditions exist. Due to the remote location and the likely delivery mechanism for the chemicals, there are no bulk storage anticipated for chemicals, Storage in the ancillary area will use the containers in which the chemicals are supplied and will be stored for no more than 30 days at all facilities. Within the CPF, chemical storage will not exceed volumes required for more than 7 day's supply.
Firewater	The CPF is provided with a firewater ring main, serviced by the firewater system contained in the Ancillary Area.
Facility Storage Tanks in CPF	Crude Oil, Make-Up Water/Firewater, Injection buffer, off-spec crude, off-spec water, Potable water, Produced Water Settling Tank, Mineral Oil Tank, Diesel Tank

5.4.6 Integrated Waste Management Facility

The IWMF is a waste reception, sorting and storage facility which will be located within the main CFA footprint. The engineered landfill will be located separately to the CFA (Section 5.4.9)

It is proposed that the IWMF will be developed to manage wastes from the drilling and operational phases and that wastes from the construction phase will be managed by the Engineering, Procurement and Construction (EPC) contractor.

The IWMF will comprise the following key elements:

- Recycling facility (RF);
- Incineration facility (IF);
- Autoclave for medical waste;
- Anaerobic digestion (AD) system;
- Effluent treatment plant (ETP);
- Sewage treatment plant (STP);

- General and medical waste shredder, crushers, shaker and other solids handling machinery;
- Fire water tanks, fire pump house and sprinkler system;
- Hardstanding;
- Attenuation and spent fire water tanks;
- Odour abatement;
- Weighbridges;
- Road and car park;
- Utilities;
- Landscaping; and
- IWMF office with meeting room and welfare facility.

The proposed layout of the IWMF is presented below in Figure 5.4-6.

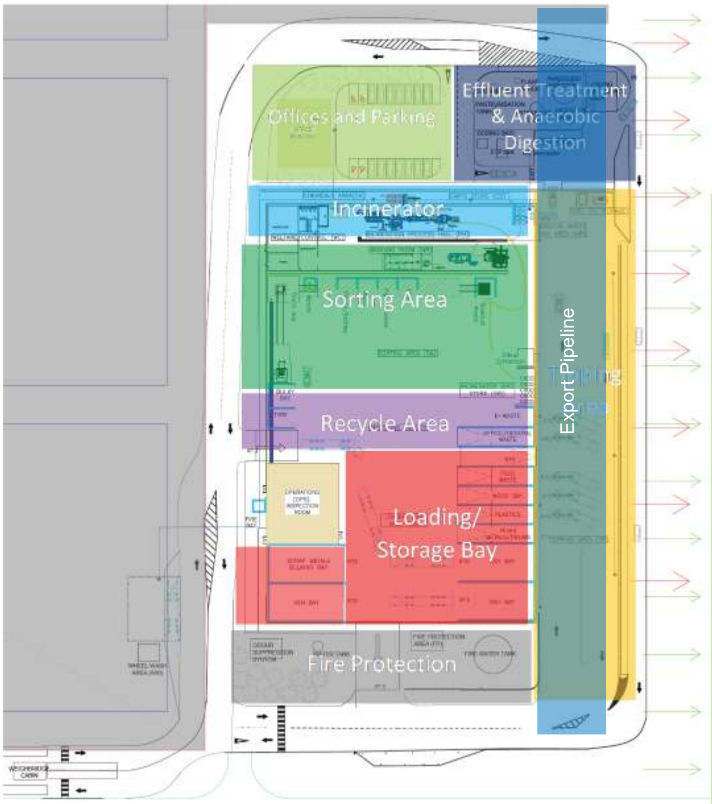


Figure 5.4-6: IWMF Layout

Any hazardous waste or incorrectly declared waste streams will be quarantined and dealt with in accordance with Company waste management procedures. The site has been designed such that all residual wastes will be processed and removed within 24 hours.

The incineration plant will include Flue Gas Treatment (FGT) and monitoring system, fuel oil system for burners and a flue gas stack which is anticipated to be less than 15 m in height. Rotary kiln incineration has been identified as Best Available Technology (BAT) for the IWMF because it is a suitable combustion method for a variety of non-hazardous and hazardous waste streams with varying density.

Incinerator Bottom Ash (IBA), resulting from the combustion process, will be collected, stored and potentially reused as aggregate. Hazardous fly ash will be directly disposed to landfill separately without cross contamination with non-hazardous ash. The FGT will consist of Selective Non-Catalytic Reduction (SNCR) injection within the combustion chamber. This will be followed by scrubbing. From the scrubber, partially treated flue gas will be further treated in a ceramic or bag filtration system with Activated Carbon injection to remove the remainder of the contaminants before being discharged into the atmosphere via an exhaust stack. This scheme will ensure that the treated exhaust gas stream is compliant with the limits as defined by NEMA.

Medical waste will be treated by disinfection and subsequent shredding into very small particles and incineration.

The AD will be designed to International Organization for Standardization (ISO) 28765 standard and British Standards Institution Publicly Available Specification (BSI PAS) 110. Any biogas collected in the headspace of the digester roof, will be discharged at a pressure of 4 to8 millibars (mbar) into an onsite flare, which will form part of the AD facility.

All items in the ETP will conform to the relevant Kenyan and/or equivalent latest industry codes of practice, regulations and laws applicable to effluent treatment and discharge. The ETP will be designed for 2.2 m^3/hr of effluent during operations. The pH neutral treated and clarified effluent will be discharged to the Sewage treatment plant for further treatment. Sediments and sludges are collected for disposal.

All items in the STP will conform to the relevant Kenyan and/or equivalent latest Project or international best practice standard. Wastewater will be collected from septic tanks and treated in the STP. The final polished and pathogen free effluent from the system will be discharged into the onsite process water tank where it can be used either in the AD plant feed preparation or utilized for irrigation.

5.4.7 Infield Flowline Network

The infield network includes the following:

- Gathering network;
- Water injection network;
- Service water network - parallel to the water injection network through Ngamia and Amosing fields only.
- Power transmission cables and communications fibre optic cables between:
  - CPF and the wellpads;
  - CPF and the airstrip; and
  - CPF and the water intake.

The gathering network will not have a leak detection system. The flowlines are buried and are fully welded lines with flanged joints at the wellpad. If a leak were to occur it would most likely be at these joints, which will be visible. Due to the waxy properties of the crude, any leak would solidify on exposure to the atmosphere.

The minimum depth of cover (to the top of the pipeline) for the interconnecting network are detailed in Table 5.4-3.

Table 5.4-3: Depth of Cover to Top of Pipeline

Category	Minimum Depth of Cover[1]
Pipeline General	1.2 m
Watercourse – Non-Scour	1.5 m
Watercourse – Scour Potential	2.0 m
Road/Track	1.5 m

[1] Minimum depth of cover may need to be increased based on results of upheaval buckling assessments.

5.4.7.1 Gathering Network

The gathering network consists of a network of pipelines sized to meet production requirements. A main spine trunkline is provided connecting each field directly with the CPF (Twiga – 8”, Amosing – 16”, Ngamia -16” and Ngamia high CO_2 – 4”).

Individual wellpads are then connected to the trunkline via a series of flowlines (8” or 10”). All lines remain below ground from the CPF until they arrive on a wellpad.

All trunklines and flowlines will be pigged (inspection) as part of regular maintenance activities.

5.4.7.2 Water Injection Network

The Injection Network follows the same infield pipeline routings to distribute the re-injection water to the wellpads to maintain reservoir pressure. Two main trunklines are provided to connect wellpads to the north and south of the CFA to the CPF (Twiga – 10”, Ngamia & Amosing – 16”).

Individual wellpads are then connected to the trunkline via a series of flowlines (8”). All lines are insulated to minimise heat loss and remain below ground from the CPF until they arrive on a wellpad.

5.4.7.3 Service Water Network

The service water system is buried and follows the injection network but does not supply the Twiga wellpads. The service water system is designed to supply water to each wellpad to support drilling activities. Infield trucking of water will be required for Twiga.

5.4.7.4 Communication Network

The fibre optic cables used to enable telecommunication are, where relevant, routed in the same corridors as the flowlines and water pipeline.

5.4.7.5 Overhead Transmission Lines

The main power supply to production wells shall be provided using 33 kV overhead lines from the substation located in the CPF area. The OHTL (33 kV, double circuit) will be routed from the CPF substation to provide power to the wellpads in the TAN oil fields. Pylons will typically be approximately 15 m high. Pylons can be extended when a higher clearance height (e.g. over roads) is required. The maximum height of these pylons is 21 m.

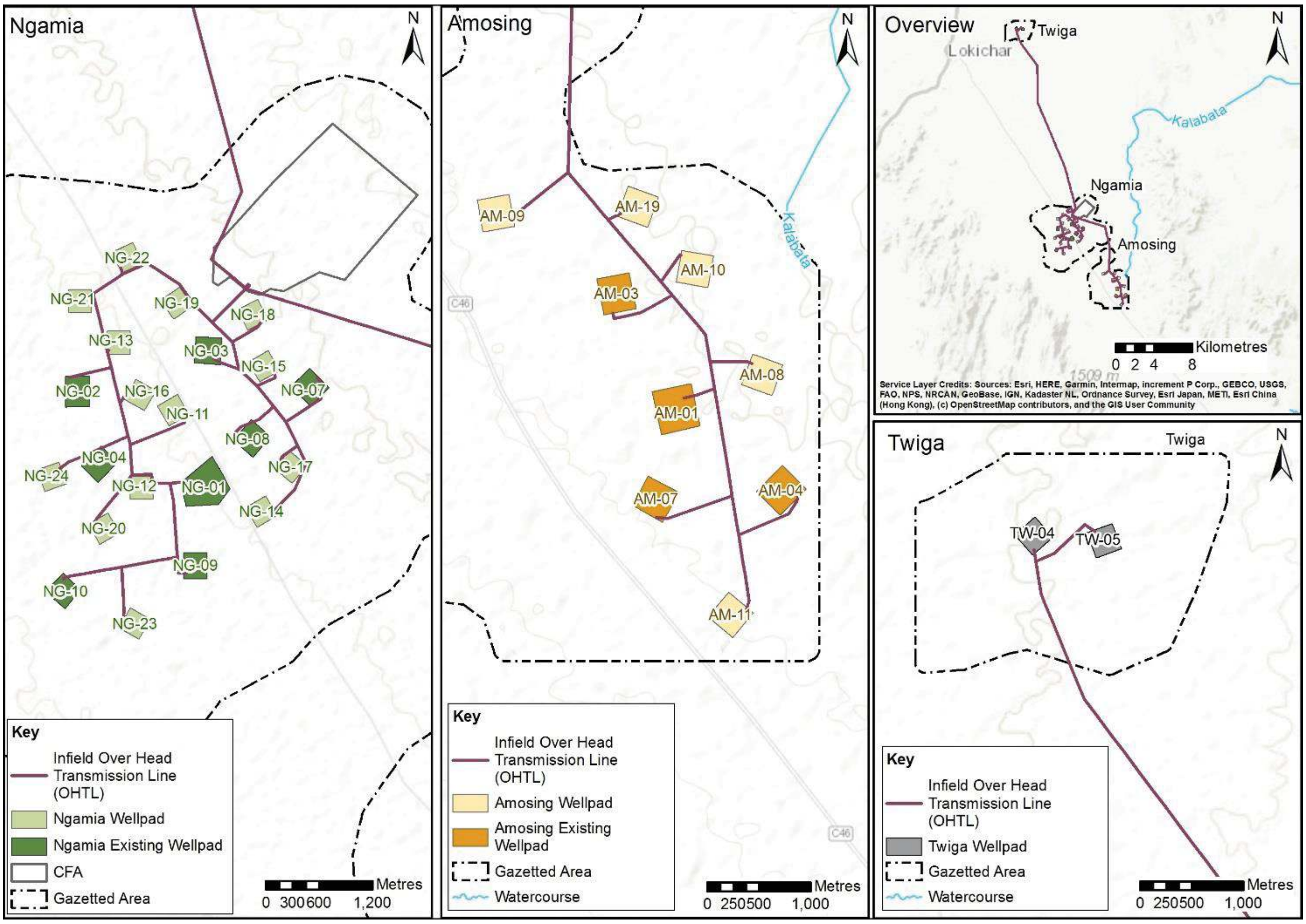


Figure 5.4-7: Infield OHTL Network

5.4.8 Water Pipeline

Water for the Project will be extracted from the Turkwel Dam (headrace) and transported by the fully buried water pipeline to the CPF to meet the demand described in Section 1.3.5.

The abstraction facility will consist of extraction pumps floating on pontoons, which pump water to a break tank located at the high point of the escarpment adjacent to the dam. The tank provides a break in the system as the water gravity flows, using the natural elevation difference between the Turkwel Dam and the CPF, through approximately 90 km of pipeline.

The design requires facilities to be located at 3 areas outside of the CFA:

- Abstraction facilities at Turkwel Dam:
  - 2 x 50% pontoon pumps.
- Break Tank Area:
  - Break Tank; and
  - Chemical Injection (30 days storage of 12% grade sodium hypochlorite).
- Pressure reduction station (bottom of escarpment).

The pipeline details are as follows:

- 18” Carbon Steel (CS) Pipeline + High- Density Polyethylene (HDPE) Liner (from abstraction point to Pressure Reduction Station at the bottom of the escarpment, including the Malmalte River crossing); and
- 24” Ductile Iron Cement Lined (DICL) (from pressure reduction station to CFA).

Two base camps will be used for the construction of the water pipeline and facilities, including the existing 400 bed Kapese camp and a new 200 bed make-up water camp near the Turkwel Dam.

Power supply to the make-up water abstraction facilities shall be from the Turkwel Dam substation located approximately 5 km from the facility area.

A 6 m wide permanent easement will be in place once the water pipeline is built. The construction Right of Way (RoW) will be allowed to revegetate after completion of construction activities. No permanent structures will be permitted within the permanent easement and trees with extensive root systems will be removed.

The minimum burial depth for the water pipeline is detailed in Table 5.4-4.

Table 5.4-4: Water Pipeline Minimum Burial Depth

Category	Minimum Depth of Cover
Rock	0.5 m
General Route	0.8 m
Watercourse – Non-Scour	1.5 m
Watercourse – Scour Potential	2.0 m
Roads	1.5 m
Malmate River	15 m

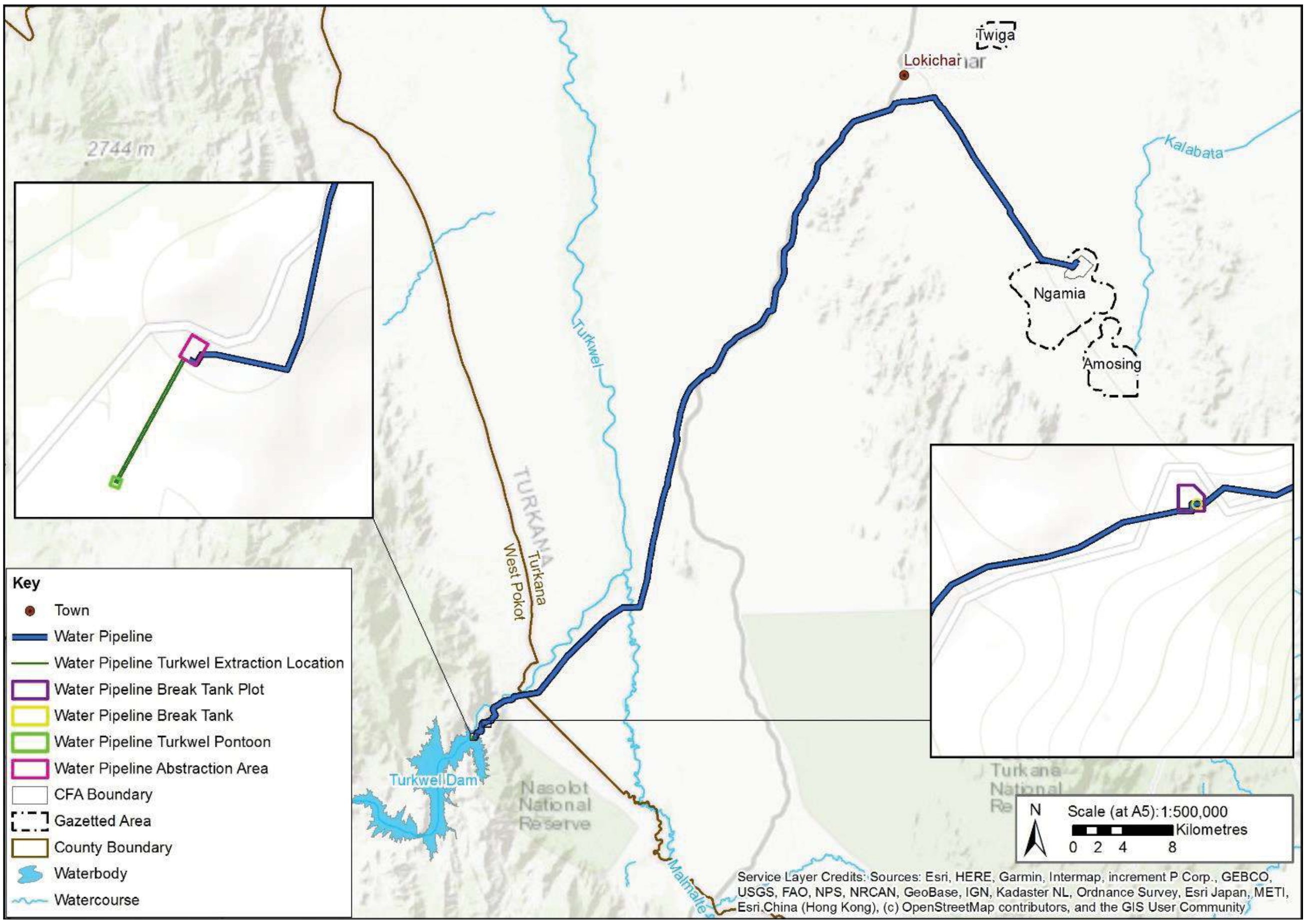


Figure 5.4-8: Make-up Water Abstraction Facilities and Pipeline

5.4.9 Landfill

The landfill will be located outside of the CFA. Approximately 5 hectares of land area is required based on an estimated maximum landfill cell volume of 150,000 m^3 and at 3 m depth; although it is expected to have a nominal gross capacity of 98,000 m^3.

An artificial geosynthetic clay layer will be installed. Suitable non-calcareous gravels and crushed rock will be used for the drainage layer and non- calcareous washed sand for the leak detection layers. In addition to the natural materials (or artificial geosynthetic clay) a HDPE layer will be used for both lining and capping. The specification of the lining and capping system for each cell will be defined prior to landfill construction and will be dependent upon the waste streams to be contained within each individual cell.

During the drilling, construction and operational phases of the development, waste will be created which will be sorted and processed in the IWMF. The waste types which cannot be treated and recycled will be disposed of on an on-Site landfill, which will accept a combination of hazardous, non- hazardous and inert waste streams.

A cuttings processing plant treating up to 752 m^3 of material per month will be located at the landfill to manage the waste arisings (total of 89,000m^3) from the three phases of the Project. Table 5.4-5 contains a description of the indicative waste types which are anticipated to be disposed of in the landfill.

Table 5.4-5: Landfill waste types

Project Phase	Waste types
Drilling and Workover wastes	■ Treated Synthetic-Based Mud (SBM) cuttings; and ■ Pit/tank bottoms e.g. IBA, APC ash.
Construction Wastes	■ packaging e.g. metals, glass, cable; ■ vehicle waste e.g. brake pads, vehicle waste; ■ miscellaneous e.g. used chemical and paint containers, other waste from demolition of temporary; and ■ camp, IBA, Air Pollution Control (APC) ash, concrete from demolition of temporary camp.
Operational Wastes	■ Packaging e.g. glass; and ■ vehicle waste e.g. brake pads, broken lightbulbs/ lighting tubes, spent water polishing media.

5.4.10 Roads

The construction of roads required by the Project will be the responsibility of the Project. The national roads (C46 and A1) will remain the responsibility of GoK. Roads will be designed to manage runoff and discharge it at an equivalent rate to pre-construction, while maintaining quality in line with Kenyan water standards. Wherever practical, the infield roads will utilise existing roads. The infield road network is shown in Figure 5.4-7.

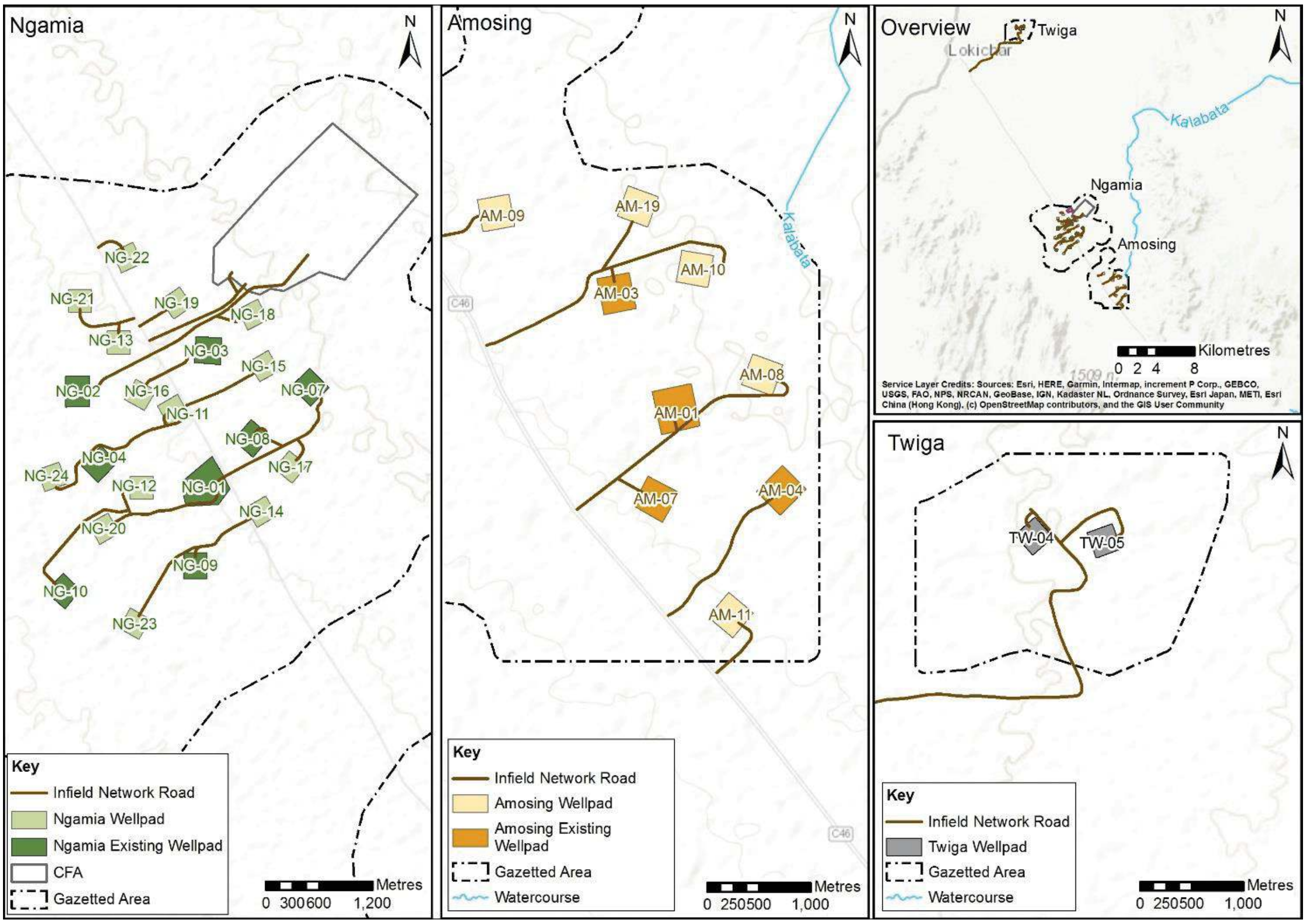


Figure 5.4-9: Infield Road Network

5.4.11 Kapese Airstrip

TKBV currently have a leasing arrangement in place for use of the airstrip at Kapese camp. The airstrip located within the existing Kapese camp will be upgraded, but the permitting for the upgrade does not form part of this ESIA, as it is the responsibility of a third party.

The airstrip will be designed for Code C aircraft e.g. Dash 8 Q400, with a seating capacity of 50 passengers. It will be 2 km long and 23 m wide. Existing buildings will be upgraded and the existing runway will be resurfaced with a bituminous surface dressing or equivalent. Drainage will be designed to ensure no change in surface water flows during 1 in 100-year flood events.

5.4.12 Accommodation

5.4.12.1 Construction Accommodation

Based on FEED definition construction and drilling manpower schedules, peak construction will occur in month 19, requiring around 2,500 skilled, semi-skilled and unskilled labour. A construction manpower histogram is provided in Figure 5.4-10, with construction activities detailed in Section 5.5.

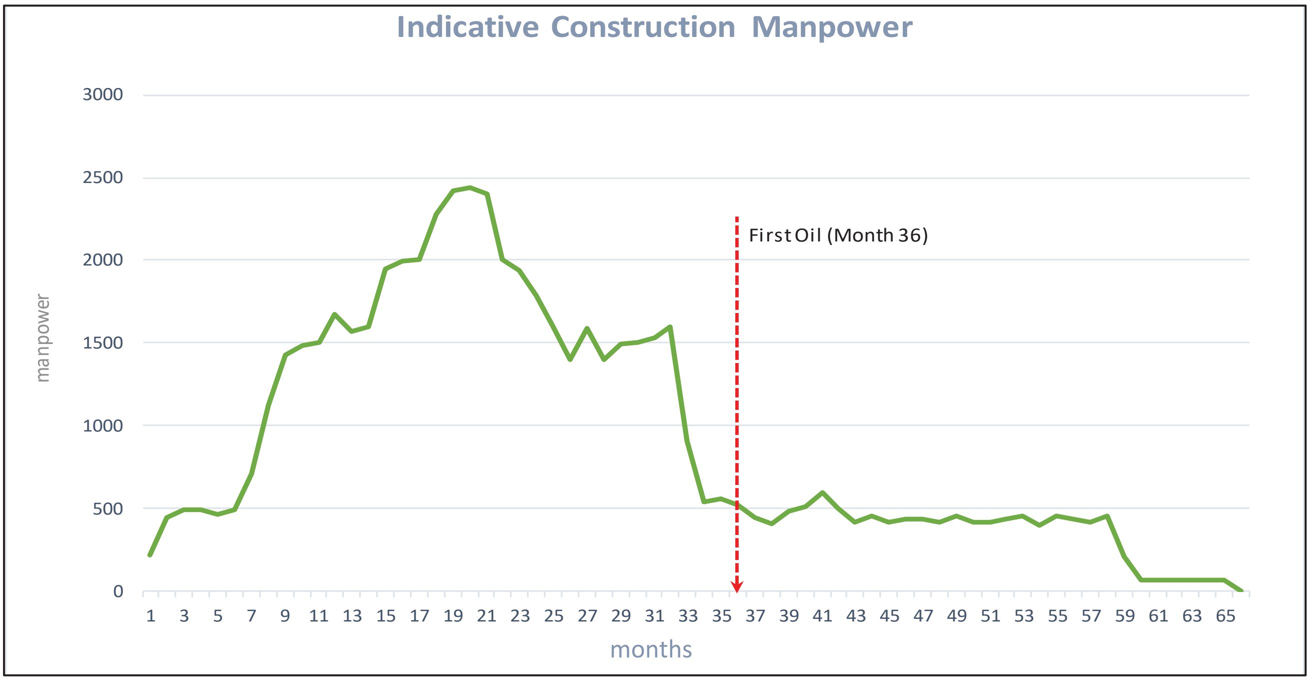


Figure 5.4-10: Construction Manpower Requirements

To support the construction and drilling phase of the Project, temporary infrastructure will be required.

Temporary Camps, comprising both construction camps and rig camps, will be located at strategic areas to support construction and drilling and to meet the construction demand. The main camps will be located at the CFA with satellite camps on the wellpads, at Kapese and for the Make-up water pipeline. These are estimated to comprise:

- Kapese (under a leasing arrangement) – 400 beds;
- Local Beds (Lokichar) – 400 beds;
- CFA – 2,000 beds;
- Make-up Water Camp in the Kerio Valley Development Authority (KVDA) area at the Turkwel Dam – 200 beds;

- Rig Camp (CFA) – 400 beds; and
- Drilling mini-camps – 20 personnel moving with rig (3 rigs).

During construction, a mini-camp will be erected on each pad for providing accommodation to the rig workers. It will have a capacity of 20 personnel. Freshwater (non-drinking) will be supplied to the mini-camp via water tankers during the initial phase (prior to CPF operation) and through dedicated water supply lines post set-up of CPF. Bottled water from a reputable source will be used for drinking purposes. Sewage will be collected in a portable septic tank and along with general waste will be periodically transported to a centralised treatment area for processing.

A residential area will be located within the CFA and will be designed to house both the permanent and construction camps. The CFA construction camp will be provided to support the construction of the main works and will be developed in a phased manner to allow it to be scaled up and down as required. At the end of the construction period, the construction camp will be demobilised with the exception of all the necessary facilities to provide a 500-bed permanent camp, which will be retained. All temporary buildings will be removed at the end of the construction phase.

Initially, one construction pioneer camp will be set up, using the existing camp at Kapese. This will support the construction of the enabling and early works as the CFA and the main construction Camp are developed.

Two base camps will be used for the construction of the water pipeline and facilities. The existing Kapese camp will be used along with a new 200-bed make-up water camp local to the Turkwel Dam.

Any temporary area used for accommodation during the construction and drilling phase of the Project will require re-instatement to its' original condition upon completion of construction.

5.4.12.2 Operations Accommodation

The residential area within the CFA will be designed to house both the permanent and construction camps. Accommodation will be provided for 500 personnel during operations. Several buildings from the construction camp will be retained for the permanent camp. The design of the facilities retained for the permanent camp is based on the following assumption:

- Local personnel will be on the same rotation pattern as the non-local personnel;
- The accommodation units will be shared between the two personnel rotations; and
- Accommodation will also be provided to support planned Maintenance Campaigns.

5.5 Construction

Construction will be undertaken by an EPC Contractor with international experience of the design and construction of major Upstream facilities, supported by a range of specialist local and international sub-contractors.

Parallel progress during construction of the CPF, CFA, wellpads, water pipeline and interconnecting pipework and infrastructure will be maintained by establishing separate construction teams.

The Project will follow the typical construction sequence for onshore facilities as detailed below:

- Enabling Works:
  - Pioneer camp, quarries, batch plant, temporary water system establishment, access road construction and site preparation.

- Early Works:
  - Construction of wellpads, CFA and CPF civil works, construction camp and temporary facilities establishment, construction of landfill, water abstraction facility/pipeline construction, airfield construction and infrastructure construction.
- Main Works:
  - Construction of CPF, ancillary area and wellpad facilities, Interconnecting infield network, (IWMF and permanent camp.
- Commissioning:
  - Commissioning and handover of systems.

5.5.1 Construction Right of Way

A RoW is a type of land use right, allowing for use of private and public property by the Project. For the Project, the following temporary working widths will be used for construction:

- 27 m RoW for the make-up water pipeline; and
- 30 m RoW for the infield flowlines, with an additional 10 m RoW for OHTL.

The technique for installation of the above infrastructure will be open-cut trenches. The RoW needed for safe installation using this technique is between 15 m to 50 m. The RoW allows sufficient space for digging the trench, laying buried infrastructure alongside the trench before installation, storing topsoil and sub-soil separately during installation and enabling access for construction or emergency vehicles. At times, wider RoWs will need to be used for short distances, for example at road and river crossings. An indicative RoW along the water pipeline route is shown in Figure 5.5-1

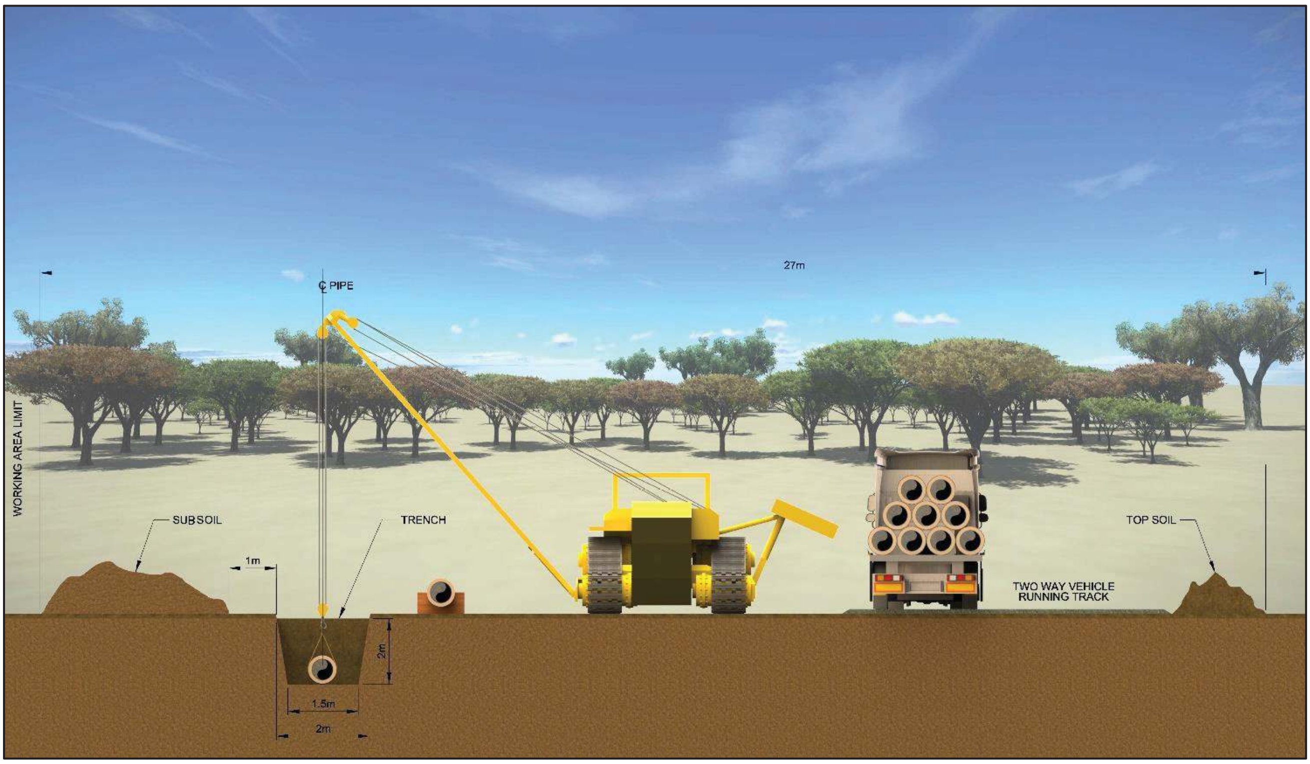


Figure 5.5-1: Indicative RoW for Water Pipeline Construction

In areas where the pipeline parallels major roads, it is assumed that the RoW is directly accessible from these roads (A1 and C46) for the majority of the pipeline sections across this terrain. The C46 and A1 roads are sealed and are in reasonably good conditions. The section of the route south of Kalemnogorok deviates away from the A1 road in a south-westerly direction. However, dirt track roads will be used to access the RoW. Use of RoW as a transportation route will be maximised as far as practical.

5.5.2 Wellpad and Well Construction

5.5.2.1 Wellpad

The wellpads are required to be constructed in phases. Initial construction is required to be completed prior to drilling. The sequence of construction comprises the following:

- Site Preparation:
  - Clearing and grubbing;
  - Cut and fill;
  - Excavation of pits;
  - Site levelling and drainage;
  - Access roads; and
  - Perimeter fence and gates installation.
- Installation of below ground facilities and infrastructure;
- Drilling operations and well completions, including removal of drilling spoils;
- Construction of above ground well site facilities;
- Commissioning of wells and equipment; and
- Handover and demobilisation.

The work on each wellpad needs to be scheduled in a sequential manner to allow construction groups to work on more than one wellpad at a time. Presently it is estimated that each wellpad will take approximately 2 to 3 months to construct, which includes the steel (or concrete) cellars. The current construction sequence assumes no requirement for pilling of foundations.

The site will be sloped slightly to encourage rainwater to run off and prevent the site flooding. Flood defences will also be required for the wellpads and to provide purpose-built drainage for clean surface water, which will be discharged to the closest natural lugga. Typical wellpad layout will have an evaporation ditch internal to flood protection berm where required. Drainage will be put in place to ensure no increase flood risk downgradient of the wellpads.

During the drilling phase, the wellpad will have a bunded diesel storage area to support temporary power generation. Part of the wellpad will be used for the storage of drilling wastes and therefore the drillings waste/ cuttings pit, cutting storage pit and drilling mud pit, will be provided with bunds to contain any rainwater run-off. The bunds will be lined to prevent soil contamination.

5.5.2.2 Wells

Wells will be drilled simultaneously by three drilling rigs (inducted in a phased manner). A typical drill rig is shown in Figure 5.5-2.

Figure 5.5-2: Typical Drill Rig

During drilling of each well, a system will be installed on the wellhead that acts as a robust mechanical barrier against any hazardous release of hydrocarbons to the environment. This is known as a Blow Out Preventer (BOP) and comprises a large, specialised valve to prevent the uncontrolled release of fluids from a well.

5.5.3 CFA and CPF Construction

The CFA and CPF will be the centre of construction activities. Due to the nature of the schedule, all areas will be worked on simultaneously. The construction will follow a sequence of enabling works, early works, construction installation period and commissioning.

The enabling infrastructure works that will be carried out in the CFA prior to mobilising to site includes upgrades to existing access roads, the installation of new access roads in the vicinity of the CFA and vegetation stripping, ground levelling and earth compaction within the CFA footprint.

Construction will involve civils works to prepare the area, erection of safety fencing and any pre-fabrication of concrete structures for the CPF. Earthworks will be carried out in conjunction with the installation of underground services, where possible. Concrete works will include a batching plant to supply all the Project requirements including aggregates. Subject to geotechnical surveys, piling works may be required.

The construction of the CFA will use a hybrid method, including stick build, modularisation and pre- assembly, as follows:

- Stick Build will be used for the majority of structural steel and piping for all areas;
- Modularised construction will be used for more complex structural steel and piping components (Pre-assembled racks (PAR's); Pre-assembled units (PAU's); Skid Mounted equipment modules) in the CPF to reduce the manpower peak;

- Pre-assembled structural frames and piping will be used for the CPF; and
- The main racks for the CPF area will be assembled at ground level and then lifted into position.

The construction method for buildings will be dependent on the complexity, for example fewer complex buildings will be stick built, although modular and prefabricated construction will be used where required. Large equipment will be pre-assembled where possible, although tanks will be erected on site by dedicated crews and construction equipment. Vessels and heat exchangers will be assembled at ground level and lifted into position and any units which are shipped in multiple components, for example flares, blowers, heaters, GTGs, will be assembled on site in their final location.

5.5.4 Water Pipeline Construction

The construction of the make-up water pipeline will involve the following separate work fronts:

- Steep slope construction, including establishing a gondola system, plus shallow blasting[3] or rock cutting for trenching and installation of the buried pipeline; and
- Construction of facilities including the break tank area and pressure reduction station.

A cable crane system may be installed to allow construction of the steep slope pipeline. The cable crane can also be used for transportation of materials and equipment for the pipeline and Above Ground Installation (AGI) construction at the Turkwel area.

An example cable crane is provided in Figure 5.5-3.

Figure 5.5-3: Cable Crane System for Water Pipeline Construction

The length of the make-up water pipeline requires construction camps, additional pipe storage and laydown areas along the route to reduce travel distances for loaded trucks and facilitate shorter pipe stringing durations. The final location of the pipe storage and laydown areas will be confirmed by the construction contractor, will involve consultation with local communities and could be subject for further permitting.

The main significant watercourse crossing is at the Malmalte River for the make-up water pipeline. The proposed crossing method will comprise the horizontal directional drilling (HDD) method. Figure 5.5-4 shows

[3] Blasting will likely be done in 50 m lengths.

an indicative HDD crossing method. The length of the HDD crossing is 1.2 km. The choice of the proposed HDD will be based on the results of the geotechnical survey and the following:

- Riparian vegetation community at the banks of the river; and
- Preliminary scour assessment indicates a scour depth of 16 m.

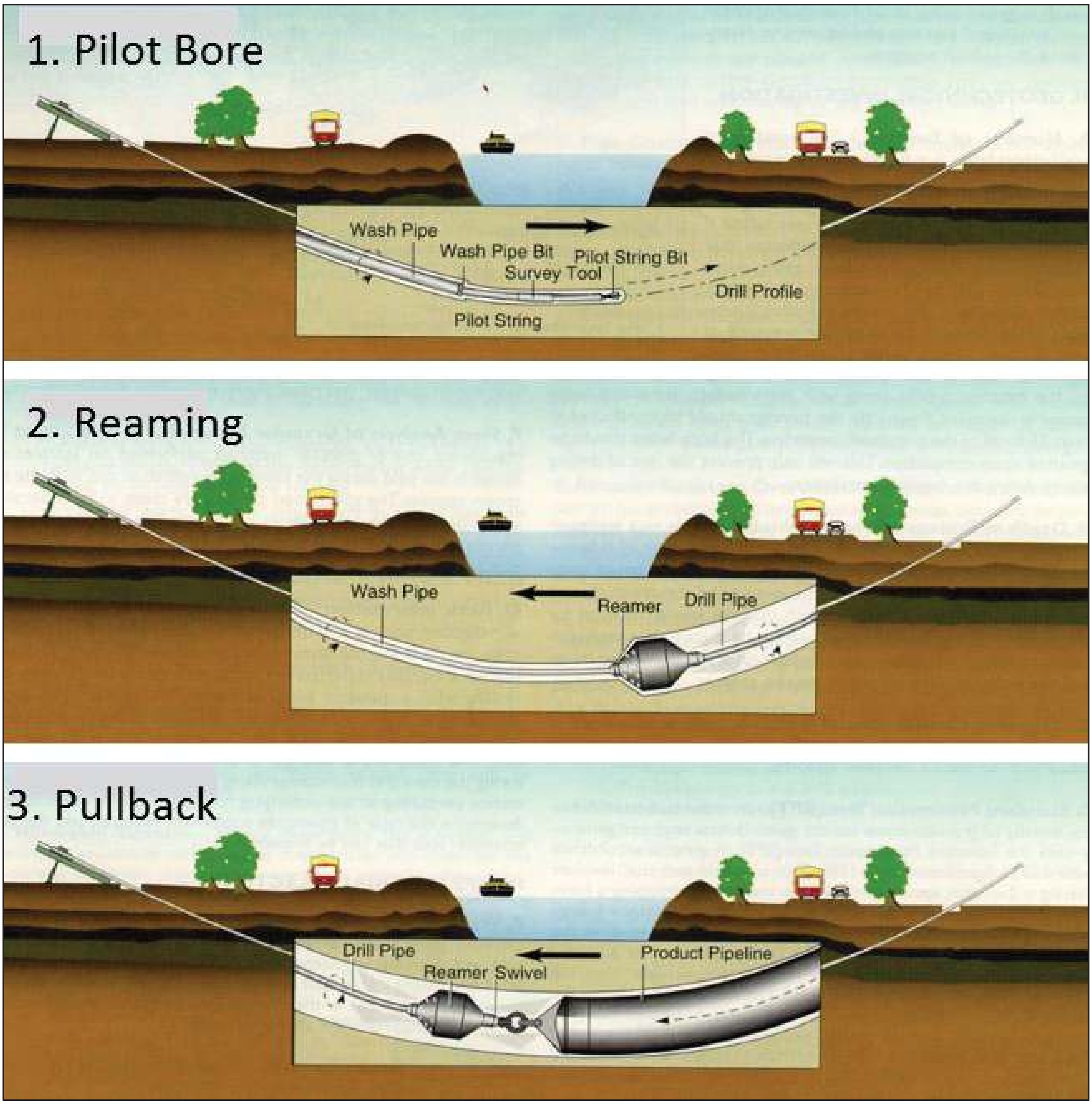


Figure 5.5-4: Indicative 3 Stage Horizontal Directional Drilling (HDD) Method

Access to the Malmalte River via the construction RoW may not be suitable for the mobilisation of the HDD rig. Where there is no direct access from the main roads to the Malmalte River crossing location, temporary tracks will be made.

Watercourse Crossings

Watercourse crossings will be installed using open cut techniques wherever possible.

Road Crossings

Road crossings will be installed using open cut techniques. For open cut installation, concrete slabs will be installed above the pipeline at crossings of tarmac roads, gravel roads and graded roads. An indicative method for road crossings is presented in Figure 5.5-5.

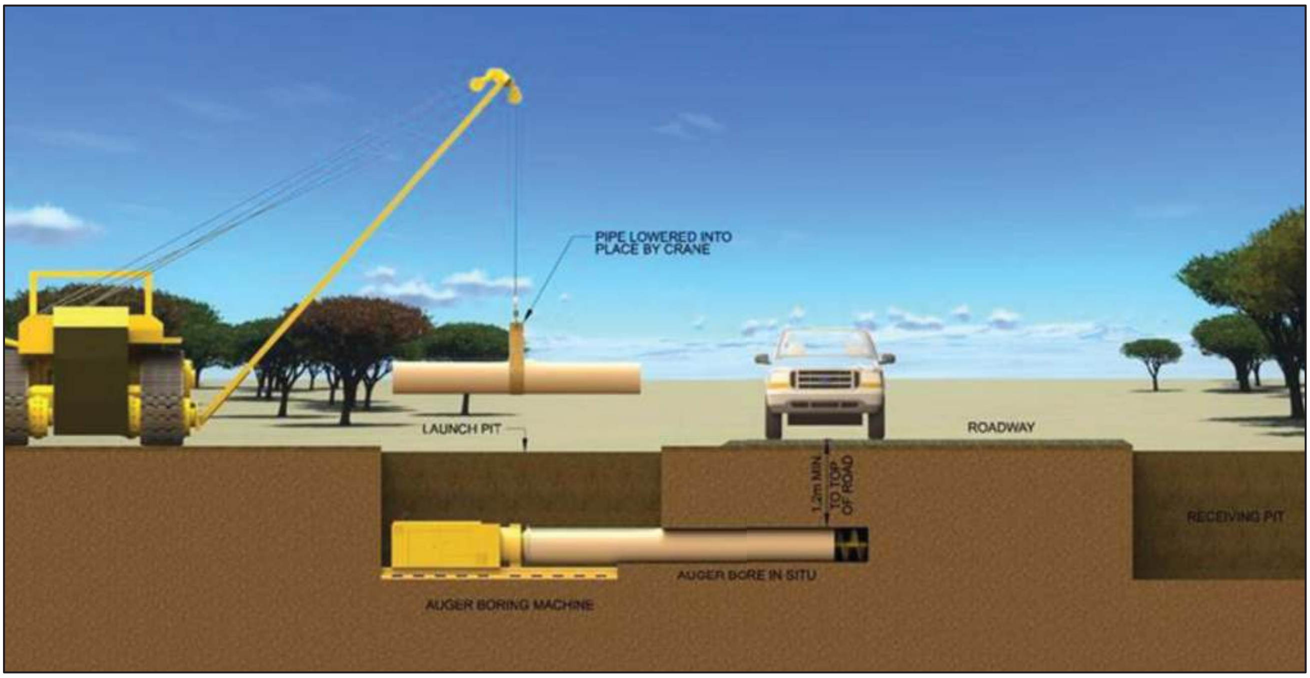


Figure 5.5-5: Indicative Method for Road Crossings

Track Crossings

Where potential exists for future upgrade of tracks, concrete slabs will be installed above the pipeline.

Service Crossings

At crossing of buried services (e.g. cables, pipelines), a minimum separation of 0.6 m will be maintained between pipelines and the service being crossed. Concrete slabs will be provided to protect the pipelines.

5.5.5 Infield Flowline Construction

The infield network (including the OHTL) will be constructed in parallel with the CPF. Construction of the network will start at the CPF and branch out to the wellpads. Construction activities will include preparation works, installation of crossing culverts, trenching (with the gathering network, water injection and fibre optic lines in one trench and service water lines in a separate trench), installation and connection. Watercourse, road, track and service crossings will be constructed in line with the philosophy for the water pipeline (Section 5.5.4). An indicative flowline installation sequence is presented in Figure 5.5-6.

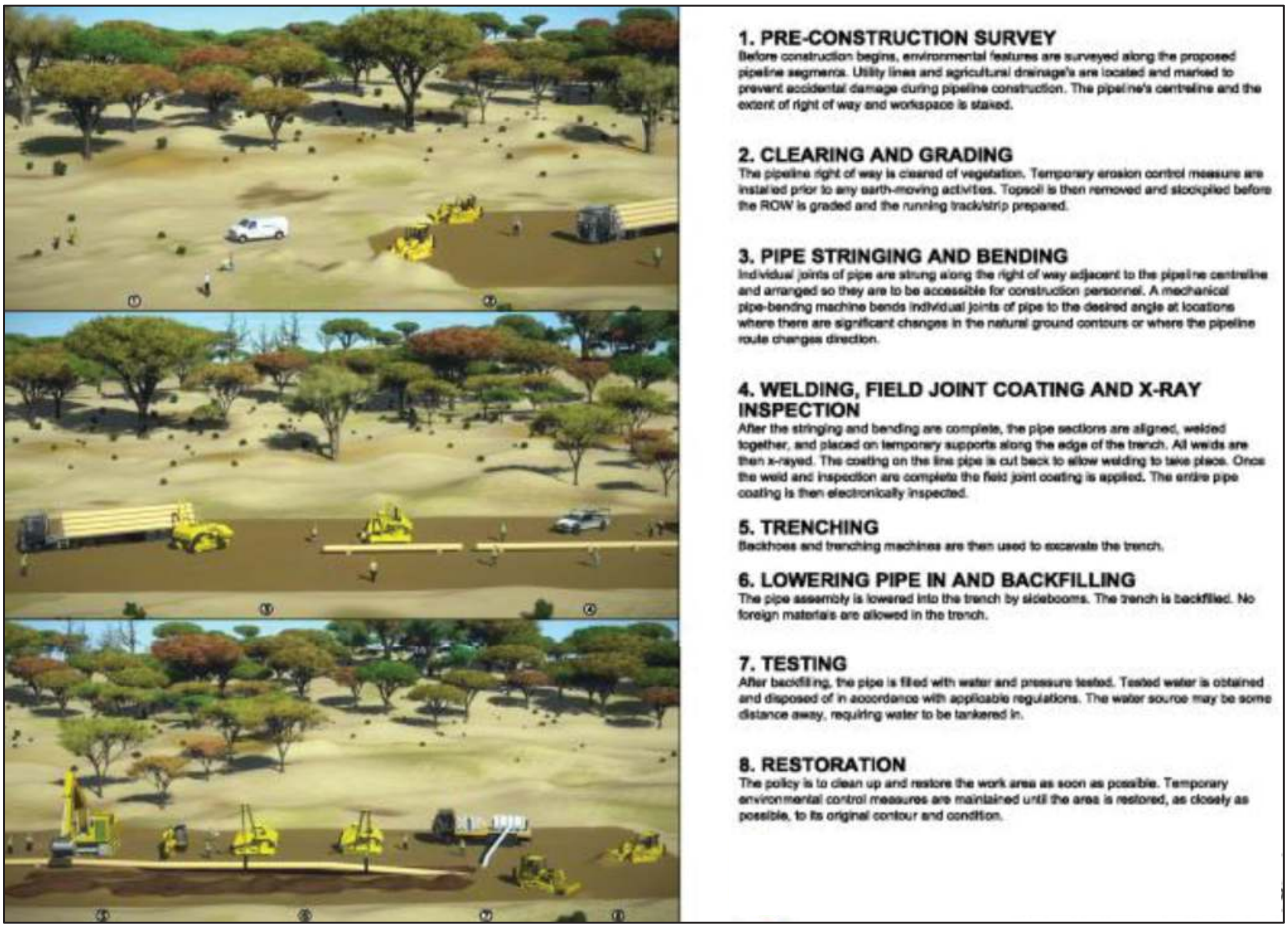


Figure 5.5-6: Indicative Flowline Installation Sequence

5.5.6 Construction Roads

Infield access roads will be designed to provide access to the infield facilities from the existing main C46 road. Roads will be designed in accordance with GoK Design Manual for Roads and Bridges[4]. Roads will not be black-topped, and will be constructed to meet the well drilling sequence and the facilities construction sequence.

Project speed limits will be set based on the road location and any potential risks identified during the ESIA e.g. weather, wildlife, people and condition but will not exceed national speed limits.

5.5.7 Construction Waste

The construction phase will generate significant quantities of inert wastes and incidental quantities of hazardous materials. Wastes will be generated by the construction camps and from physical construction activities (unavoidable off-cuts and surplus materials, combined with any arisings from demolition, site clearance and preparatory groundwork). Basic waste management facilities and protocols will be established at each construction camp with an objective of segregating and reducing waste and promoting recycling where possible.

The IWMF unit will not be installed, commissioned and operational until further into the construction period. Therefore, construction waste will be minimised where possible, with any remaining construction waste, where possible, incinerated in a purpose-built temporary facility to assist with housekeeping of the construction site.

[4] The Republic of Kenya- Ministry of Roads. Design Manual for Roads and Bridges, 2009

The resultant fly ash produced will be mixed with aggregate and used as a sub-surface for road construction, which is a common practice. This will reduce resource depletion, lead to a reduction in overall CO_2 emissions, divert material from landfill and reduce vehicle movements.

Inert wastes from the infield that cannot be readily recycled or re-used will be directed to a temporary IWMF at the CFA for temporary storage until treatment or disposal capability at that site is available. Wastes will be transported by dedicated vehicles or if possible, backhauled by construction deliveries. It is unlikely that significant hazardous waste quantities will be generated, although processes and protocols will be established to adequately store (temporarily) such materials before haulage and final disposal at the IWMF.

Temporary waste management areas will be established at the main construction sites. Waste will be segregated and disposed of in line with waste management protocols. Infield and water pipeline construction waste will be transported to a suitable facility for disposal. Prior to the construction and commissioning of the IWMF, a temporary waste management facility will be set up in the IWMF to handle construction wastes.

Waste storage areas will be developed at each wellpad to store drill cuttings/ wastes, segregate WBM (non-hazardous) and SBM (potentially hazardous) waste streams until it can be transferred to the IWMF for treatment and the recycling of drilling fluids.

5.5.7.1 Material Logistics

The primary supply chain will require transportation to site from Mombasa or other hubs within Kenya. The estimated truck movements during the initial 3-year construction campaign are detailed in Table 5.5-1. Material will be stored in the CFA construction laydown area before distribution to the relevant worksites.

The dominant traffic volume sources, excluding aggregates required for site preparation, are associated with the delivery of food and fuel, CPF chemicals and well chemicals with minor sources including the delivery of the water pipeline, CPF plant, the GTG and the rig pad.

Table 5.5-1: Trucking Requirements

		Truck Movements		
	Total Tonnage	Year One	Year Two	Year Three
Upstream CPF	16,925	200	652	252
Wellpad	4,736	62	185	62
Power Distribution	500	7	20	7
Interconnecting Flowlines	11,442	451	451	451
Water Pipeline	7,056	52	52	0
Site Prep	1,655,286	22,882	23,811	22,882
Food & Fuel	-	7,327	5,626	5,626

Post year three, to support the ongoing construction and hook-up of wellpads, it is envisaged that all material will have been previously supplied to the CFA and stored.

5.5.7.2 Operations Logistics, Procurement and Transportation

Project vehicles and movements will be a shared Project resource and organised through a centralised facility.

The Project will require significant quantities of material to be brought to site during each phase of the Project. The main supply route for imported material is as shown in Figure 5.7-1.

5.5.7.3 Well Logistics

Drilling material and equipment will be transported to site and primarily stored within the drilling area at the CFA. As required to support the drilling campaign, material will be moved to multiple staging areas within the fields (existing wellpads will be utilised for this purpose). All well-related materials will be delivered by the individual contractors under the Incoterm Delivery Duty Paid (DDP) to the primary storage area at the CPF and indicative volumes are detailed in Table 5.5-2. Infield movements will be carried out through a dedicated fleet of prime movers and trailers. This fleet will also carry out the drilling and completion rig moves between wellpads. The fleet will consist of approximately 70 prime movers and a variety of standard and low bed trailers.

Table 5.5-2: Indicative Wells/Drilling Material Supply Logistics

		Truck Movements		
	Indicative Total Tonnage	Year One	Year Two	Year Three
Wells/Drilling	181,036	675	2024	675

5.6 Commissioning

Commissioning is the preparation of a production system for start-up, or the preparation, start-up, and test of a non-production (utility) system to verify that it's functional and operational performance is in accordance with the Project design and specification.

5.6.1 Commissioning Water Pipeline and Flowlines

Hydrotesting of the water pipeline, the CPF and infield flowlines will be undertaken to confirm the strength and integrity of the systems. Hydrotesting water will be sourced from the Turkwel Dam and the existing boreholes. This water is considered raw water and as such, additional water quality testing may be required prior to hydrotesting. Chemical treatment of test water prior to any discharge to the environment is not envisaged given that the material of construction is ductile iron cement lined (DICL) and lined carbon steel.

Hydrotesting will occur for several construction sections (or 'spreads') of the water pipeline. The number of hydrotest spreads will be minimised. All efforts to re-use water will be taken as far as practical. Where possible, test water will be transferred from one test section to another. A nominal 250 m³ of hydro-test water per month has been included in the water demand profiles. Hydrotesting will begin at approximately month 15 of construction and the water will be reused wherever possible. There is the potential for used hydrotest water to be used for dust suppression during construction.

It is anticipated, due to the construction sequence, that not all test water will be able to be re-used. In this case, quantities of test water will need to be discharged during construction. At the completion of hydrotesting activities, test water will be discharged from the pipeline system, typically into purpose-built ponds or other storage facilities. Water can be designated for alternative Project use (e.g. dust suppression) or evaporated in these ponds.

5.6.2 CPF Commissioning

The following systems are required to be operational prior to start-up:

- Gas compression/fuel gas;
- the Vacuum Deaerator Package and Injection Water Buffer tank, to allow for injection into the wells when the system has been brought up to temperature;
- Heating medium;
- Other utilities e.g. flare, instrument air, nitrogen, chemical injection facilities;
- The diesel storage tanks should be full and supply pumps available; and
- Control Systems - The Integrated Control and Safety System (ICSS) and Fire and Gas Shutdown system at the CPF will be available at commissioning (power supply from the grid, emergency diesel generator or Uninterruptible Power Supply (UPS)). The wellpad control system should be available (powered through grid or main power generation).

5.6.3 Commissioning Other Key Facilities

Activities will be performed by the construction contractor to ensure the pipeline is ready for overall commissioning:

- No commissioning of existing facilities will be required; and
- Wellpad facilities will be commissioned prior to hydrocarbon introduction. Due to the phased construction of wellpads, new wellpads will be hooked up and commissioned throughout the first few years of operation.

5.6.3.1 Well Commissioning and Start-Up (Stimulation)

Wells will be completed and suspended using packer fluid. Wells will be started up when the wellpad facilities have been completed and hooked up to the gathering network. Well clean-up will involve flowing the wells (including packer fluid) to the CPF. The following comprises the chemical requirements for the packer fluid:

- Biocide;
- O_2 Scavenger;
- Corrosion Inhibitor; and
- Potassium Formate.

5.6.3.2 Well Testing and Flaring

Each wellpad will contain a concrete lined flare pit and ground flare for well testing. The flare will also be used for well flowback prior to hook-up or for flow line depressurisation if a flowline is blocked.

5.6.3.3 Power

There are two scenarios to consider, as the potential connection of the external grid relies on 3rd party involvement. Those two scenarios are:

- Power available from the grid; and
- Power must be internally generated.

Where power is to be internally generated, the emergency diesel generator will be required to run essential services until the main GTGs can be started on diesel. Once operational, production will be targeted to ramp up as quickly as possible to ensure sufficient gas is generated to start another GTG on fuel gas, and so curtail diesel consumption as quickly as possible. A relatively slow increase in production flowrate, and therefore gas production, will require a longer period before fuel gas is available for the GTGs.

5.6.3.4 Waste and Landfill Commissioning

Waste generated during the commissioning phase will be handled in the same way as construction waste or will be treated in the IWMF, which will have been constructed as part of the early works programme.

5.7 Operational Infrastructure

The operations base for the operating phase of the Project will be at the CFA. The main operations workshops will be located in the ancillary area, with travel to the remote facilities (wellpads and water abstraction) via road transport. The site operations will be supported by an office located in Nairobi.

5.7.1 Wellpads

The wellpads will not normally be manned. Visits may be required on a daily, weekly or monthly basis to undertake well testing, basic sediment and water sampling, waste collection, chemical changeout and water injection choke adjustment. In the first few years of operation it is anticipated that the wellpads will be continually manned to some degree, with well workover and development drilling taking place and regular visits by operations and maintenance (O&M) personnel until steady-state operations have been achieved.

A completion/workover rig will be available for running initial completions and subsequently conducting workover operations during the full life of the TAN fields.

Most producers in Ngamia and Amosing will have jet pumps as the initial artificial lift method, with changeover to Progressing Cavity Pumps (PCP) once water cut has increased to around 60% or when there is insufficient spare capacity in the hot water system. The high CO_2 Ngamia wells, high rate Amosing wells and all Twiga wells will have Electrical Submersible Pumps (ESPs) as the artificial lift method.

Sewage will be collected in a portable septic tank and, along with general waste, will be periodically transported to a centralised treatment area for processing.

5.7.2 Interconnecting Network

The infield flowlines operating conditions (temperature and pressure) will be continuously monitored. Trunklines on the gathering network will be pigged using the permanently installed pig traps to monitor pipeline integrity. The flowlines will be periodically pigged using temporary pig traps. The water injection trunkline will be pigged periodically to monitor pipeline integrity. All waste from pigging activities will be collected and returned to the CPF for processing.

5.7.3 Central Facilities Area

The CFA will act as an operations hub for the development. All operations personnel will be located within the 500 bed permanent camp. The control room, administration building, workshops and laboratory are all located within the ancillary area, local to the CPF. The operators will access the CPF as required to carry out their daily maintenance and observation tasks.

5.7.4 Central Processing Facility

The CPF will require significant operations attention. Operators are required to undertake routine maintenance activities, while ensuring the process operating conditions are optimised. The majority of the operations activities will be carried out from the adjacent ancillary area.

5.7.5 Waste Management

Recovered brine and wellbore cleaning chemicals from wells, as well as any hydrocarbon waste generated during well testing and workover, will be transferred to the CPF or transferred to the IWMF where it will be further processed/recycled/disposed as per applicable regulations.

During drilling of the surface, as well as the production sections, a significant quantity of drill cuttings (rock fragments cut by the drilling bit) will be generated. The surface section will generate WBM cuttings, whereas the production section will generate SBM cuttings. The treatment of the cuttings as well as recycling/disposal of the drilling fluids for both the sections will be different, depending upon the base used (oil or water). The strategy is outlined below:

- Surface Section (WBM):
  - Cuttings – mixed with native soil in 1:3 (cuttings: soil) and buried around the wellpad; and
  - Drilling Fluid – dewatered, recovered water reused, while residue disposed with cuttings.
- Production Section (SBM):
  - Cuttings – transferred to the remediation facility at landfill for further treatment; and
  - Drilling Fluid – conditioned and integrated into SBM inventory for reuse.

5.7.5.1 Landfill

Waste will enter the landfill via a waste reception facility where it will be weighed and a ticket or electronic tagging system will be used to define the waste streams being carried and the required destination cell. This will be checked immediately prior to waste deposition to ensure the correct disposal location is used. Waste will be covered, using site derived cover material, at the end of each working day to minimise nuisance. Potential options for leachate management may include recirculation or transfer to lagoons either for evaporation or tanker removal to the ETP or a combination of the two methods determined by seasonality. The waste will only comprise a small biodegradable fraction and therefore landfill gas generation rates are anticipated to be negligible and a passive venting system is likely to be employed to manage the gas.

5.7.6 Operations Logistics, Procurement and Transportation

Project vehicles and movements will be a shared resource and organised through a centralised facility.

The Project will require significant quantities of material to be brought to site during each phase of the Project. The main supply route for imported material is shown below in Figure 5.7-1.

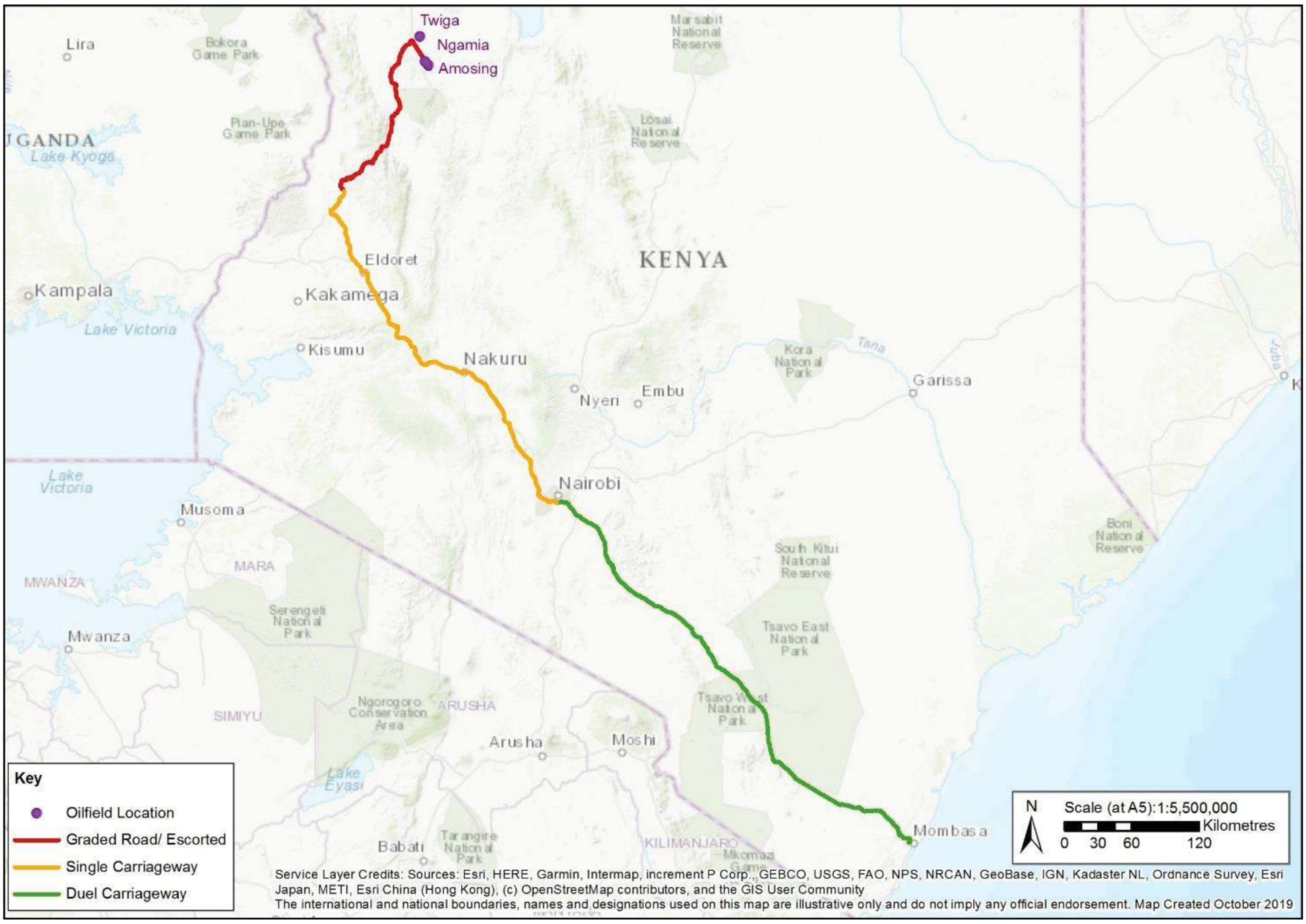


Figure 5.7-1: Main Supply Chain Route – Mombasa to Site

5.7.7 Materials

During operations, material required to support the local activities will be transported to site by truck, and will include food, fuel, chemicals, equipment and consumables

5.7.8 Airstrip

The airstrip will service a Bombardier Dash 8 Q400 which has a capacity of approximately 50 passengers. A total of two return flights a week are planned from Wilson Airport Nairobi to the Kapese Airstrip in Lokichar for operations personnel. Passengers will be transferred within the field by a fleet of minibuses.

5.8 Control and Shutdown

The wells, wellpads and the CPF will be controlled by an ICSS, located in the wellpads and Instrument Equipment Rooms in the CPF. Wells, wellpads and the CPF will be linked to the central control room by means of fibre-optic cable.

The ICSS will comprise the following elements:

- PCS (Process Control System);
- ESD (Emergency Shutdown System); and
- F&G (Fire & Gas System).

5.8.1 Emergency Response

An emergency response facility is provided within the ancillary area of the CFA.

5.9 Decommissioning

This section provides an overview of the decommissioning activities that will likely be undertaken once individual facilities cease operation. Decommissioning refers to the dismantling, decontamination and removal of process equipment and facility structures and any appropriate remediation.

The likely decommissioning activities would be focused on:

- Production and injection wells with corresponding wellpads;
- The interconnecting network;
- Surface facilities in the CFA; and
- Other outfield infrastructure.

Decommissioning will be undertaken in accordance with Kenyan legislation and applicable standards. Decommissioning costs will be assigned in accordance with the license obligations will be included in the economic assessment of the development. Assuming there is no other use for infield and outfield facilities, all structures including production, processing, treatment, storage, pumping, power, and related infrastructure facilities will be dismantled for recycling, sold for scrap, or disposed to a suitably licensed NEMA-approved facility. The design will also allow for routine monitoring and inspection to ensure that there is sufficient information on the in-situ condition to support decommissioning.

Key considerations for decommissioning (both after construction and following the conclusion of operations) may include:

- Site reclamation;
- Extent of restoration and revegetation;
- Road access; and
- Disposal of contaminated materials and residues.

5.10 Analysis of Alternatives

5.10.1 Introduction

The design and configuration of the Project as described in the Project Description was developed through an iterative design process, which considered a variety of project alternatives for the Project. These included considerations for siting, layout, technology selection, produced fluids processing, transportation, storage and export of the crude oil from the TAN fields and associated CPF at Lokichar.

5.10.2 Need for the Project

The development of the oil and gas industry in Kenya is considered to be an important strategic goal for achieving sustainable economic growth and the Project represents a fundamental component of this strategy. The Production Sharing Contract for Blocks 10BB and 13T provides authority to explore and produce oil in South Lokichar Basin. The route to market is provided by the LLCOP project which will be used to transfer stabilised oil from Turkana to the international export market via Lamu Port, whereby making oil production from the Project commercially feasible. Without the Project, the capacity of the GoK to deliver its aspirations for wider economic growth through oil export will be limited.

Under the Vision 2030 programme of the GoK, development of the oil and gas sector is identified as an economic imperative. In addition, the LAPSSET development is also part of the Vision 2030 process for the economic development of northern Kenya, providing a linear multi-spoke land corridor for strategic infrastructure development. It is a major initiative for Kenya and the East African region and, as part of its initial mandate, it includes the crude oil pipeline from Turkana to the Indian Ocean.

5.10.3 Project Alternatives

5.10.3.1 No-Project Option

The ‘no project’ alternative represents a scenario in which the Project does not exist. In such a scenario, it is considered that the baseline environmental conditions, would prevail and the impacts would not materialise. As such, whilst any adverse environmental and social effects would not occur, the beneficial socio-economic effects of the Project would also not be realised and the established need for the Project would not be met.

If the ‘no project’ alternative were pursued, then the LLCOP project would also become unfeasible, with the socio-economic benefits of that project similarly lost.

5.10.3.2 Refining Versus Crude Export

The primary strategic alternative that was considered focused on whether it was feasible to refine or partly process the crude oil at Lokichar. This was soon ruled out on economic grounds as the scale of the hydrocarbon resource discovered in the South Lokichar Basin is not sufficient to justify the large investment required to develop a refinery. In addition, the Lokichar crude has a high wax content (approximately 30%), which would require additional processing at high cost to produce a valuable product.

To be economically viable, refineries typically need to process large volumes of hydrocarbons on a constant basis (i.e. operating 24 hours a day) and need to be located where they can process large volumes of hydrocarbons. In addition, the local market for refined product (i.e. northern Kenya) would be too small to provide a viable market for large volumes of refined oil products. There would therefore still be a requirement for the long-distance transport of large volumes of processed hydrocarbon product to other market destinations, meaning a pipeline would still be required.

In order to develop the discovered hydrocarbon resources in the South Lokichar Basin, the only feasible economic option is to export the resources on a large scale. To realise the full potential of the reserves, such export would need to be international.

5.10.3.3 Phased Development Approach

Developing a hydrocarbon basin is commonly phased to allow for an extended appraisal period and minimise costs. The decision for adopting a phased approach for developing the Lokichar fields was made after consideration of numerous combinations of fields (including Twiga, Amosing, Ngamia, Ekales, Agete and Etom) and different export approaches (road, rail, road/rail, pipe/rail and pipeline).

A review of the options lead to the following conclusions:

- The TAN fields are the most mature and production resources are enough to underpin a pipeline with a positive economic outcome;
- The Project reservoir volumes economically justify investment in an export pipeline. Pipeline export is therefore the optimal method offering flexibility (via additional pump stations within the scope of the LLCOP project) and enables future expansion at low cost;
- Further E&A may be carried out in parallel, to assess the potential to develop the other fields; and
- Learnings from the Project will also improve cost/schedule for future phases.

5.10.4 Facilities Siting Alternatives

5.10.4.1 Field Architecture and CPF Location

During development of the design, assessment of potential facility layouts (based on full field development rather than phased development) was carried out to optimise the hydrocarbon gathering network. The objective was to offer a solution which minimised land take and infrastructure requirements, while minimising heat loss in the flow lines so wax deposition could be suppressed.

In addition, consideration was given to key design criteria including:

- Well fluids would reach the CPF at maximum arrival pressure, so no additional compression was required to move fluids through the oil and gas processing trains;
- Operational pigging for wax management would not be required;
- Wax formation would be mitigated by pipeline insulation and electrically heating the flowlines (heat tracing);
- Minimising distances and line sizes of flowlines; and
- Maximising routing to follow existing road networks to minimise impact to natural habitat and communities whilst allowing easy access to pipelines and flow lines for visual inspection and maintenance.

A location in the north-east of Ngamia was taken as the Base Case; it is considered optimal as it is close to the most productive and highest reserve base reservoirs (Ngamia and Amosing).

5.10.4.2 CFA Location

Early consideration was given to a development option which supported two CPFs, one located in the north of the field and one in the south. The Northern CPF would service Agete, Twiga and Ekales, and a Southern CPF would service Ngamia and Amosing. This option was not pursued once a phased development approach was identified.

Once the single CPF option was identified it was decided to locate it within the CFA to reduce the development footprint. Alternative CFA locations were considered and the following factors were assessed to inform the decision-making:

- Flood risk;
- Geophysical risk;
- Geotechnical risk;
- Environmental sensitivities;
- Social sensitivities;
- Proximity to camps (drilling, pioneer, permanent);
- Personnel movement within the fields (day to day) - proximity to the C46 road and centralised between fields;
- Ease of access for removal of wells waste to the CFA;
- Reduce back pressures on the Amosing Field by reducing the distance to the CPF;
- Flow assurance;
- Minimising pipeline lengths; and
- Potential security issues.

Out of the sites investigated, two sites were considered feasible and based on further evaluation of a selected number of the criteria listed above, the location to the north of Ngamia was strongly favoured over the one between Ngamia and Amosing. Both locations are shown in Figure 5.10-1.

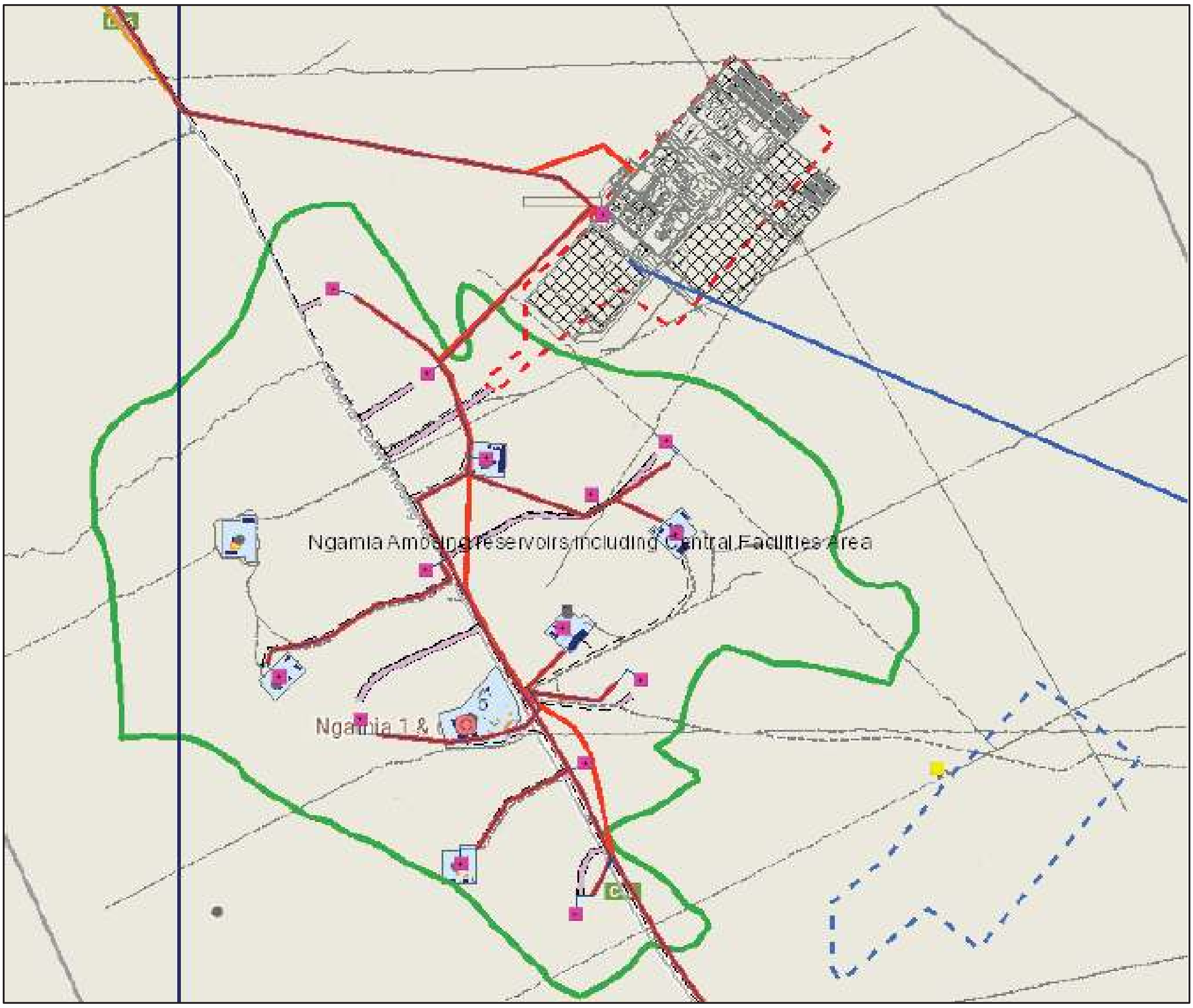


Figure 5.10-1 Base Case CFA (Red), Alternate Case (Blue).

5.10.4.3 Wellpad Siting

Initial studies evaluated single well tie-back vs a cluster (wellpad) development. The single well tie-back option was disregarded due to the increased land take requirements, increased operational complexity and cost associated with a more complicated infield pipeline arrangement.

The location of wellpads was predominantly determined based upon optimum placement relative to a sub-surface target or well targets. Once the sub-surface targets were determined and generated, well planning software was used to calculate the optimal position and number of pads required to reach the targets with a given set of trajectory criteria such as reach, maximum inclination, build rate and kick-off depth limitations.

The calculated locations were then initially compared to the location of any existing E&A pad locations. Where an existing pad was located in close proximity to a calculated pad location, the existing pad was selected in place of the calculated pad. In the case where a calculated pad location was so far from an existing pad location that the well trajectories would be significantly compromised, the new pad was selected.

Other factors that influenced locations of drilling pads included the following:

- The terrain is bisected by a significant number of ephemeral water courses or luggas;
- Social constraints such as the location of roads, homesteads and animal shelters are abundant, particularly in the areas around the luggas and
- A local geological fault system.

5.10.4.4 Landfill Location

Due to the land requirements for the landfill site, it could not be co-located within the CFA. Preliminary work was carried out on five potential locations outside the immediate CFA boundary giving due consideration to local factors including:

- Proximity to centres of population;
- Distance from places of waste generation;
- Ease of access;
- Security issues;
- Natural topography and landscape;
- Proximity to protected areas;
- Geology; and
- Land availability.

Other factors taken into consideration came through using best practice guidance provided by the WBG EHSG for Waste Management Facilities and landfill siting criteria and included considerations such as:

- Gently sloped topography which facilitates leachate drainage;
- No areas inside the landfill within a 10 year groundwater recharge area for water supplies;
- No protected forest within 500 m of development;
- No environmentally sensitive/endangered species, wetlands, important biodiversity areas etc. within the development area;
- No open areas susceptible to high winds;
- No major utility lines crossing the area;
- No residential development within 250 m of the perimeter;
- No visibility of cell development from residential areas within 1 km (or use of shielding as necessary);
- No perennial stream within 300 m downgradient of landfill;
- No siting within 3 km of airports (catering for jet aircraft) or 1.6 km (for piston aircraft). Between 3 and 8 km of a jet airport, express permission must be sought from the aviation authority;
- No siting within a floodplain subject to 10-year floods;
- If located within 100-year floodplain the site must be designed against washout (this was interpreted as perennial river floodplains and not applicable to flash flooding or transient water courses);

- Avoid siting within 1 km of socio-politically sensitive sites (memorial sites, churches, schools, hospitals); and
- Avoid access roads that pass sensitive sites.

The Ngamia area was preferred due to its proximity to the CFA and the Ngamia and Amosing wellpads. This area is where most of the waste associated with the Project will originate (primarily during construction). This location will significantly reduce waste related vehicle journey distance, time, road traffic volume and transport emissions when compared to locating the landfill at Twiga. The Ngamia site will be confirmed as the location once geotechnical studies are completed during detailed design.

Sites near Twiga were considered as members of the local community expressed an interest in waste facilities being situated in the area. Such a location was seen as having potential to provide benefits in terms of community engagement and potential for local job provision. Twiga is also located closer to potential future field developments in the north, and if these developments were to go ahead, could reduce future waste related vehicle journey distance, time, road traffic volume and related emissions.

5.10.5 Water Resource Options

5.10.5.1 Introduction

In order to meet the water demand for the Development and Production phases in the South Lokichar Basin, a strategic source of water is required. Water is a fundamental requirement for delivery of the Project and is required to enable injection of water into the oil reservoirs being developed. The implementation of a waterflood development on the South Lokichar oil reservoirs serves two key purposes:

- Enables the maintenance of pressure within the reservoirs as oil gets extracted – for each barrel of oil produced approximately 1.3 barrels of water will need to be injected to maintain the initial reservoir pressure; and
- Enables oil in the reservoir to be pushed from water injection wells to oil production wells to sustain oil recovery.

Notably the amount of oil recovered from the reservoir is directly related to the injection of water attributable to the combination of the two key drivers. If no water is injected the reservoir pressure would decline and the oil production wells would cease to flow. This would result in only one third of the oil in the reservoir flowing to surface and stop the viability and commerciality of the Project. Initial water resource assessments included:

- River Nile in Uganda;
- Turkwel Dam;
- Lake Turkana;
- Local groundwater;
- Indian Ocean;
- Distant groundwater; and
- Lake Victoria.

The seven options were reduced to a shortlist of four (Turkwel Dam; Lake Turkana; local groundwater; and distant groundwater), using a multi-criteria decision analysis technique and a programme of technical studies on the four remaining options was undertaken[5].

[5] Strategic Water Supply for Development, Selection of preferred option, January 2016.

5.10.5.2 Preferred Option: Turkwel Dam

5.10.5.2.1 Rationale for Selection

The Turkwel Dam is a concrete-arch dam built in a narrow gorge, commissioned in 1991, with a maximum generating capacity of 106 MW and a quoted total reservoir volume of 1.6 billion m^3. The Turkwel Dam is on a tributary of the Turkwel River and falls under the remit of the KVDA.

The Turkwel Dam was formally selected as the preferred option for the following reasons:

- It can meet all the water needs of full field development in the South Lokichar Basin;
- It is owned and operated by a government body with a mandate to initiate projects that contribute towards poverty reduction and wealth creation, especially across administrative borders;
- The infrastructure needs are simple: one intake at the dam with power available on site; one buried pipeline with no intermediate pumping stations;
- Minimal water treatment requirements at the CPF; and
- There is also great potential for positive social impact through improvement of community water supplies along the water pipeline route and by converting existing boreholes into local water schemes.

Water Abstraction

5.10.5.2.2 Introduction

The current design abstracts water from the Turkwel Dam via pontoon pumps to a break tank at the top of a hill (i.e. escarpment), and then gravity fed to the CPF. As water levels in the lake are constantly changing due to the demand from the power station and sporadic rainfall in the area, any make-up water abstraction system at the lake shore will be required to handle the change in water level. The sections below discuss the options considered for the water intake.

5.10.5.2.3 Intake Locations at Turkwel Dam

Four potential intake options were studied including:

- Above the dam (Headrace);
- Below the dam (Tailrace);
- Turbine bypass; and
- Sluice Gate.

Option (iii) and (iv) were discounted early in the design development. From a security of supply perspective and to minimise potential operational changes in dam operation and impact on the Turkwel River system, the reservoir intake option (headrace) was selected.

5.10.5.2.4 Floating Pontoon Selection

A floating pontoon is required on the Turkwel Dam due to constantly changing water levels derived by sporadic rainfall and power station demand. The following two options were considered:

1) Floating Platform – Moored to Shore

Booster pumps will be located on a floating platform in the main body of the reservoir with suction lines and filters below. In this case the pontoon will be moored in position by a series of mooring lines and a mooring buoy. The mooring lines will provide flexibility to allow for rise and fall with the water level. Should access be required for inspection or maintenance then the mooring lines can be used to retrieve the pontoon and bring it back to shore where work can be carried out.

2) **Floating Platform – Pontoon Type**

Booster pumps will be located on a floating pontoon a safe distance from the lake shore, the pump suction will be taken from beneath the pontoon with local filters at the inlet to each suction line. The pontoon is connected via a walkway to the lakes edge which doubles as a flexible pipeline support. In order to accommodate the varying levels within the lake, the system is hinged at both the top and bottom of the walkway, allowing the platform to rise and fall with the water level. This system is similar to that employed by maritime access pontoons which are in common use around the world, so the technology is proven, and the flexible walkway provides for easy inspection and maintenance of the booster pumps.

Option 2, the Floating Platform- pontoon type was selected as the preferred option for the Project as it was the most robust solution with ease of maintenance and access.

5.10.5.2.5 Pontoon Location

Three potential pontoon locations were reviewed (see Figure 5.10-2). It was considered that Option A was too close to the dam wall and could cause an obstruction in the event of access requirements for dredging or other maintenance activities. Option C was considered to have too steep a slope for effective deployment of the pontoon in the event of significant falls in water level in the reservoir and hence Option B was selected. The exact location will be fixed during detailed design.

Figure 5.10-2 Water Abstraction – Pontoon Location

5.10.5.3 Water Pipeline

The preferred route (Figure 5.10-3) runs from the water abstraction location to the CPF and extends for approximately 90 km. The alternative routes (route option 1 and 2 shown in Figure 5.10-3) were considered to avoid the mountainous terrain around the Turkwel reservoir. The options consider routing the pipeline from a make-up station at the north-east corner of the reservoir approximately 15 km north in order to find a suitable location to cross the mountains east of the reservoir safely, before following the existing road infrastructure to the CPF.

The base case routing requires the water pipeline to go over a rocky escarpment (located close to the Turkwel Dam). An additional option was also considered, which required a mobile drilling rig to drill a tunnel from the north-east corner of the reservoir through the mountains to a location adjacent to the tail race canal from where the existing route is followed to the CPF. The route requires a 3.6 km tunnel to be drilled through the hillside. This option removes the pumping station requirement as the severe elevation change leading to the static head within the system is replaced with a 1.2% sloped tunnel line. With the pumping station gone, associated visual impacts within the first 4 km of the route cease to exist, however this option was discounted as it was much more costly and technically complex compared to the other two solutions.

Following design analysis, the selected route shown in Figure 5.10-3 (crossing directly over the escarpment) presented the shortest route. Calculation determined the hydraulics can be made to work and from a constructability perspective, technology is available to getting materials and install pipelines in such terrain.

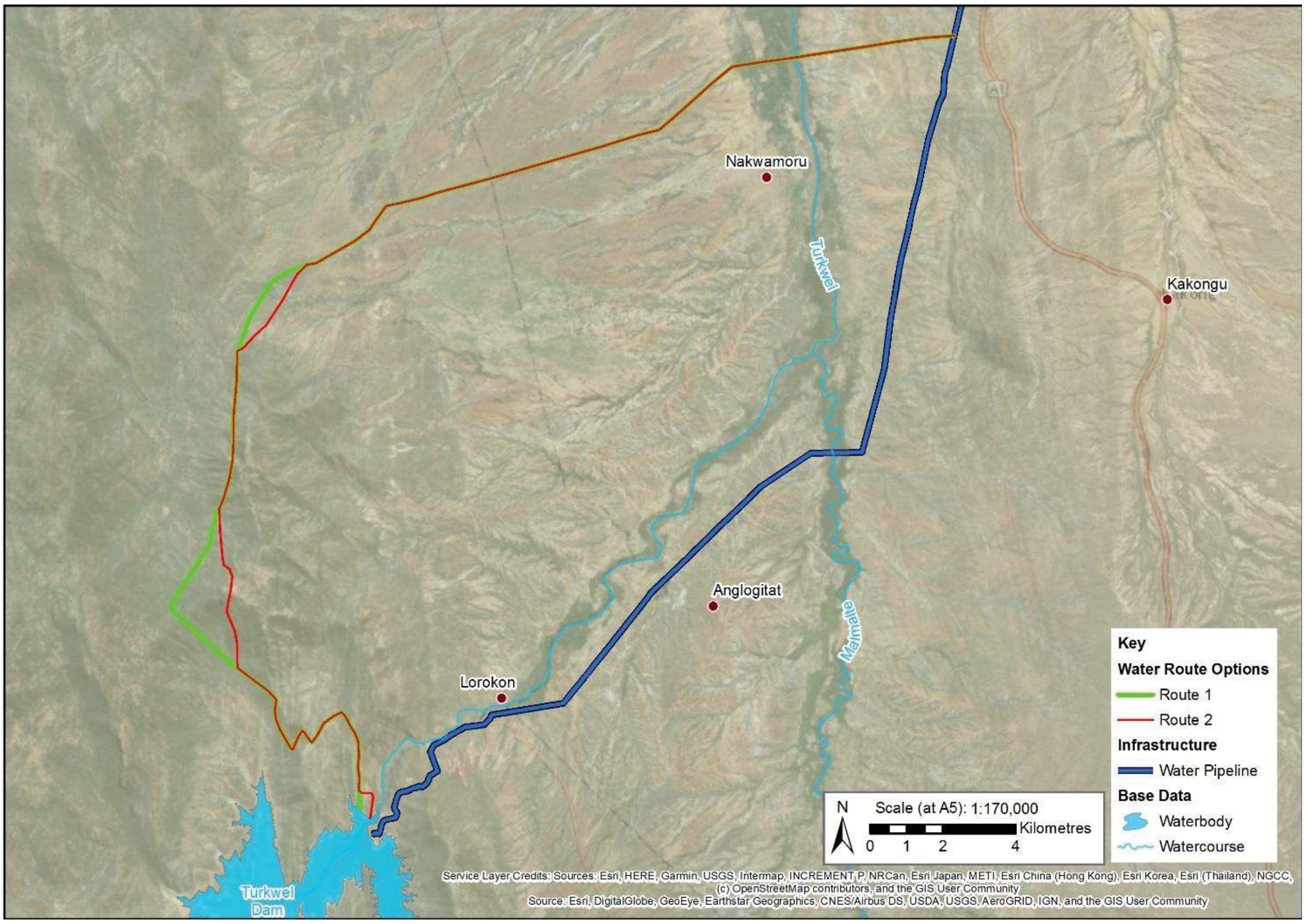


Figure 5.10-3 Water Pipeline Route Options – Vicinity of Turkwel Dam (Blue Route Chosen)

East of the Malmalte River, two alternative potential routes were identified from Turkwel Dam to the CPF, (see Figure 5.10-4), a longer route (88 km) and a shorter route (76 km). The shortened route reduced the pipeline length by 12.4 km, but slightly increased the peak elevation from the tailrace by approximately 50 m.

The following criteria was used to determine which of the two make-up water pipeline routes would be selected as preferred, including:

- Minimise land take and reduce impact on existing facilities, apply buffer/separation distances to RoW constraints;
- Avoid settlements and other social constraints;
- Avoid environmentally sensitive locations;
- Run RoW to existing roads (A1 & C46) for ease of access;
- Use common pipeline corridors where possible;
- Minimise number of crossings (roads/rivers/luggas, etc.);
- Cross other services close to 90°, not less than 60°;
- Maximise straight lengths of the route and minimise bends; and
- Avoid steep slopes and rocky areas and outcrops.

The shorter route (shown in Figure 5.10-4) was identified as having greater biodiversity value and would require some land clearance therefore was rejected on the following grounds, including:

- Large, as yet, uncharacterised luggas cross in the elevated sections of the route - rapid erosion is a risk and changes to the runoff regime could pose a risk;
- Uncharacterised human health risk associated to the potential for asbestiform minerals on this route;
- Vegetation communities would need to be characterised, in particular scattered amphibolite domes which offer unique biodiversity features, such as *Euphorbia turkanensis* and *Aloe turkanensis* and rocky hills, characterised by mixed Acacia species and scree slopes. These may offer unique habitat for many habitat specialist species, as yet undescribed;
- Consideration must be made for the potential presence of the striped hyena in this area;
- Five abandoned settlements were observed on the route, implying potential for temporary pastoralist use; and
- Archaeological material was found.

A desktop review of the proposed alternate route highlighted no significant technical challenges, compared to the Lokichar bypass route, however the longer route pipeline RoW follows alongside the A1 and around the C46 and was preferred on the basis that it would have less net impact.

At an early stage of the Project a two (parallel) water pipeline option was evaluated (one providing water for the Project and one for the community offtakes). This was disregarded during the design process owing to significant increase in cost and construction schedule that this would have over a single, larger line.

Figure 5.10-4 Water Pipeline Route Options – Turkwel to CFA (Green Route Chosen)

5.10.6 Technical and Process Alternatives

5.10.6.1 Wellpad Design

The Project is implementing a factory drilling operation on a cluster wells approach. The principal objectives of the "cluster" approach is to have multiple wells co-located on a single pad. This reduces the unit cost per well, increases the short-term production rate and maximise the cumulative recoverable oil volumes from the field. Well cost reductions are achieved through improved rig utilisation (i.e., a factory drilling operation). Applying a "*factory drilling*" operation employs specialised rigs designed to maximise drilling efficiencies and reduce drilling time and associated costs. These highly mobile units are optimised for rig moves and/or pad. Rigs are designed for zero-discharge and full containment.

All the other options considered have a greater environmental impact and increase land take, and potential for resettlement through an increase in footprint. Drilling efficiencies means shorter drilling times (and therefore noise impacts over shorted drilling periods).

Drilling will be a combination of WBM for the upper top-hole section and SBM for the lower sections. SBM was selected for the drilling of the lower sections to enable faster drilling and increased hole stability.

5.10.6.2 High CO_2 wells

A section of the Ngamia reservoir has been identified as having a higher than expected CO_2 content when compared to the rest of Ngamia. The gas associated with these wells has an average CO_2 content 50 mol% and a maximum CO_2 content of 95 mol%. The high CO_2 wellpads have been identified as NG-02, NG-04, NG-10, NG-20, NG-23 and NG-24.

For the utilisation of the gas, consideration was given to whether the high CO_2 gas could be blended and used in the GTGs to assist with power and heat generation. The materials selected within the CPF can only accommodate the equivalent of 0.15 mol.% CO_2 without corrosion inhibition. The introduction of corrosion inhibitor significantly increases cost to the overall operational expenditure and also adds to the chemical inventory held at the CFA which introduces the potential for chemical spills.

Disposal of the high concentration CO_2 associated gas streams can either be achieved via venting or flaring. Venting to the atmosphere is not considered GIIP[6] so provision has been made at the CPF to flare the high CO_2 gas via a separate Acid Gas Flaring System.

5.10.6.3 Wax Management Strategy

The oil produced from the South Lokichar Basin reservoirs has a high wax content, with a high wax appearance temperature. This creates problems in operation, as without careful management, wax will deposit on surfaces with the potential to impair or block flow through the gathering network and the CPF. Numerous strategies were reviewed, falling under two main categories, to assess how the wax deposition could be managed:

- Operational Management:
  - Regular operation pigging of flowlines to remove wax deposits; and
  - Intermittent flushing with hot water to remove wax.

Initial assessments ruled out operational pigging as the wax deposits may generate 'hard' wax that is impossible to remove with regular pigging. Moreover, operational pigging can be risky and may also result in blockages in the gathering system. Intermittent flushing with hot water was found to be inefficient, which meant that a large volume of water would be required over a prolonged period to remove the oil from the gathering system. In conclusion, pigging would not be feasible as the sole means of wax management, and continuous hot water flushing would be preferred over intermittent flushing. The system was designed to mitigate against wax deposition, by keeping the system warm, above the wax appearance temperature.

- Mitigation:
  - Electrically heat traced flowlines; and
  - Continuous hot water circulation.

[6] WBG EHS Guideline for Onshore O&G (draft 2017 art.19)

All mitigation options involve ensuring the system is kept warm. To limit the heat losses to the environment and reduce the energy input requirements to the system, all flowlines are to be insulated.

Continuous hot water circulation involves artificially increasing the water cut in the system at each wellpad by the addition of hot water from the water injection system. In addition to ensuring the system remains hot, the hot water addition to a minimum of 60% has the advantage of inverting the operating regime of the fluids (post inversion). Post inversion operation reduces the pressure drop in the flowlines, thus reducing the energy consumed by each artificial pump and helping the oil-water separation required at the CPF. Hot water can be added at the wellpads, either through the use of artificial lift jet pumps, or through a surface connection. The water addition concept does not require any additional equipment or equipment capacity at the CPF as is able to make use of ullage in systems.

Electrically heat tracing the flowlines is technically feasible and a proven technique but was not taken further due to the additional cost, when compared with the continuous hot water circulation option.

Continuous hot water circulation was chosen as the wax management method as the benefits of post inversion operation extend beyond just wax management, and increase the operational flexibility of the facilities, covering start-up and turndown operations. Hot water injection is required for reservoir injection to avoid wax blockages in the reservoir pores, hence hot water circulation is able to make use of existing equipment already installed. In addition, it allows the use of artificial lift jet pumps, which defers the Capital Expenditure (CAPEX) commitment required for installing ESP/PCPs until after FO.

At the CPF to prevent wax deposition a combination of insulation and heat tracing will be used for equipment, piping, instrumentation, and tanks. Water circulation would not be feasible, due to the requirement to separate the oil and water.

5.10.6.4 Power Generation

Produced (associated) gas from the reservoir will be used to generate power and heat to support the needs of the CPF, CFA, wellpads, landfill and booster pumps at the make-up water pontoon at Turkwel Dam. The use of GTGs were found to provide the most cost-efficient solution to power generation with GTGs being more efficient at converting fuel burnt into MW power than steam turbines and for generating less emissions for the power they deliver. In addition, the power to heat ratio required by the facility is better suited to GTG rather than steam turbines.

A 100% grid power option was not considered practical from a security of supply perspective and the Project also aimed to maximise its utilisation of produced gas to deliver heat and power for use on its facilities.

5.10.6.5 Process Heat Recovery

Throughout the facility there is a requirement to add heat to stabilise the crude and to prevent wax formation. The options available for heat generation have been reviewed, with a combination of WHRUs and fired heaters selected. Waste heat recovery is the practice of capturing hot flue gases exiting the gas turbines and utilising its energy for other industrial processes including the generation of heat. Essentially, this process reuses heat energy that would otherwise be expelled and wasted.

The Project has adopted WHRUs as an integral part of meeting its heat demand needs and each of the two GTGs has a WHRU attached to recover waste heat. Where there is a deficit or back-up heat requirement to cover interruptions in the GTG operations, this will be made up by utilising Fired Heaters (2 x 20 MW) with power supplied from the grid connection.

In addition to the WHRU, two cross exchangers are provided on the oil rundown line from the stabiliser to recover heat into the make-up water and produced water streams, to reduce the required injection water heat duty. This option was selected to optimise heat recovery, which is particularly important when the facility becomes fuel gas deficient.

5.10.6.6 Excess Gas Management

Several studies were conducted during the FEED concerning the options available for gas management. Initially the intent was to reinject gas, but no suitable formation was located. Liquified petroleum Gas (LPG) production was investigated but due to the quantity produced for a short duration, was similarly not preferred. Power export was then evaluated, but uncertainty remained over demand, revenue and timing of infrastructure to support this solution. This is further discussed in section 5.3.6.3

5.10.6.7 Flare Selection

The purpose of the main plant flare is to collect all pressure relief loads and emergency disposal of liquid and gaseous hydrocarbons from the CPF with the exception of connections from the Ngamia High CO_2 Separator. A separate flare system has been provided for high CO_2 releases via the acid gas flare, which takes the off gas and any relief from the Ngamia High CO_2 Separator. The acid gas flare is designed from material suitable to handle the corrosive nature of the gas, with the dual flare solution avoiding the material upgrade that would be required for the larger main plant flare and pipework system. Both flare systems combine in a single ground flare.

The current design selected for the flare is a ground flare. Originally, the flare was designed as an elevated flare. Elevated flares are the simplest and most widely used relief system, offering safe and efficient combustion of waste gases with varying degrees of smokeless burning. Using steam injection and effective tip design, heavy hydrocarbons can be burnt smokeless. Ground flares are more suitable for "*clean*" gases (i.e. where toxic or malodorous concentrations are unlikely to be released through incomplete combustion or as combustion products).

The change from elevated flare to ground flare occurred as a result of noise mitigation modelling, as a ground flare offers lower noise characteristics (and with the use of acoustic abatement barriers) is believed to reduce the noise footprint at the north fence, which currently extends beyond the CFA boundary. Additionally, a ground flare reduces the visual effect of a flame.

5.10.6.8 Produced Water Management

Water is reinjected into wells to maintain reservoir pressure over time and ensure oil recovery rates are maximised. All of the water that is produced with the well fluids will be treated, heated and re-injected to assist well fluids to flow. This means the design has adopted a minimum produced water discharge regime at surface or to land. Feasible alternatives for the management and disposal of produced water were evaluated in line with IFC guidelines for onshore developments and the main disposal alternatives may include:

- Injection into the reservoir to enhance oil recovery;
- Injection into a dedicated disposal well drilled to a suitable receiving subsurface geological formation;
- Irrigation, dust control, or use by other industry, may be appropriate to consider if the chemical nature of the produced water is compatible with these options; and
- Produced water discharges to surface waters or to land, which should be the last option considered and only if there is no other option available.

The option for treating, heating and injection of produced water into the reservoir is considered the best practicable environmental option enabling the production of oil from the reservoir under ongoing waterflood conditions and in turn reducing the amount of water required from an external water source over the life of the Project.

5.10.6.9 Waste Management

Given the volume of waste generated during construction and from the experience during E&A it was recognised that a bespoke waste management solution would need to be developed for the Project and waste could not be moved significant distances from the point of generation to existing facilities outside Turkana.

A range of potential locations for new waste management facilities outside the South Lokichar Basin were considered along with the potential to co-share these with other users. On further review it became clear that the greatest volume of waste being generated was anticipated during construction of the CFA and associated infrastructure, and hence the proximity to this location was a key driver to minimise Operational Expenditure (OPEX) of the facilities.

Further consideration as to the possibility of using the Project as an “anchor client” for building a waste management business in Turkana was evaluated but given the lack of other industrial clients in the area and the low volumes of arisings from Lokichar Town, it was decided the facilities would be located near the CFA and for the Project use only.

6.0 ESIA BASELINE

6.1 Introduction

Establishing and reviewing the existing environmental and socioeconomic conditions and legislative requirements pertaining to the Project AoI and its surrounds and highlighting receptors and resources sensitive to potential impacts is an essential component of the ESIA process. Potential environmental and social changes caused by the realisation of the Project will be evaluated during the ESIA and the changes will be compared to the established baseline conditions. In addition, establishment of an accurate set of baseline conditions allows for any future changes to be monitored and managed.

Baseline studies, conducted by the Golder Associates (Golder) Team, commenced in October 2015 and concluded for the purposes of this ESIA in June 2019.

The Environmental and Social baseline is characterised by the following technical areas:

- Geology, Geohazards and Seismicity;
- Soils;
- Weather and Climate;
- Air Quality;
- Noise and Vibration;
- Water Quality;
- Water Quantity;
- Biodiversity;
- Ecosystem Services;
- Landscape and Visual;
- Social; and
- Cultural Heritage.

The AoI[1] for the Project is presented in Section 3. This is defined based on the administrative boundaries (location and/or sub-locations) around the area in which the Project could have a direct influence and therefore within which baseline data has been gathered to inform the impact analyses.

6.2 Geology, Geohazards and Seismicity

For the purposes of this baseline report on geology, geohazards and seismicity, regional information on Kenya and more specific data relating to Turkana and West Pokot are presented. The soil baseline conditions are discussed in Section 6.3.

The AoI for the geology and geohazard assessment comprises the areas of potential direct and indirect change during operations and construction of the Project. This mainly comprises an area that encompasses the principal development locations and their immediate surroundings and is shown on Figure 6.2-3. Geohazards located outside this AoI still have the potential to influence the Project and therefore some baseline information

[1] referred to on occasion in this document as the Potential AoI, although this is the same as the AoI.

for geohazards (and the geology associated with those geohazards) has been collated for a wider regional setting.

6.2.1 Secondary Baseline Data

The following summary of the geological setting of the region is based on secondary information only. These secondary information sources include the following:

- Geology of the Loperot Area (Ministry of Natural Resources Geological Survey of Kenya Report No. 74, 1966);
- Conceptual Hydrology of the Lake Turkana Basin (Mike Price, June 2016);
- South Lockichar Geological Summary (TKBV, January 2016);
- LLCOP – FEED Phase 1 Geohazard Desktop Study (Wood Group, 2018);
- 1:10,000,000-scale geological map of Kenya (Commission for the Geological Map of the World (CGMW), 2016);
- 1:2,00,000-scale mapping of the geology of Kenya (Mines and Geology Department of Kenya, 2004); and
- Water Pipeline Scoping Site Visit field report (Golder, 2018a).

Unless specifically referenced, the information presented in this baseline has been collated from a combination of these sources.

6.2.2 Regional Geological and Tectonic Setting

The East African Rift System (EARS) is a zone of crustal extension where the Eastern African continent being pulled apart and split into the Nubian and Somalia Plates as it separates from the Arabian plate. It extends over 3,000 km from Mozambique to the Afar depression. The crustal extension causes an elongated system of normal faults; the surface expression of which is a series of basins (rift valleys) that are separated from each other by uplifted sections that form escarpments.

As it extends southwards, the EARS splits into eastern (active) and western (passive) branches. The Kenya Rift is part of the active eastern branch of the EARS. The rifting at the Kenya Rift started from Turkana and extended southwards towards Magadi to Mozambique. In the area of Lake Turkana, the Kenya Rift is also referred to as the Turkana Rift. The Lokichar Basin has formed within the EARS. The main active rift in the area is the Suguta Valley. A dramatic increase in topographic elevation around the boundary between the Turkana and Samburu counties marks the eastern edge of the EARS.

The 1:10,000,000-scale geological map of Kenya with an overlay of the potential AoI is presented in Figure 6.2-1 (background mapping from CGMW, 2016). Larger scale (1:2,00,000) mapping of the geology of Kenya is presented in Figure 6.2-2 (Mines and Geology Department of Kenya, 2004). This scale of mapping highlights the complexity of the geology.

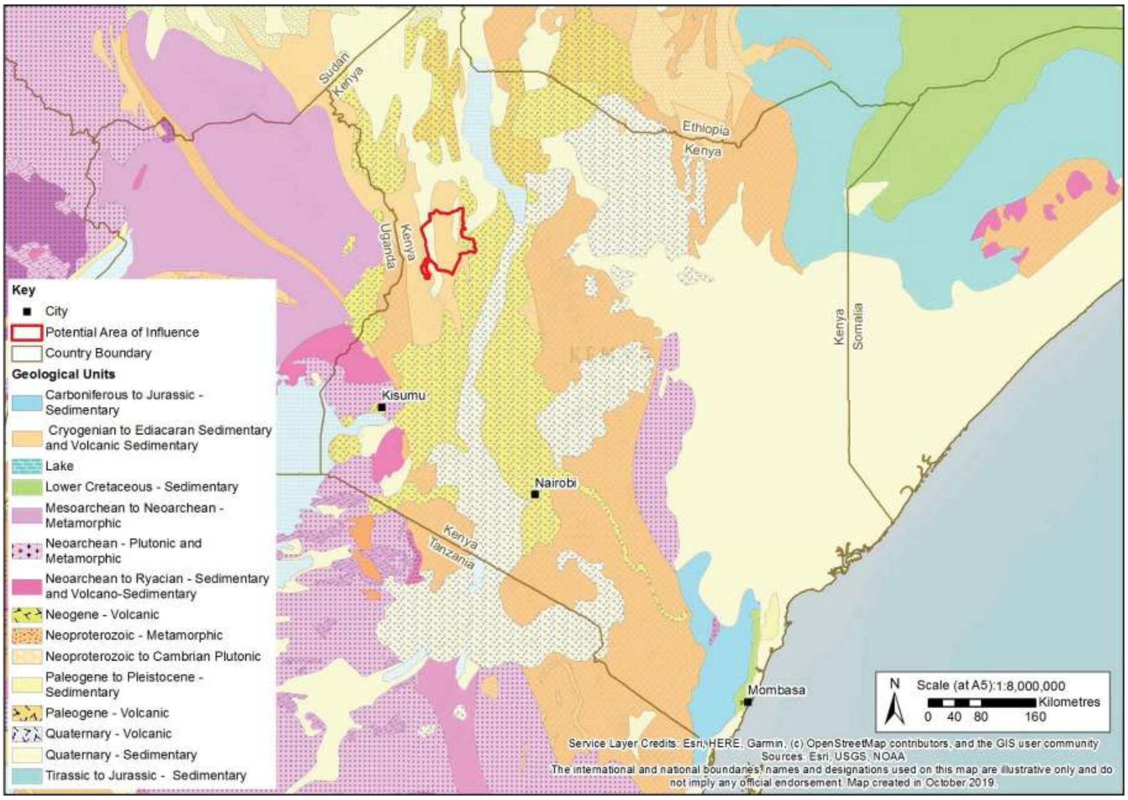


Figure 6.2-1: General Geology of Kenya (1:10,000,000 Scale)

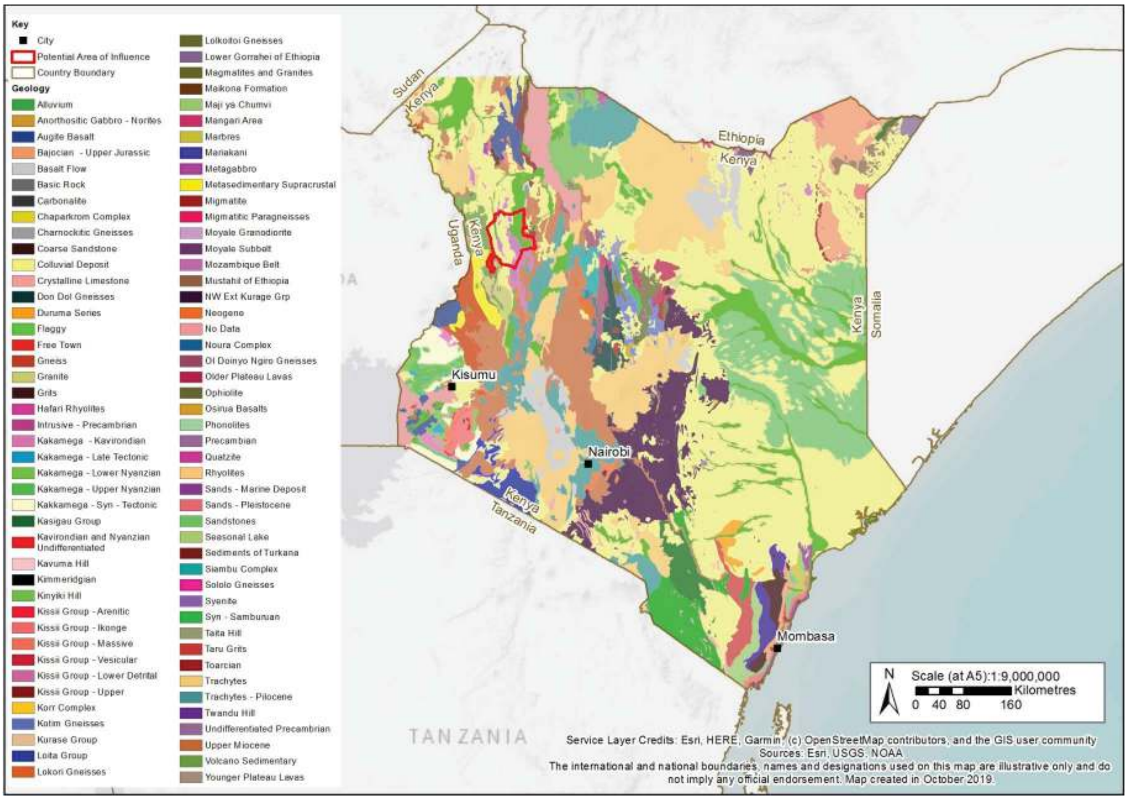


Figure 6.2-2: 1:2,000,000 Scale Geology of Kenya

The mapped rock formations in Kenya can be grouped into five major geological successions (Wood Group, 2018):

- The Archean (Nyanzian and Kavirondian);
- The Proterozoic (Mozambique Belt and Bukoban);
- Palaeozoic/Mesozoic sediments;
- Tertiary/Quaternary volcanics; and
- Tertiary/Quaternary sediments.

The mapped surface geology comprises a mixture of the older Archean and Proterozoic basement rocks, and the Tertiary and Quaternary sediments and volcanic rocks that are typically mapped in the northwest of Kenya.

The basement rocks are of Precambrian age and comprise gneisses, schists and granulites that were predominantly sedimentary grits, sandstones, limestones and shales before being subject to periods of intense heat and pressure around the beginning of the Cambrian Period that lead to their metamorphosis. In some areas there are considerable developments of migmatites (a rock that has a banded appearance and comprises a mixture of granitic material and high-grade metamorphic material), which have arisen by the injection of granitic magma into the gneisses and schists, or by their permeation by granitic fluids. Several granites of northern and north-western Kenya are the products of granitisation of meta-sediments. Pegmatites of various types are frequently associated with the Basement System rocks, particularly where metasomatic action has been prominent. The metamorphic and granitic rocks are intensely folded giving them a banded appearance.

From the early Cambrian until the Jurassic or Cretaceous periods the area formed part of the Pangaea 'supercontinent', which then broke apart during the Middle Jurassic and led to the development of a series of rifts running roughly east to west across Africa with the Anza Graben running north-west to south-east across what is now northern Kenya. During that time, the areas was above sea level and the land was subject to erosion and continental deposition. During the Eocene epoch (part of the Tertiary period), further rifting occurred in a roughly north to south direction and cut across the earlier rifting.

Later in the Tertiary period (late Oligocene to early Miocene epochs) a series of half grabens began to develop west and south-west of the current position of Lake Turkana. The rifting was preceded and accompanied by volcanism. Towards the middle Miocene a new series of inner half-grabens began to develop, which include the North Lokichar, Turkana and Kerio Basins.

The basins that resulted from the development of the grabens now contain Tertiary and Quaternary material that comprises volcanic rocks (predominantly alkaline lavas and tuffs) and a series of sedimentary deposits that were deposited by rivers or in ephemeral lakes. Unconsolidated alluvial material is also present in the valleys.

6.2.3 Geology of the AoI

An extract of the geology of Turkana County taken from the 1:2,000,000 scale geology of Kenya (Mines and Geology Department of Kenya, 2004) is shown in Figure 6.2-3. The geology in the AoI largely comprises Tertiary and Quaternary sediments and volcanic rocks.

The AoI is located within a basin that has been formed by rifting of basement rocks and is now partially infilled with superficial (drift) deposits. The South Lokichar Basin is a north-north-west to south-south-east trending asymmetric half graben within the Turkana Rift, which is at its maximum, approximately 70 km long and 30 km wide.

To the west of the valley the Precambrian basement rocks are exposed at the surface and comprise intensely folded gneisses and migmatites. To the east of the rift the Precambrian basement rocks are overlain unconformably by the Tertiary Turkana Grits, Tertiary sedimentary deposits and a Tertiary volcanic succession. The Turkana Grits are mapped as comprising grits, sandstones, silts and sandy limestones and are derived from the erosion of the Precambrian basement rocks. The Turkana Grits are highly fractured and jointed. The Tertiary sedimentary deposits were deposited by rivers or in ephemeral lakes and comprise sandstones (including the Lower and Upper Auwerwer Sandstones) separated by shales. The volcanic sequence includes basalts of various composition and phonolites, which are fine- grained extrusive rocks.

The superficial geology that underlies the South Lokichar Basin, and that dominates the area between the Kalabata River to the east and the ridge of Archaean basement to the west, is mapped as Alluvium. The alluvial material comprises Plio-Holocene unconsolidated alluvial fan material that have in places been redistributed by ephemeral stream, and fluvial sediments. There are localised outcrops within the Alluvium of Archaean basement rock and Tertiary volcanics.

The area between Lokichar and the Turkwel Dam, where the proposed water pipeline will be located passes through areas where the mapped geology comprises outcrops of basement rocks between areas of Quaternary Colluvium. As it nears the location for the proposed upstream infrastructure, the area is mapped as Alluvium. The geology underlying the Colluvium and Alluvium is likely to comprise Archaean basement rock or Tertiary volcanics. The mapped geology correlates well with the observations made during the water pipeline scoping fieldwork (Golder, 2018a) in which the following observations on the surface geology were recorded:

- Between the Turkwel Dam and the Turkwel Reservoir tailrace the surface geology is dominated by gneissic rocks that form the hills on the west side of the fault that bounds the Turkwel valley;
- In the area between the Turkwel Reservoir outfall and the Malmalte River the geology comprises Quaternary red brown lateritic soils overlying gneiss;
- At the Malmalte River, the shallow geology dominated by Quaternary Alluvium comprising fine sands and silts. There are occasional outcrops of gneiss; and
- The A1 south of Lokichar traverses Quaternary Alluvium, followed by a section across shallow bedrock and outcrops of gneiss and amphibolite.

The most significant faults in the area are those related to the Kenya Rift, including the Lokichar Fault and faults bounding the Suguta Valley, which is located near the boundary between Turkana County and Samburu County (Wood Group, 2018). From the Wood Group (2018) work, the Lokichar Fault was determined to be inactive. The closest active rift is the Sugata Valley. The work as part of the Geohazard Desk Study (Wood Group, 2018) observed and mapped up to 20 active and potentially active faults, mainly in the Turkana province and at the borders of the Suguta (Rift) valley. The major faults shown on small scale mapping are present (see Figure 6.2-3).

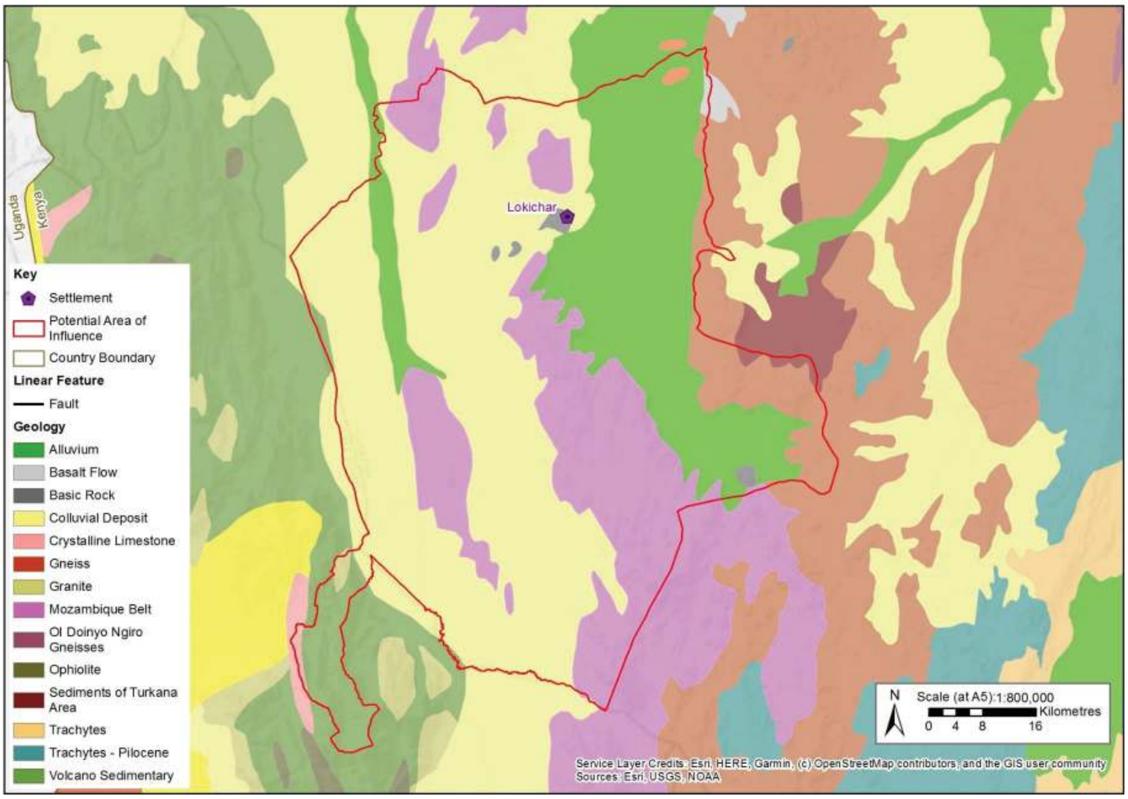


Figure 6.2-3: Geology in Turkana County, Including AoI

6.2.4 Seismicity and Volcanicity

Turkana, and Kenya as a whole, is vulnerable to seismic activity and volcanicity associated with the presence of the EARS, which runs north to south through Kenya. The overall earthquake hazard level in Kenya is considered low compared to neighbouring countries. The highest hazard levels within Kenya are in the north-west and south-west of Kenya (GSDRC, 2013).

In Turkana and West Pokot, the natural earthquake hazard is rated by WHO (2010) as low to medium with Peak Ground Acceleration (PGA) in the region of 0.2 metre per second squared (m/s^2) - 2.4 m/s^2 (see Figure 6.2-4). A map showing the intensity of earthquakes (United Nations Office for the Coordination of Humanitarian Affairs, [OCHA] 2007) is shown in Figure 6.2-5. The map indicates the intensity of earthquakes in the region of South Lokichar is degree VI (strong) on a scale of I (instrumental) to XII (catastrophic).

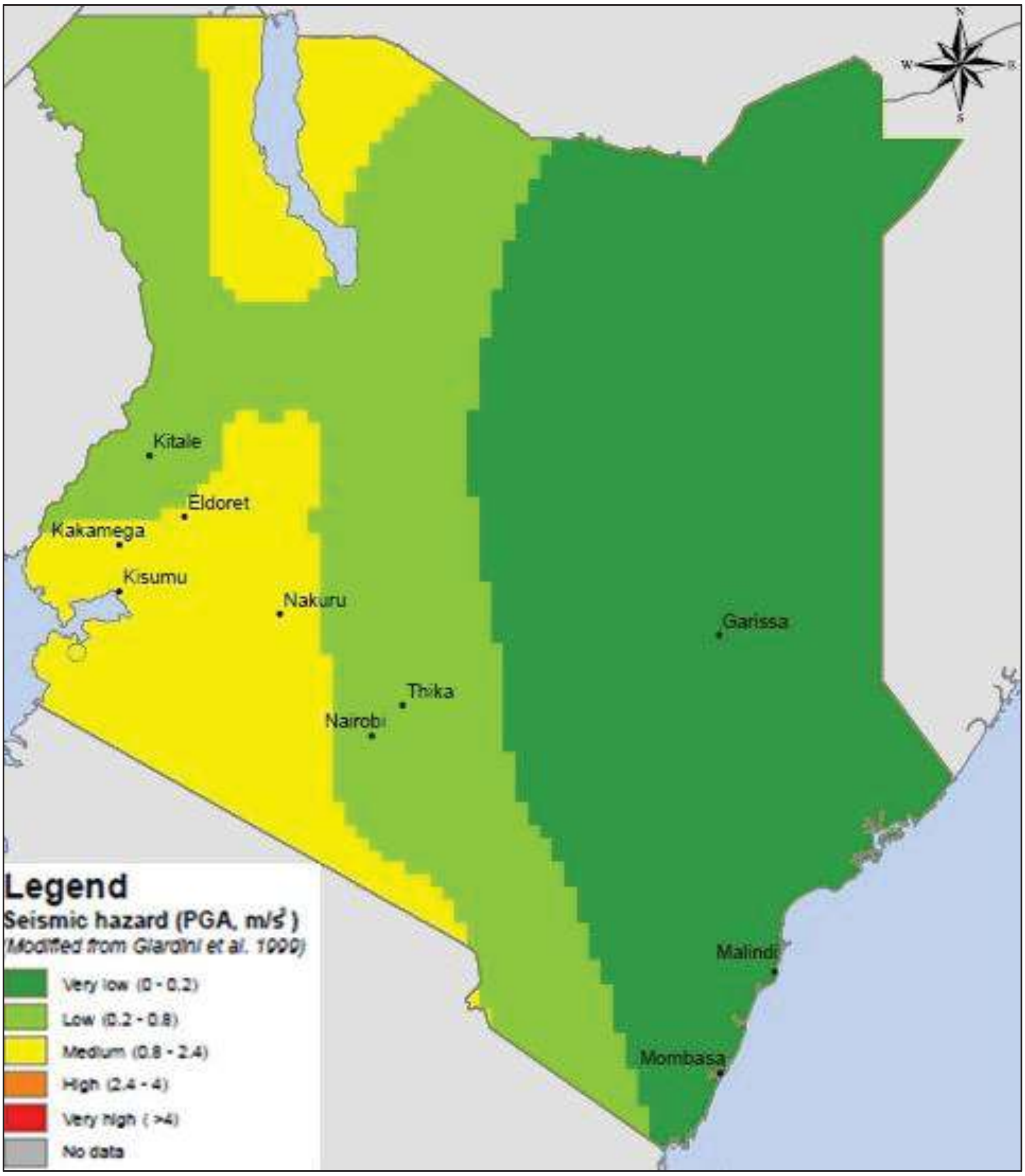


Figure 6.2-4: Seismic Hazard Rating Zones for Kenya

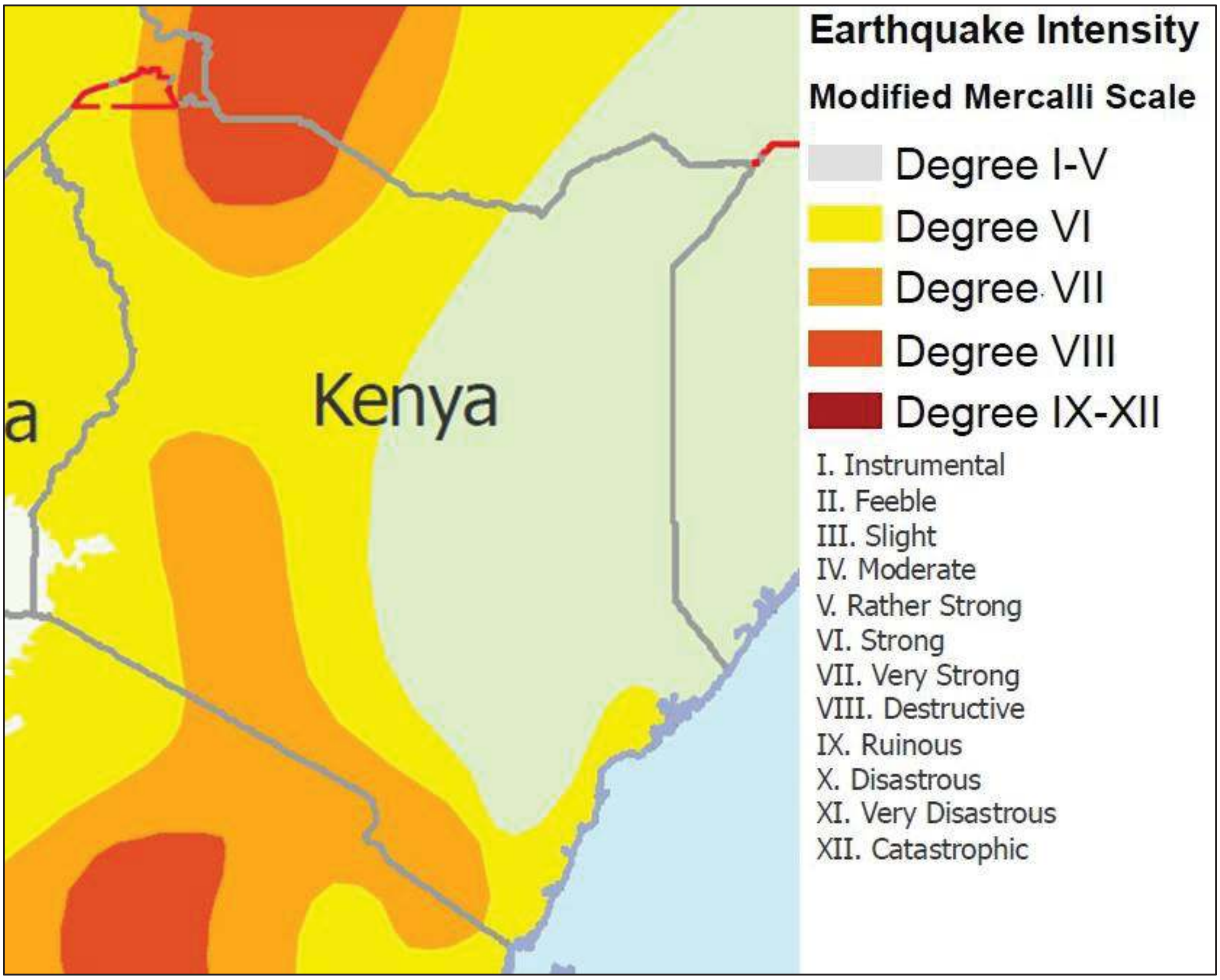


Figure 6.2-5: Earthquake Intensity Mapping for Kenya

A map showing earthquakes in Kenya recorded in the past 100 years (United States Geological Service [USGS], 2019) is shown in Figure 6.2-6. The closest earthquakes to South Lokichar and West Pokot range from a magnitude 3.9 in October 1998 to two magnitude 5.2 earthquakes in January 2012. Earthquakes are relatively infrequent, but high magnitude events do occur and an event of magnitude 7 was recorded with an epicentre approximately 300 km south of South Lokichar.

Active volcanoes are mapped along the eastern side of the EARS (see Figure 6.2-7) (Global Volcanism Program, 2013). The Geohazard Desk Study (Wood Group, 2018) identified no active volcanicity in South Lokichar. The closest volcanoes are Emuruangogolak (located in the Sugata Basin), Namaruna (located to the east of the AoI), and "*The Barrier*" (located on the southern shore of Lake Turkana). Emuruangogolak last erupted in 1910 and The Barrier last erupted in 1921. Both are shield volcanoes associated with the rift zone and had effusive basaltic, non-explosive eruptions. Namaruna is also a shield volcano and the last eruption was dated to 6,550 BC (+/- 1000 years).

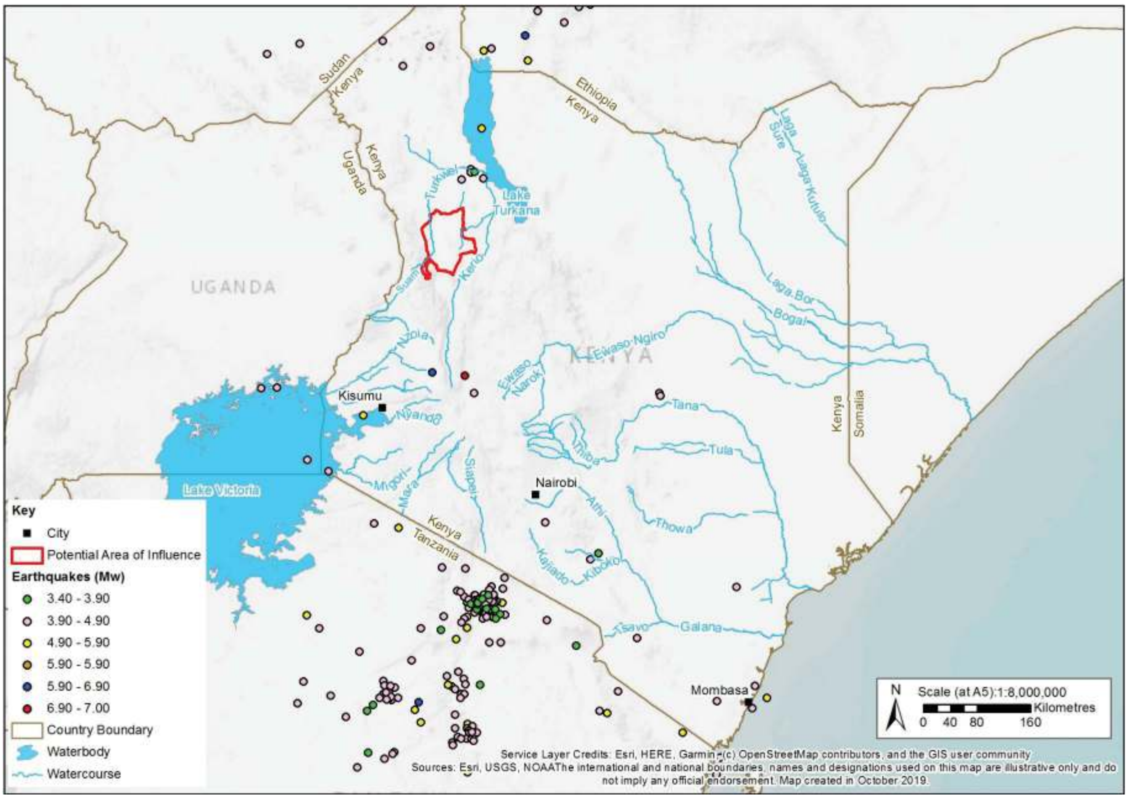


Figure 6.2-6: Earthquake Locations and Magnitude 1919-2019

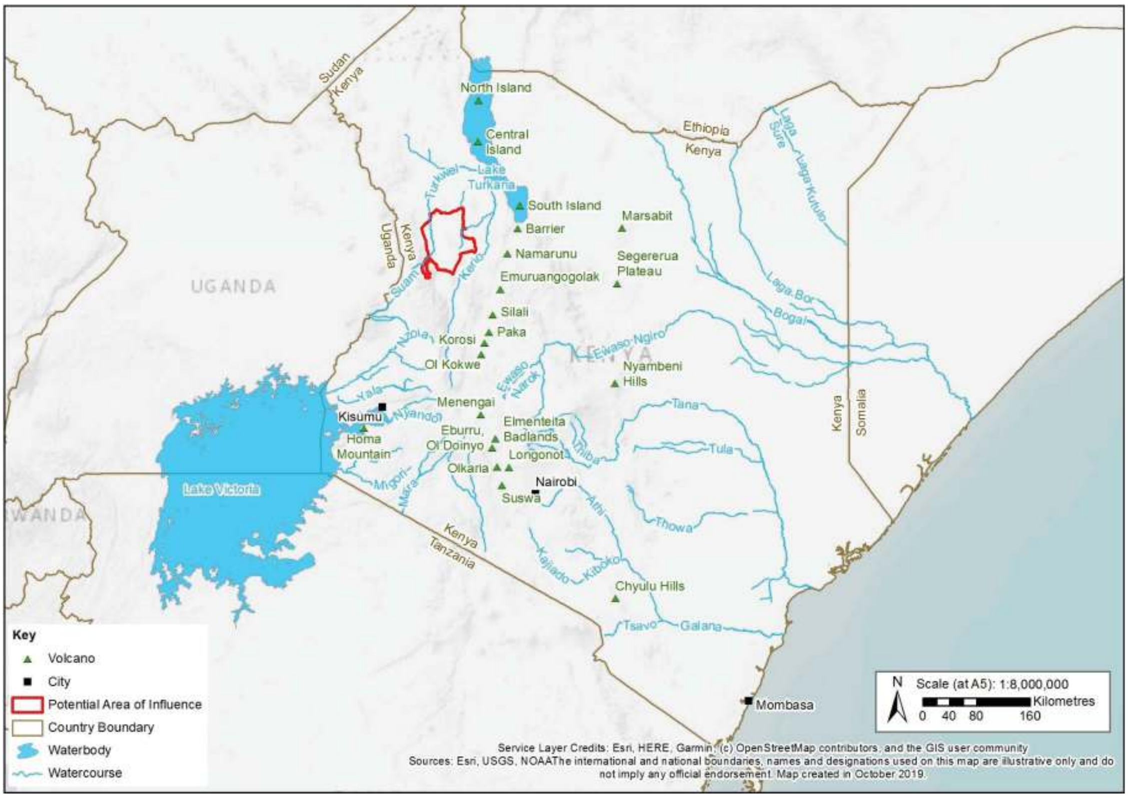


Figure 6.2-7: Active Volcanoes

The Geohazard Desk Study (Wood Group, 2018) covered the northern section of the proposed oil pipeline, which is also of relevance to the South Lokichar Basin area. It is stated in that report that no pyroclastic fall deposits have been observed.

6.2.5 Geohazards

Based on secondary research, the following summarises the key geohazards in the AoI:

- Landslides and slope instability can be caused by steep sloping topography (Wood Group, 2018);
- The majority of the landslides in Kenya are reportedly triggered by water and/or human activities, with slope saturation by water being the primary cause (Wood Group, 2018);
- There is no indication of significant active landslides in the AoI;
- Soils are locally saline, contain few rocks or stones, and are moderately susceptible to sheet and rill and gulley erosion from flood events and locally moderately susceptible to wind erosion; and
- The primary geohazards in the area are related to the coarse-textured soils. In low-lying areas that are prone to annual or periodic flood events, road washouts or undercutting of the Project infrastructure is possible.

6.3 Soils

This section presents the available baseline information on soil characteristics within the AoI.

6.3.1 Secondary Data Gathering

Publicly available digital soil survey inventory data was used to identify soils within the AoI. The soils baseline was developed to generate a baseline soil map, which delineates soil types and assemblages based on pedogenic and morphological similarities that relate to soil characteristics. Soil data from the following sources were used to develop the soil maps:

- KENSOTER Soils GIS dataset (Kenya Soil Survey, 1996);
- Kenyan Soils (Infonet Biodivision, 2019); and
- Soil physical and chemical properties of Kenyan soils GIS dataset (Kenya Soil Survey, 1997).

Soils in the AoI are presented on Figure 6.3-1 and Figure 6.3-2. The main soil types include Eutric and Calcaric Regosols. In the river valley on the south-eastern portion towards the Turkwel Reservoir, the AoI transects a local area of Eutric Fluvisols and Haplic Lixosols. Table 6.3-1 provides a generalised description of these soil types.

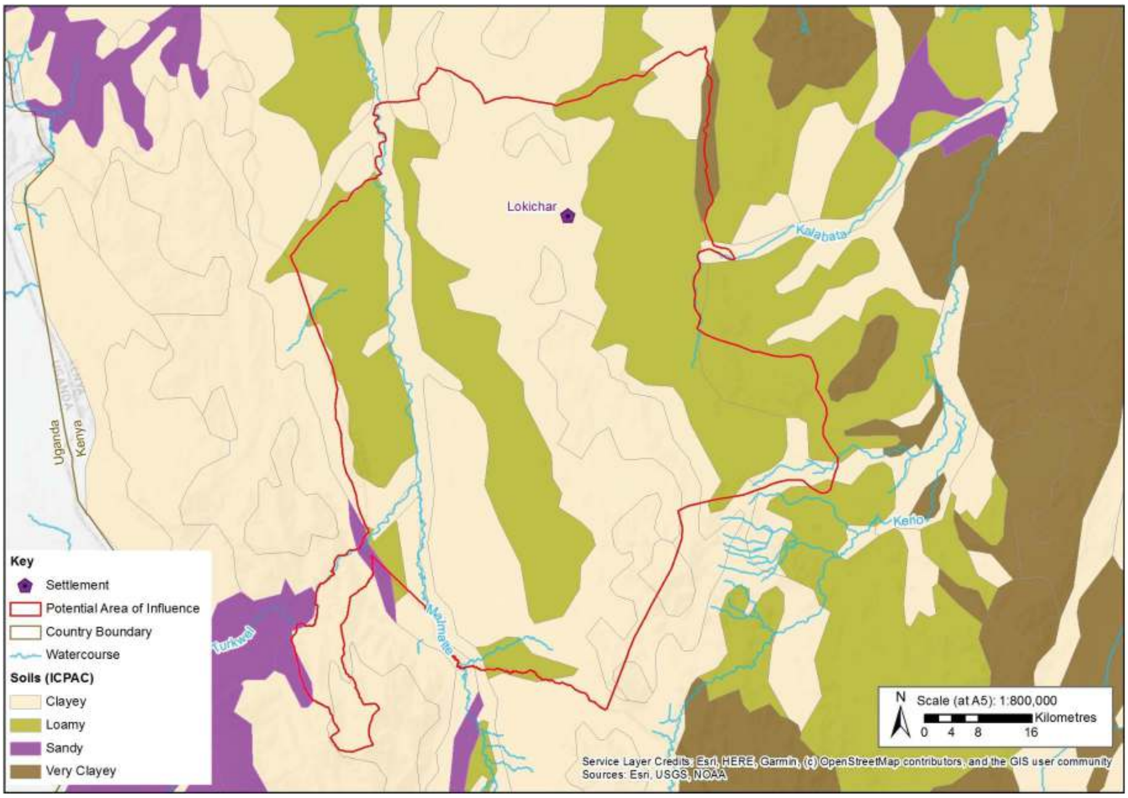


Figure 6.3-1: Soil Taxonomic Classes (ICPAC) in the AoI

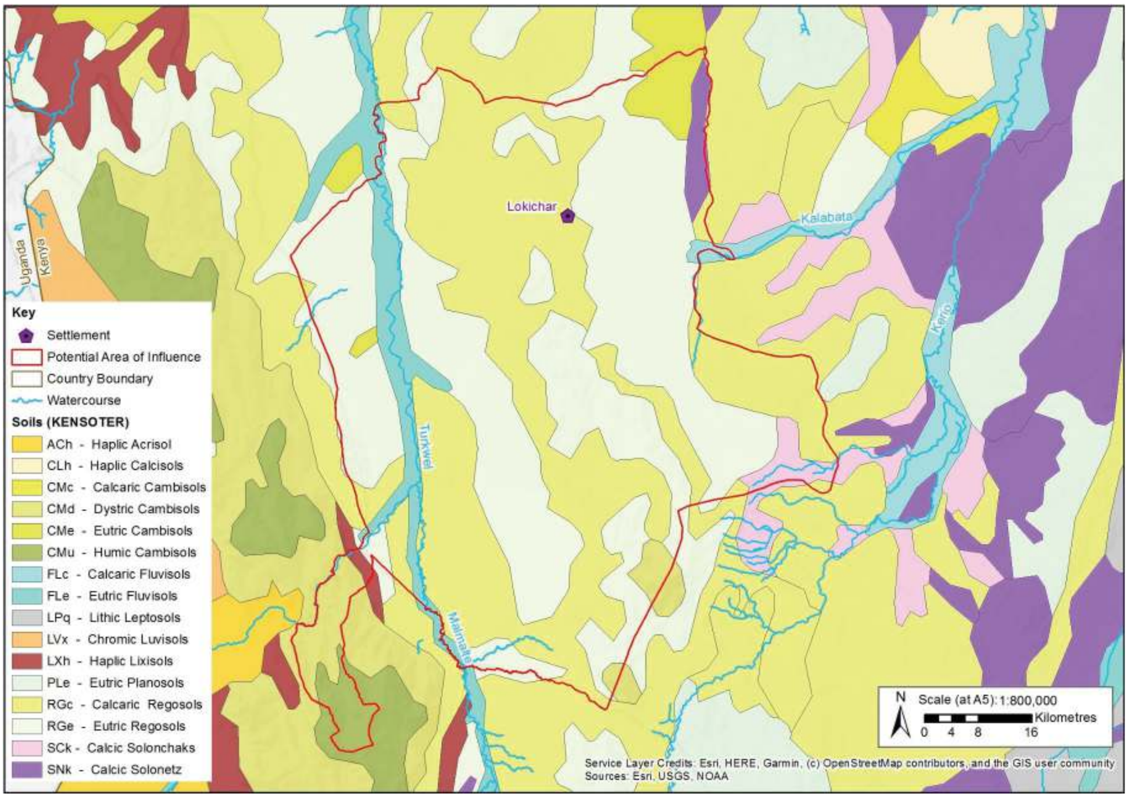


Figure 6.3-2: Soil Taxonomic Classes (KENSOTER) in the AoI

Table 6.3-1: Soil Types Encountered within the AoI

Reference Soil Group		Parent Material	Principal Soil Qualifiers		Agricultural Limitation	
Name	Description		Name	Description	Rating	Reason
Cambisols	Soils (often young) with at least the beginnings of horizon differentiation in the subsoil, evident from changes in structure, colour, clay content or carbonate content.	Medium and fine-textured materials derived from a wide range of rocks.	Calcaric	Containing calcaric material between 20 and 100 cm of soil surface	Moderate	Low organic matter, low water holding capacity
			Dystric	Effective base saturation < 50%	Low	Low organic matter
			Eutric	Effective base saturation ≥ 50%	Low	Low organic matter
			Humic	Containing >1% organic carbon in the top 50 cm of soil	Low	Rich in organic matter
Fluvisols	Poorly developed young soils developed from fluviatile, marine and lacustrine sediments	Fluvial, lacustrine, marine	Eutric	Effective base saturation ≥ 50%	Low	Potential for flooding
Regosols	Soils with no soil development	Range of unconsolidated materials	Calcaric	Containing calcaric material between 20 and 100 cm of soil surface	Moderate	Low organic matter, low water holding capacity
			Eutric	Effective base saturation ≥ 50%	Moderate	Low organic matter, low water holding capacity
Lixisols	Clay enriched subsoil from migration from upper horizons, low activity clay, high base status	Range of materials, including unconsolidated chemically weathered soils, fine textured	Haplic	Undifferentiated horizon, only has the features of the reference soil group,	Low to moderate	Degraded topsoil

The regional landscape is predominantly flat and low lying, but with isolated steep-sided hills and ridges associated with rift valley geomorphology. The soils are typical of desert-like environments, which are generally nutrient-poor, high pH, low in organic matter and clay content, and prone to rapid erosion by wind and water (RSK, 2014), as a result of the arid climate and general lack of vegetation.

The South Lokichar Basin is located in an area bound by mountains on one side and plains on the other. The soils are moderately well drained, moderately saline and strongly sodic (disproportionately high concentration of sodium). The surface consists of sealed and crusted sandy clay loam to sandy clay textured soils with low soil organic matter content, overlain by surface pebbles.

Information on the local landforms and soils in the Turkana region has also been studied by the German Agency for Technical Cooperation (GTZ) in collaboration with Kenya Ministry of Livestock Development in 2002. The AoI is shown to be situated in an area of predominantly very deep, well drained soils of a yellow-brown colour. These were described to be locally saline and containing few rocks or stones and susceptible to moderate sheet erosion from flood events and locally moderate wind erosion.

Soil data was gathered by Worley Parsons in 2014 as part of an infrastructure siting exercise, which shows that soil local to the AoI is derived from tertiary volcanic and sedimentary materials, alluvial deposits and windblown sands. Soils are generally clay loam to loamy sand textured and include neutral, calcareous, saline and sodic soil reaction.

The Worley Parsons investigation included drilling and test pitting (Drawing 6.3-1), with soil samples taken and sent for laboratory analysis. Particle size analysis and chemical analysis were conducted on samples that were taken mostly within the upper 0 to 3 metres below ground level (mbgl) (some only in upper 0 to 1.5 m), which are indicative of the soil horizons. Table 6.3-2 below presents the results from a sub-set of the full analysis completed relevant to the AoI.

Table 6.3-2: Secondary Soil Data Analysis

Location	UTM Northing	UTM Easting	Pit Id	Depth (m)	Description	Particle Size Distribution (%)				Chemical Analysis	
						Clay	Silt	Sand	Gravel		
Amosing area	810800	237990	AMO_3	0 to 1.5	Light brown silty gravelly fine to medium grained Sand. Alluvium	11	11	67	22	No sample	
	809606	238199	AWE5	0 to 3	Brown gravelly silty fine grain Sand. Alluvium	16	16	17	11	No sample	
	809606	236999	AWE7	0 to 3	Reddish brown gravelly medium to coarse grained Sand. Alluvium	12.6	5.2	80.5	1.7	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.27 0.07 0.20 440 <50 <50 <50 7.9
	810806	235799	AWE10	0 to 3	Brown gravelly silty fine to medium grained Sand. Alluvium	21	21	77	2	No sample	
	810806	241199	AUL2	0 to 3	Brown slightly gravelly silty fine-grained Sand. Alluvium.	17.4	11.3	69.4	1.9	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.35 0.10 0.24 800 <50 60 100 8.3

Location	UTM Northing	UTM Easting	Pit Id	Depth (m)	Description	Particle Size Distribution (%)				Chemical Analysis	
						Clay	Silt	Sand	Gravel		
	810206	239999	AUL4	0 to 3	Reddish brown gravelly silty fine to medium grained Sand. Alluvium.	14.9	4.3	54.5	26.3	No sample	
	812606	239399	AUL7	0 to 3	Brown slightly gravelly silty fine-grained Sand. Alluvium.	8.4	7.7	80.9	2.9	No sample	
	811406	238799	AUL8	0 to 3	Brown gravelly silty fine to medium grained Sand. Alluvium.	15	15	77	8	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.18 0.12 0.06 360 <50 <50 <50 7.9
	813206	237599	AUL13	0 to 3	Brown silty gravelly medium grained Sand. Alluvium.	18	18	80	2	No sample	
	812006	236999	AUL15	0 to 3	Brown silty gravelly fine to medium grained Sand. Alluvium.	13	13	83	4	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.15 0.09 0.06 400 <50 120 70 7.8

Location	UTM Northing	UTM Easting	Pit Id	Depth (m)	Description	Particle Size Distribution (%)				Chemical Analysis	
						Clay	Silt	Sand	Gravel		
	813806	236399	AUL20	0 to 3	Brown slightly gravelly silty fine to medium grained Sand. Alluvium.	18	18	79	3	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.16 0.07 0.10 1,320 <50 130 570 8.5
	813806	234599	AUL22	0 to 3	Brown gravelly silty fine-grained Sand. Alluvium.	24	24	73	3	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.15 0.10 0.06 440 <50 <50 50 8.0
	815006	233999	AUL24	0 to 3	Brown slightly silty gravelly medium to coarse grained Sand. Alluvium.	10	10	85	5	No sample	

Location	UTM Northing	UTM Easting	Pit Id	Depth (m)	Description	Particle Size Distribution (%)				Chemical Analysis	
						Clay	Silt	Sand	Gravel		
Ngamia area	802279	244464	NGA_2	0 to 1.5	Light brown silty gravelly Sand. Alluvium.	17	17	78	5	No sample	
	803667	245900	NGA_6	0 to 1.5	Brown silty gravelly fine to medium grained Sand. Alluvium.	14	14	82	4	No sample	
	801897	244059	NGA_1	0 to 3	Light brown silty gravelly fine to medium grained Sand. Alluvium.	15.1	6.6	72.0	6.2	Total Carbon (%): Organic Carbon (%): Inorganic Carbon (%): Total Alkalinity (mg/kg): Carbonate (mg/kg): Chloride (mg/kg): Sulphate (mg/kg): pH:	0.24 0.11 0.14 560 <50 340 260 8.0
	805586	247501	NGA_11	0.7 to 3	Purplish dark brown mottled light brown slightly cemented gravelly silty fine to medium grained Sand. Alluvium.	22.3	9.8	67.3	0.6	No sample	
	806987	245519	NGA_15	0 to 3	Light brown silty gravelly fine to medium grained Sand. Alluvium.	7	7	90	3	No sample	
	806157	243981	NGA_16	0 to 3	Light brown silty gravelly fine to medium grained Sand. Alluvium.	18	18	82	0	No sample	

Source: Worley Parsons (2014)

The results presented in Table 6.3-2 can be summarised as follows:

- The particle size distribution (PSD) results were conducted for Amosing and Ngamia test pits. Results show that the superficial samples are predominantly light brown sands. Sand is the dominant particle size at all test pits across both Amosing and Ngamia wellpads and access roads. This coincides with the naturally sandy characteristics of soil which are typical of this region;
- Alkalinity values across six sites fell within the same order of magnitude with results ranging from 360 mg/kg to 800 mg/kg, with the exception of the test pit at Amosing wellpad pit AUL20 which recorded an alkalinity result of 1,320 mg/kg;
- Carbonate levels were less than the limit of detection (50 mg/kg) in each of the test pits;
- Four samples had results over the detection limit for chloride (50 mg/kg), theses samples ranged from 60 mg/kg to 340 mg/kg; and
- Five samples had results over the detection limit for sulphate (50 mg/kg), theses samples ranged from 50 mg/kg to 570 mg/kg.

The pH results for all seven samples ranged from 7.8 to 8.3 indicating a tendency towards alkalinity for soils across all test pits presented. The laboratory results are consistent with the soil taxonomic classes mapped in Section 6.3.1.

6.3.2 Primary Data Gathering

In addition, as part of the baseline water studies, infiltration tests were completed. Primary soil data gathering was completed on behalf of Golder by SGS Kenya Ltd. in March 2019.

6.3.2.1 Methods

Infiltration Tests

Infiltration tests[2] were carried out by the Golder team between 29 and 31 May 2016 (full description in Section 6.8). Tests 1 and 5 were undertaken to the north-east of the Ngamia area. Test 3 was located to the north-east of the Amosing area, to the south of Tests 1 and 5.

Soil Tests

Soil samples were gathered by SGS Kenya Ltd. in March 2019. The SGS investigation comprised the collection of surface soil samples (topsoil) at several Golder specified locations (Drawing 6.3-2). Particle size analysis and chemical analysis was conducted on samples taken from within the upper 0 to 1 m mbgl, which are indicative of the topsoil horizon. Specific determinands included:

- Total Organic Carbon (percent by weight(w/w %));
- pH (in potassium chloride (KCl) solution);
- Electrical Conductivity (deci siemens per meter (dS/m));
- Hydrocarbons (benzene, toluene, ethylene, xylenes (sum), total petroleum hydrocarbons (TPH) C6 – C44);
- Metals (Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Aluminium (Al), Iron (Fe), Manganese (Mn), Barium (Ba), Lead (Pb), Silicon (Si); and
- PSD.

[2] Infiltration tests allow a rate of infiltration of surface water into the ground to be estimated based on field test results.

6.3.3 Results

Infiltration Tests

Results of the infiltration tests in the Ngamia area show that the hydraulic conductivity of the area is between 8 – 9 x 10^{-5} m/s, which is indicative of coarse sand material. Results from Test 3 (Amosing area) revealed a lower hydraulic conductivity of 2.6 x 10^{-5} m/s which is more indicative of loamy clay soils (Stibinger, 2014).

Soil Analysis

Table 6.3-3 below presents the results from the full analysis completed, sub-divided for the TAN areas.

Table 6.3-3: Primary Soil Data Analysis

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
Ngamia area	Golder soil 1	806413	244840	0.20-0.50	Subsoil	Nil	92.5	7.5	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	3,218
									Magnesium (mg/kg)	3,193
									Sodium (mg/kg)	210
									Potassium (mg/kg)	3,152
									Aluminium (mg/kg)	13,620
									Iron (mg/kg)	17,610
									Magnesium (Mn) (mg/kg)	410
									Barium (mg/kg)	96
									Lead (mg/kg)	31
									Silica (mg/kg)	570
									Organic Carbon (%)	0.05
									pH	7.11
	Golder soil 2	807260	244816	0.0-0.05	Surface soil	Nil	100.00	Nil	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	4,126

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
									Magnesium (mg/kg)	2,985
									Sodium (mg/kg)	148
									Potassium (mg/kg)	2,396
									Aluminium (mg/kg)	9477
									Iron (mg/kg)	20,502
									Magnesium (Mn) (mg/kg)	299
									Barium (mg/kg)	106
									Lead (mg/kg)	41
									Silica (mg/kg)	706
									Organic Carbon (%)	0.03
									pH	7.89
	Golder soil 3	806202	246529	0.0-0.05	Surface soil Sandy	Nil	92.50	7.50	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	3,479
									Magnesium (mg/kg)	2,239
									Sodium (mg/kg)	232
									Potassium (mg/kg)	1,772
									Aluminium (mg/kg)	7,868
									Iron (mg/kg)	14,119
									Magnesium (Mn) (mg/kg)	281
									Barium (mg/kg)	78
									Lead (mg/kg)	32

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
									Silica (mg/kg)	606
									Organic Carbon (%)	0.04
									pH	7.65
Amosing area	Golder soil 4	811605	239850	0.20-0.50	Subsoil Loamy Sand	Nil	80.10	19.90	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	4,960
									Magnesium (mg/kg)	4,766
									Sodium (mg/kg)	430
									Potassium (mg/kg)	3,840
									Aluminium (mg/kg)	21,966
									Iron (mg/kg)	24,251
									Magnesium (Mn) (mg/kg)	517
									Barium (mg/kg)	133
									Lead (mg/kg)	84
									Silica (mg/kg)	449
									Organic Carbon (%)	0.05
									pH	7.52
	Golder soil 5	811716	239641	0.0-0.05	Surface soil Sandy	Nil	97.50	2.50	Benzene (µg/kg)	<10
									Toluulene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	6,099
									Magnesium (mg/kg)	2,552
									Sodium (mg/kg)	247
									Potassium (mg/kg)	1,553
									Aluminium (mg/kg)	5,513
									Iron (mg/kg)	13,474
									Manganese (Mn) (mg/kg)	212
									Barium (mg/kg)	84
									Lead (mg/kg)	48
									Silica (mg/kg)	316
									Organic Carbon (%)	0.01
									pH	7.63
	Golder soil 6	812091	238889	0.0-0.05	Surface soil Sandy	Nil	85.06	14.94	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	4,693
									Magnesium (mg/kg)	4,834
									Sodium (mg/kg)	274
									Potassium (mg/kg)	4,402
									Aluminium (mg/kg)	16,339
									Iron (mg/kg)	21,470
									Manganese (Mn) (mg/kg)	514

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
									Barium (mg/kg)	164
									Lead (mg/kg)	66
									Silica (mg/kg)	815
									Organic Carbon (%)	0.03
									pH	7.41
	Golder soil 7	812571	238513	0.0-0.05	Surface soil Loamy Sand	Nil	77.50	22.50	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	5,837
									Magnesium (mg/kg)	5,014
									Sodium (mg/kg)	375
									Potassium (mg/kg)	5,015
									Aluminium (mg/kg)	17,481
									Iron (mg/kg)	23,172
									Manganese (Mn) (mg/kg)	540
									Barium (mg/kg)	199
									Lead (mg/kg)	52
									Silica (mg/kg)	1,691
									Organic Carbon (%)	0.04
									pH	7.03
Twiga area	Golder soil 8	801550	265694	0.20-0.50	Subsoil Loamy Sand	Nil	80.00	20.00	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	4,203
									Magnesium (mg/kg)	4,138
									Sodium (mg/kg)	289
									Potassium (mg/kg)	3,680
									Aluminium (mg/kg)	17,360
									Iron (mg/kg)	21,234
									Manganese (Mn) (mg/kg)	472
									Barium (mg/kg)	95
									Lead (mg/kg)	55
									Silica (mg/kg)	458
									Organic Carbon (%)	0.05
									pH	7.18
	Golder soil 9	801486	266557	0.0-0.05	Surface soil Sandy Loam	Nil	52.50	47.50	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	19,972
									Magnesium (mg/kg)	8,712
									Sodium (mg/kg)	612
									Potassium (mg/kg)	10,345
									Aluminium (mg/kg)	34,444

Location	Sample ID	UTM Easting	UTM Northing	Depth (m)	Description	Particle Size Distribution (%)			Chemical Analysis	
						Clay	Sand	Silt		
									Iron (mg/kg)	38,790
									Manganese (Mn) (mg/kg)	910
									Barium (mg/kg)	311
									Lead (mg/kg)	95
									Silica (mg/kg)	2,470
									Organic Carbon (%)	0.08
									pH	7.77
	Golder soil 10	800603	265988	0.0-0.05	Surface soil Sandy	Nil	95.00	5.00	Benzene (µg/kg)	<10
									Toluene (µg/kg)	<10
									Ethylbenzene (µg/kg)	<10
									Xylenes (sum) (µg/kg)	<20
									TPH C6 - C44 (mg/kg)	<1.0
									Calcium (mg/kg)	2,839
									Magnesium (mg/kg)	2,157
									Sodium (mg/kg)	209
									Potassium (mg/kg)	1,454
									Aluminium (mg/kg)	7,412
									Iron (mg/kg)	9,883
									Manganese (Mn) (mg/kg)	253
									Barium (mg/kg)	53
									Lead (mg/kg)	20
									Silica (mg/kg)	551
									Organic Carbon (%)	0.02
									pH	7.77

The results presented in Table 6.3-3 can be summarised as follows:

- The PSD results were conducted for every Ngamia, Amosing and Twiga test pit. Results highlight that soils are generally sandy to loamy sand in texture, with sand being the dominant particle size at all test pits across all the TAN locations. Particularly sandy topsoil was observed at Ngamia. This coincides with the dominantly sandy characteristics of soil which are typical of this region;
- No elevated hydrocarbon concentrations were identified in any of the 10 topsoil samples, with results below their respective limits of detection;
- Low organic carbon levels were identified in the soil results, ranging from 0.03% to 0.08%; and
- The pH results for all 10 samples ranged from 7.03 to 7.89 indicating a slight tendency towards alkalinity for soils across the TAN sample locations.

6.3.4 Discussion

Based on the available data sources presented above, the following characterisation can be defined for soil in the AoI:

- The area is characterised by typical desert-like sandy soils with some, minimal areas of clay loam;
- Sand is the dominant particle size at all test pits across the TAN areas, which coincides with the dominantly sandy characteristics of soil which are typical of this region; and
- Chemical analysis show that total carbon, organic carbon and inorganic carbon values are low across the TAN areas which reflects the naturally very low soil organic matter content of soils in the region; and results from infiltration tests undertaken near to the Ngamia field are indicative of a fine to medium sandy soils and results from the infiltration test undertaken near to the Amosing field is indicative of loamy soils.

6.4 Weather and Climate

The meteorological conditions were determined with a focus on the AoI through on-site monitoring (primary data) at Kapese and Ngamia and with reference to existing meteorological data from the wider region (secondary data) at Lodwar as well as Mesoscale Model Interface Program (MMIF) Modelled Data, generated for the global dataset.

6.4.1 Secondary Data

Table 6.4-1 presents station details, parameters and the period of record for the meteorological stations used as secondary data, to develop the baseline characterisation of meteorology for the Project. Secondary data was analysed and applied as regional reference for the primary data (see Section 6.4.2) gathered within the potential AoI. Figure 6.4-1 illustrates the locations of the meteorological stations presented in Table 6.4-1.

Historical data from Lodwar meteorological station were used from 1978 to 2018. Meteorological parameters measured at Lodwar included precipitation, minimum and maximum temperature, wind speed and wind direction. Lodwar meteorological station is situated approximately 85 km north of Lokichar and is the only source of secondary data within the Turkana region.

The station is operated on a part-time basis and the data availability is greatly reduced when compared with a meteorological station that is reporting once per hour. This is particularly important for rainfall which is presented as the total as rainfall data for part-time stations may not report correct annual totals. Therefore, Lodwar meteorological data should only be regarded as providing a general regional context, and rainfall totals as representing the minimum amount of rainfall recorded given that there is missing data.

The MMIF converts prognostic meteorological model output fields to the parameters and formats required for direct input into dispersion models. Data is generated for a specific location based on global datasets. This data has been acquired for the use in ESIA modelling, however, is presented here as a reference point of comparison with regional and local data. The MMIF data is based on five- years of surface and profile meteorological data (2014 to 2018) which was provided using Weather Research and Forecasting (WRF) data.

Table 6.4-1: Secondary Data Station Details

Name	Station Type	Coordinates		Elevation (masl)	Parameter used	Period of record used
		Latitude	Longitude			
Lodwar	Meteorological Station	3.12	35.61	523	Daily maximum temperature	2008-2013
					Daily minimum temperature	2008-2013
					Daily total precipitation [1]	1978-1988, 2004-2015
					Total annual precipitation	2016-2018
					Daily average wind speed	2008-2013
					Daily average wind direction	2008-2013
MMIF Version 3.4	Modelled Meteorological Data	2.23	35.77	n/a	Hourly total precipitation	2014 - 2018
					Hourly average temperature	2014 - 2018
					Hourly average relative humidity	2014 - 2018
					Hourly average wind speed	2014 - 2018
					Hourly average wind direction	2014 - 2018

Note: [1]1973-1977 and 1989-2003 rainfall data excluded due to missing data.

6.4.2 Primary Data

6.4.2.1 Meteorological Station Setup

The following two meteorological stations were supplied by Campbell Scientific and installed by a TKBV contractor between December 2015 and January 2016 within the AoI:

- Kapese met station located at Kapese Integrated Support Base accommodation unit, situated at an altitude of approximately 700 metres above sea level (masl); and
- Ngamia met station at Ngamia 8 wellpad, situated at an altitude of approximately 730 masl.

The meteorological stations comprise a general research-grade station mounted on a 10 m mast. Figure 6.4-1 shows the location of the on-site meteorological stations in relation to the secondary data locations from the wider region. Figure 6.4-2 presents a photograph of the meteorological station located at Ngamia 8. The sensors installed and meteorological parameters recorded on an hourly basis at each on-site station are presented in Table 6.4-2

Table 6.4-2: Kapese and Ngamia Meteorological Station Details

Component	Model name	Meteorological Parameter Measured	Unit
Temperature and relative humidity probe (air)	CS215-L	Average air temperature	Degrees Celsius (°C)
		Relative humidity	Percentage (%)
Barometer	Vaisala PTB110	Barometric pressure	Millibars (mbar)
n/a (calculated)	n/a	Evapotranspiration	Millimetres (mm)
Rain gauge	n/a	Precipitation	Millimetres (mm)
n/a (calculated)	n/a	Calculated clear sky solar radiation	Megajoules per metre squared (MJ/m^2)
Pyranometer	Li-200R M200	Solar radiation (total)	Megajoules per metre squared (MJ/m^2)
		Solar radiation (average)	Watts per metre squared (W/m^2)
Temperature probe (soil at 1.5m)	107-L	Soil temperature at 1.5 m depth	Degrees Celsius (°C)
Temperature probe (soil at 0.5m)	107-L	Soil temperature at 0.5 m depth	Degrees Celsius (°C)
Wind direction and speed	05103-L RM Young	Wind direction	Degrees Celsius (°)
		Wind direction standard deviation	Degrees Celsius (°)
		Maximum wind speed	Metres per second (m/s)
		Average wind speed	Metres per second (m/s)

TKBV provided the primary meteorological data. A detailed description of calibration procedures, data logging frequency, quality assurance and control plans, as well as inspection and maintenance plans are described in TKBV's Quality Assurance/Quality Control and Maintenance Plan (TKBV, 2016b).

All sensor calibrations expired on 01 October 2017 (TKBV, 2016b). Recalibration was completed by a qualified engineer on 22 September 2018 on all sensors producing data which is reported in this baseline. All sensors were found to be in calibration which validates the monitoring data included in this assessment.

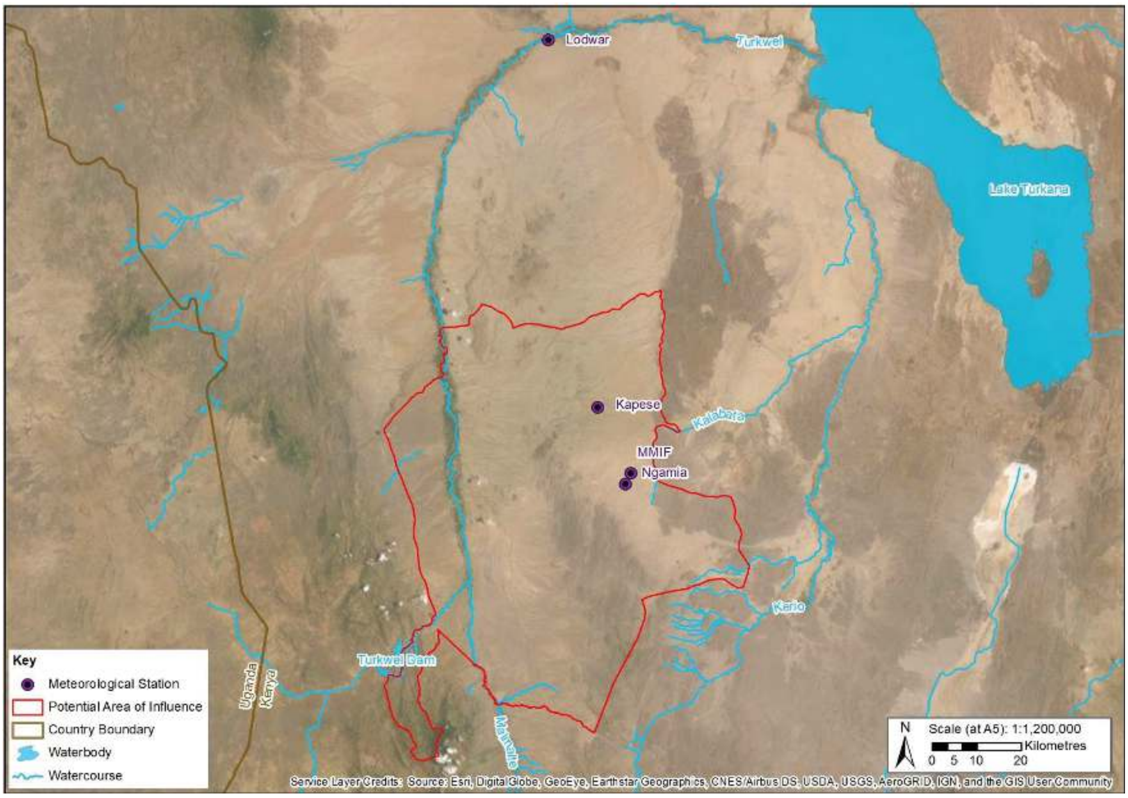


Figure 6.4-1: Kapese and Ngamia Met Station, in Relation to Secondary Data Sources

Figure 6.4-2: Ngamia Meteorological Station

6.4.2.2 Method

The following key meteorological parameters have been considered in this assessment to describe meteorological baseline conditions in the AoI:

- Ambient air temperature (°C);
- Relative humidity (%);
- Total precipitation (mm);
- Wind speed (m/s); and
- Wind direction (°).

For all parameters, except for total precipitation and wind direction, monthly averages as well as monthly minimum and maximum values (based on hourly data) were calculated and plotted. For total precipitation, the monthly total sum was calculated and plotted. Only months with less than 35% of missing data were included in the analysis. Wind direction was plotted in conjunction with wind speed as wind roses covering all available data in the entire period of data analysis. Total annual precipitation and average annual temperatures were calculated for years with less than 35% of missing data to further characterise the primary data in its regional context. Results are tabularised in Annex I.

For Kapese meteorological station quality assured hourly data was provided by TKBV and analysed for the period of 01 December 2015 to 31 December 2018, with the exception of rainfall data, for which quality assured data was provided from 01 January 2016 to 31 December 2018. The months of January to July 2017 were excluded from the analysis due to missing data from all sensors. For total annual precipitation and average annual temperatures, the year of 2017 was excluded based on professional judgement, given there was >35% of the data in 2017 which could not be validated.

For Ngamia meteorological station quality assured hourly data was provided by TKBV and analysed for the period of 22 January 2016 to 31 December 2018. The months of January 2016, April to September 2017 and May to September 2018 were excluded from the analysis due to missing data. For total annual precipitation and average annual temperatures, the years of 2017 and 2018 were excluded based on professional judgement, given there was >35% of the data which could not be validated.

While the secondary and primary data are not concurrent data sets (i.e. data are recorded during different periods), the monthly average data can provide a defendable comparison between the local and regional characterisation of meteorology, which will allow the shorter-term local data to be contextualised within a longer regional dataset.

6.4.3 Results

Ambient Air Temperature

Over the course of the monitoring period, monthly average temperatures at Kapese meteorological station varied between 27.5°C in June and 31.0°C in February. The lowest temperature recorded was 19.7°C in June and December. The highest temperature recorded was 39.2°C in March.

Monthly average temperatures at Ngamia meteorological station varied between 28.1°C in May and 31.0°C in February. The lowest temperature recorded was 15.7°C in April. The highest temperature recorded was 40.1°C in March.

Figure 6.4-3 displays the monthly average ambient temperature as well as the minimum and maximum temperature range recorded in each month for Kapese and Ngamia meteorological stations. Also shown in Figure 6.4-3 are the MMIF modelled monthly average ambient temperatures as well as the minimum and maximum temperatures modelled in each month (based on hourly data) and Lodwar (based on daily data).

As shown in Figure 6.4-3 monthly average, minimum and maximum temperatures are relatively stable lacking strong seasonal variations. Temperatures appear slightly decreased in May, June, July and August compared to the remainder of the year. Temperatures ranges measured at Kapese, Ngamia and Lodwar are very similar. Modelled MMIF temperature data matches closely the primary monitoring data and follows the same annual pattern.

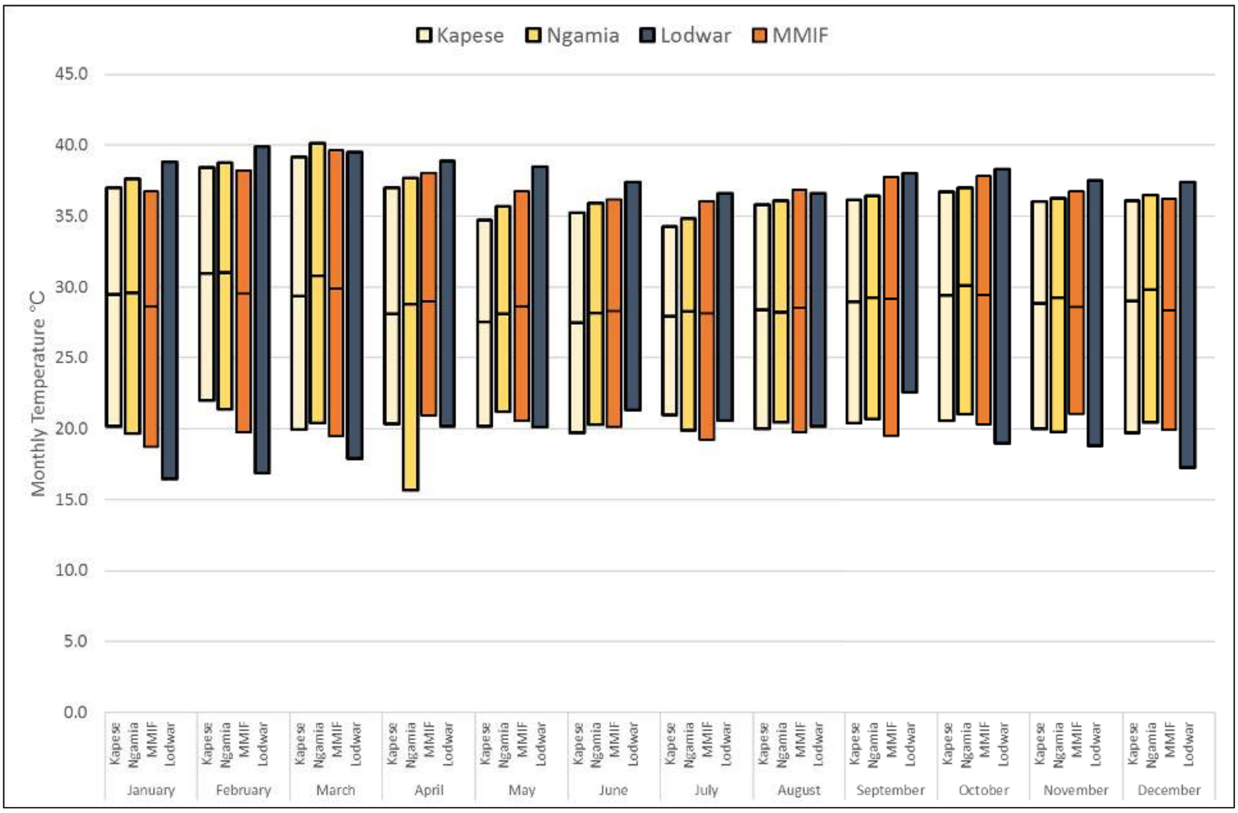


Figure 6.4-3: Average, Minimum and Maximum Monthly Temperature

6.4.3.1.1 Relative Humidity

Over the monitoring period monthly average relative humidity at Kapese meteorological station varied between 30.5% in February and 59.9% in May. The lowest relative humidity recorded was 9.6% in February. The highest relative humidity recorded was 99.4% in June.

Monthly average relative humidity at Ngamia meteorological station varied between 29.1% in January and 59.8% in May. The lowest relative humidity recorded was 9.5% in January. The highest relative humidity recorded was 98.8% in November.

Figure 6.4-4 displays the monthly average relative humidity as well as the minimum and maximum relative humidity recorded in each month for Kapese and Ngamia meteorological stations. Also shown in Figure 6.4-4 are MMIF modelled monthly average, minimum and maximum relative humidity.

As shown in Figure 6.4-4 monthly average, minimum and maximum relative humidity is very similar at Kapese and Ngamia meteorological stations. Both stations show increased relative humidity in April and May and decreased relative humidity from January to March. Modelled MMIF relative humidity data generally matches the primary monitoring data well and follows the same annual pattern.

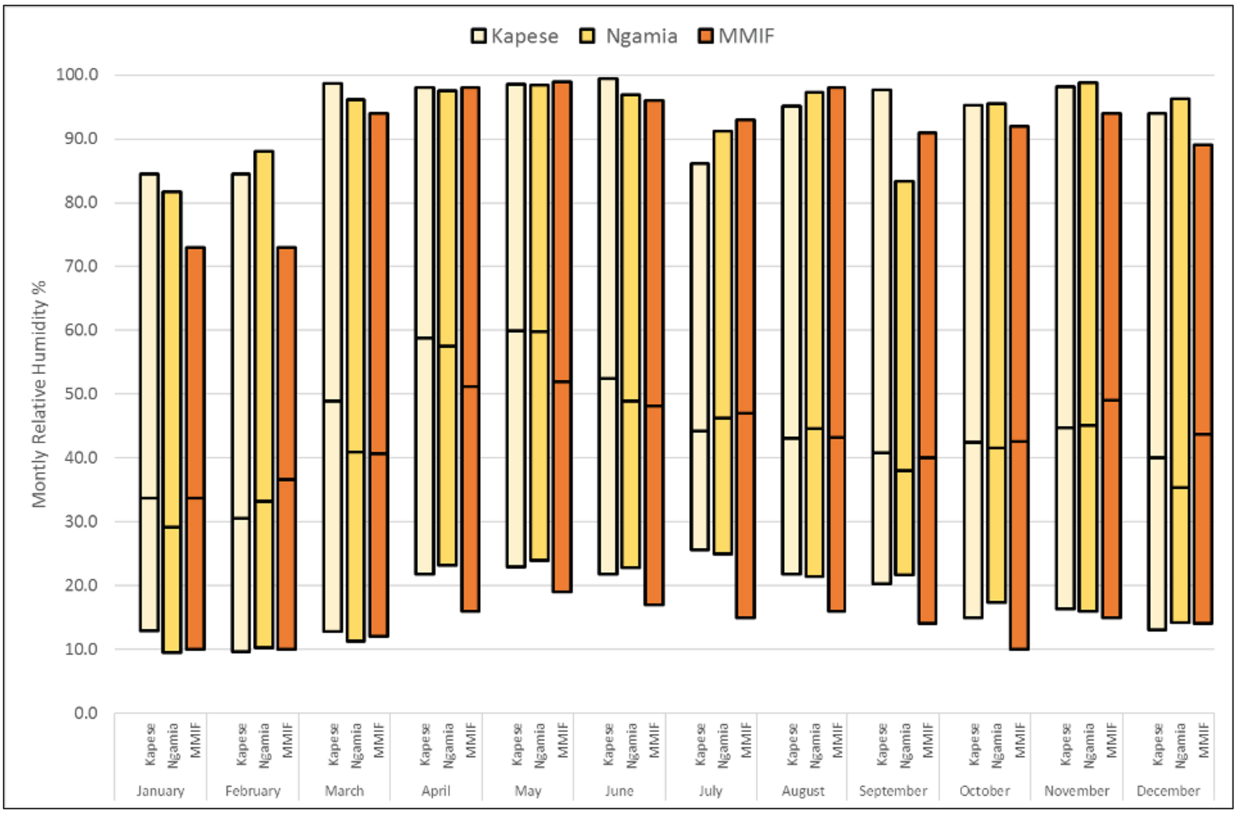


Figure 6.4-4: Minimum and Maximum Monthly Relative Humidity

6.4.3.1.2 Total Precipitation

Over the monitoring period average monthly total precipitation at Kapese meteorological station varied between 0.9 mm in February and 90.4 mm in May. The maximum daily precipitation was 59.2 mm, recorded on 04 June 2018 and the maximum intensity precipitation (1-hour total) was 34.4 mm/hr, recorded on 12 May 2016 at 03:00 am.

Average monthly total precipitation at Ngamia met station varied between 4.0 mm in September and 110.6 mm in May. The maximum daily precipitation was 44.2 mm, recorded on 07 November 2017 and the maximum intensity precipitation (1-hour total) was 39.8 mm/hr, recorded on 21 June 2016 at 15.00.

Figure 6.4-5 displays the monthly average and maximum total precipitation recorded in each month for Kapese and Ngamia meteorological stations. Also shown in Figure 6.4-5 are MMIF modelled monthly average and maximum total rainfall and monthly average as well as maximum total precipitation at Lodwar meteorological station. Maximum values are only provided where more than one month of data is available.

As shown in Figure 6.4-5 monthly total precipitation varies over the year, within years and between locations. Total precipitation at Kapese and Ngamia follow similar patterns with a distinct peak around April and May. Maximum daily and intensity precipitation events also mostly occur around this time. Modelled MMIF data shows much higher amounts of rainfall than any of the other stations, both as monthly average and as monthly maximum, however, this follows a similar annual pattern. Lodwar monthly total rainfall averaged over 34 years indicates a similar peak in precipitation as Kapese and Ngamia. The maximum monthly total precipitation at this station as compared to the average shows the variability in monthly rainfall at Lodwar on a year to year basis. The maximum daily precipitation at Lodwar was 182.9 mm on 21 June 1991, decreasing in the month of June.

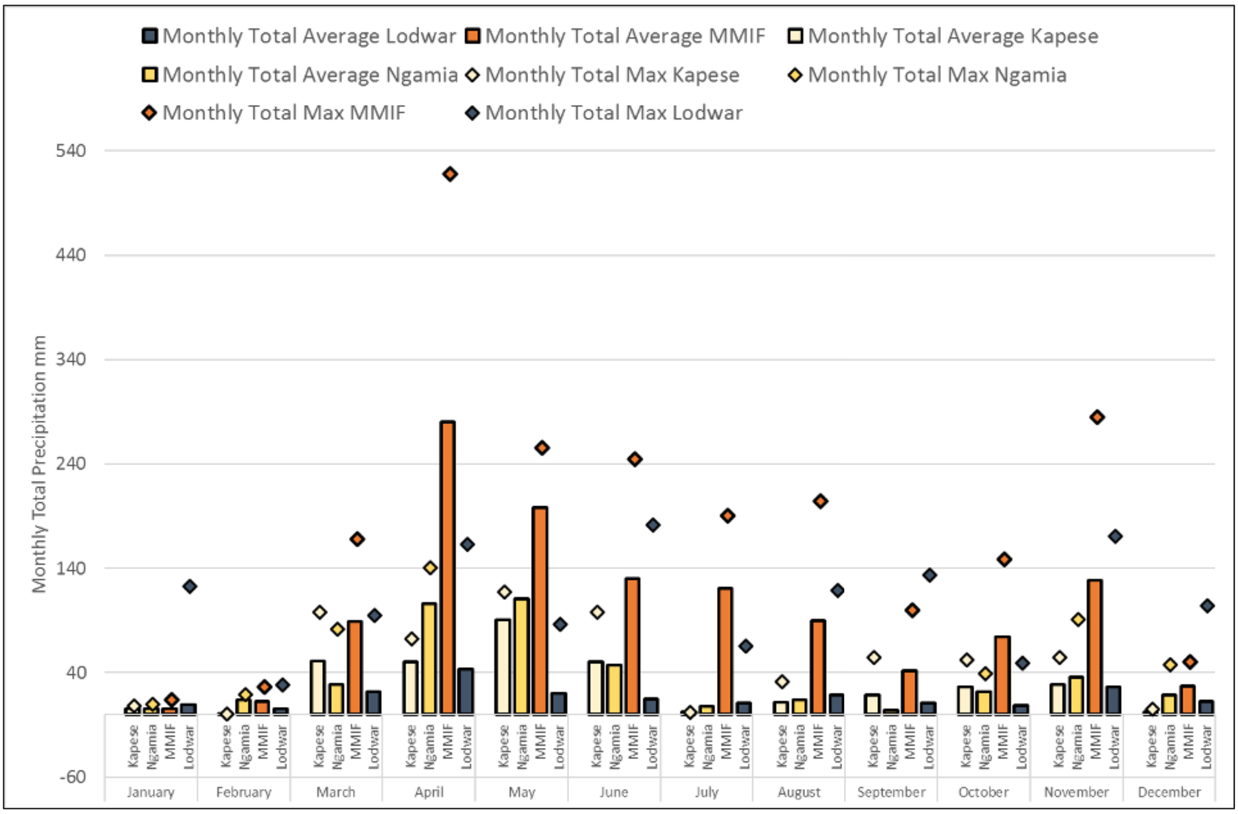


Figure 6.4-5: Average and Maximum Monthly Total Precipitation

6.4.3.1.3 Wind Speed

Over the monitoring period monthly average wind speed at Kapese meteorological station varied between 2.0 m/s in May and 3.1 m/s in February. The highest average wind speed recorded was 8.7 m/s in April.

Monthly average wind speed at Ngamia meteorological station varied between 1.8 m/s in May and 2.9 m/s in February and December. The highest average wind speed recorded was 7.4 m/s in March.

Figure 6.4-6 displays the monthly average wind speed as well as the minimum and maximum wind speed recorded in each month for Kapese and Ngamia meteorological stations. Also shown in Figure 6.4-6 are MMIF modelled monthly average, minimum and maximum wind speed and monthly average, minimum and maximum wind speed for Lodwar (based on daily data).

According to TKBV's Quality Assurance/Quality Control and Maintenance Plan (TKBV, 2016b) wind speed data for Kapese and Ngamia is removed if it is not between 0.5 and 50 m/s as one of the quality assurance clauses to filter out erroneous values. The same wind speed threshold (i.e. removal of data outside of the 0.5 to 50 m/s range) was applied to the MMIF modelled wind data to make the calculated average wind speeds at all three stations comparable. Minimum wind speed at Lodwar is based on daily rather than hourly averages and is slightly higher for this reason.

As shown in Figure 6.4-6 both Kapese and Ngamia meteorological station data show low average wind speeds of approximately 3 m/s or less throughout the year. Maximum average wind speeds are slightly higher at Kapese than at Ngamia.

MMIF modelled monthly average wind speeds are higher (approximately double) and maximum monthly wind speeds are markedly higher compared to Kapese and Ngamia. Average and maximum monthly wind speeds at Lodwar are very similar to Kapese and Ngamia throughout the year.

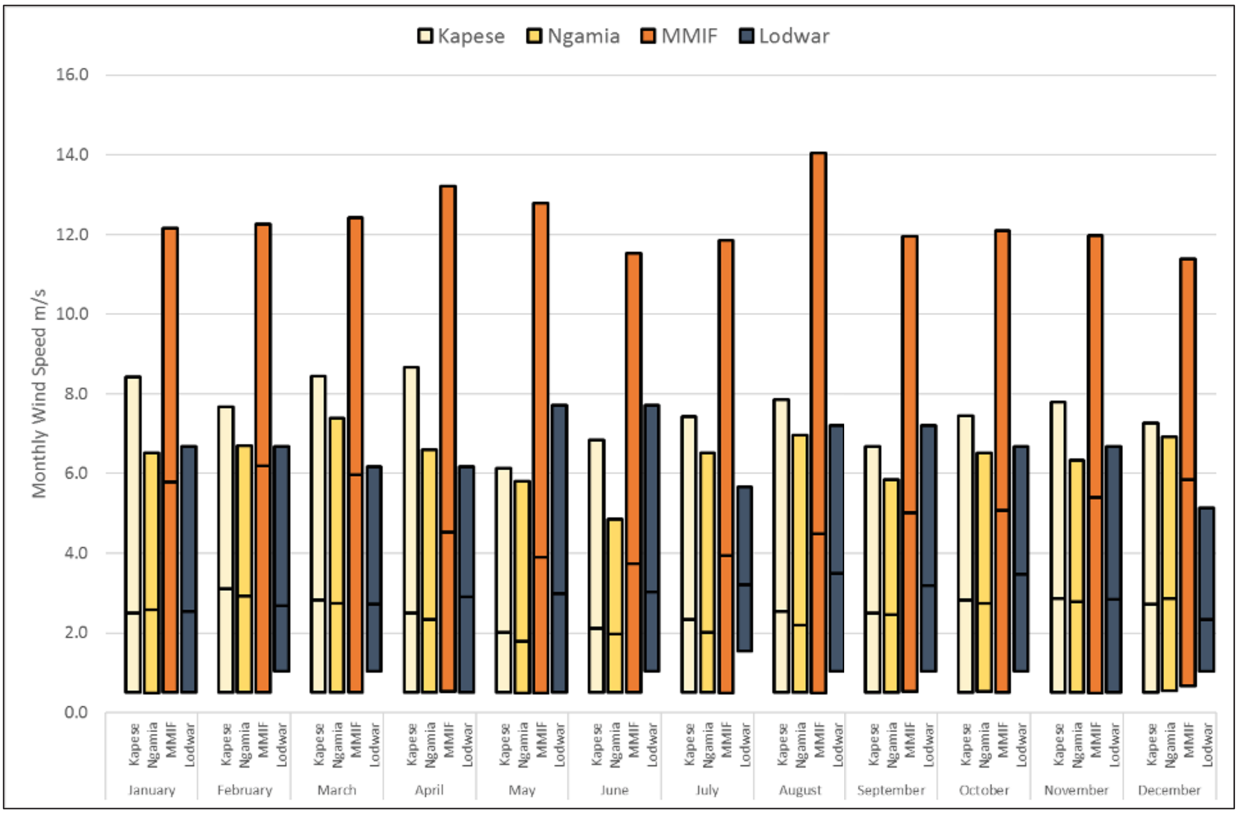


Figure 6.4-6: Average, Minimum and Maximum Monthly Wind Speed

6.4.3.1.4 Wind Direction

Figure 6.4-7 displays the annual windroses for Kapese, Ngamia and Lodwar meteorological stations as well as the annual windrose based on MMIF modelled data. The windrose for Kapese and Ngamia is based on all available wind speed and direction data within the respective monitoring periods. The MMIF windrose is based on five years modelled wind speed and direction data (2014 to 2018). The windrose for Lodwar is based on six years wind speed and direction data (2009 to 2013). At Kapese and Ngamia, winds blow predominantly from north to south-easterly directions. While the prevailing wind direction at Kapese is from the east-north-east, winds from the north-east and south-east or south-south-east prevail at Ngamia. Easterly winds prevail at Lodwar meteorological station. Easterly winds also prevail in the windrose based on modelled MMIF data however, wind speeds are higher overall.

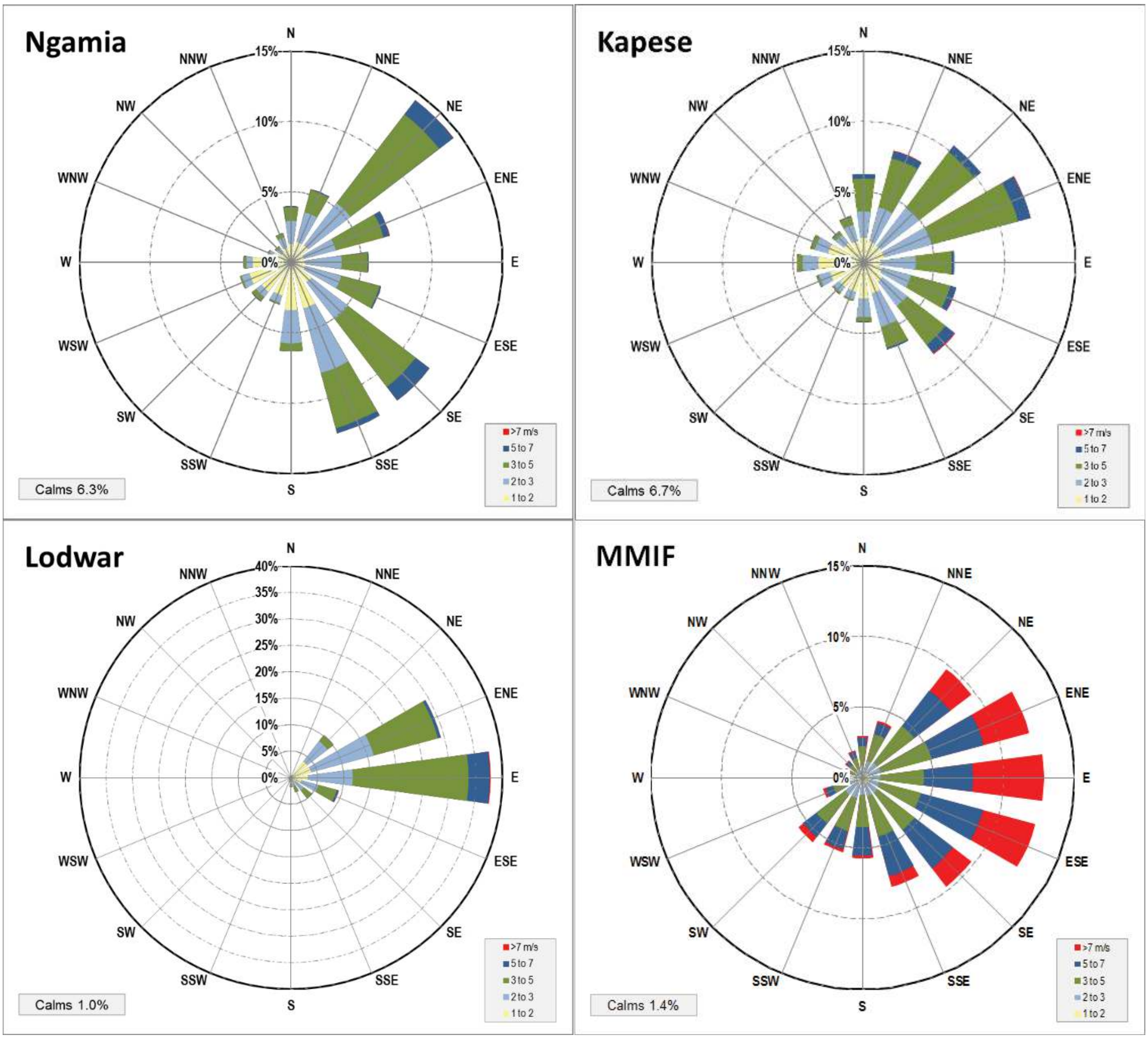


Figure 6.4-7: Windroses for Kapese, Ngamia, and Lodwar

6.4.4 Regional Context and Trends

Figure 6.4-8 displays the annual total precipitation recorded at Lodwar meteorological station between 1973 and 2018, Kapese met station in 2016 and 2018 and Ngamia met station in 2016[3]. Total annual precipitation at both Kapese and Ngamia meteorological stations in 2016 was slightly above the average annual precipitation for Lodwar between 1978 and 2014, however, within the range of typical inter-annual variations. In 2018, Kapese meteorological station data indicates a wet year in comparison to Lodwar averages, however total annual precipitation at Kapese does not exceed historic maximum values recorded at Lodwar. As detailed in Section 6.4.1, annual rainfall totals for Lodwar represent the minimum amount of rainfall recorded given that there may be missing data.

MMIF modelled data assumes markedly higher rainfall than recorded at Kapese, Ngamia and Lodwar meteorological stations. Due to the warm desert climate at the AoI, the MMIF modelled rainfall may over-estimate actual rainfall in the area.

The county of Turkana generally received a higher than normal rainfall during the 2018 long rains season. The north-western, south-western and northern parts of the county received over 350% of the normal rainfall while the rest of the county received between 140-200% of normal rainfall (KFSSG and CSG, 2018). The second half of 2018 however, was reported to be dry in Turkana. The cumulative rainfall received by Turkana for the period commencing August 2018 to January 2019 was lower than the 12-year long term average cumulative rainfall for the same period by 66.3 mm, i.e. Turkana only received 36% of the rainfall normally received from August 2018 to January 2019 (NDMA, 2019a).

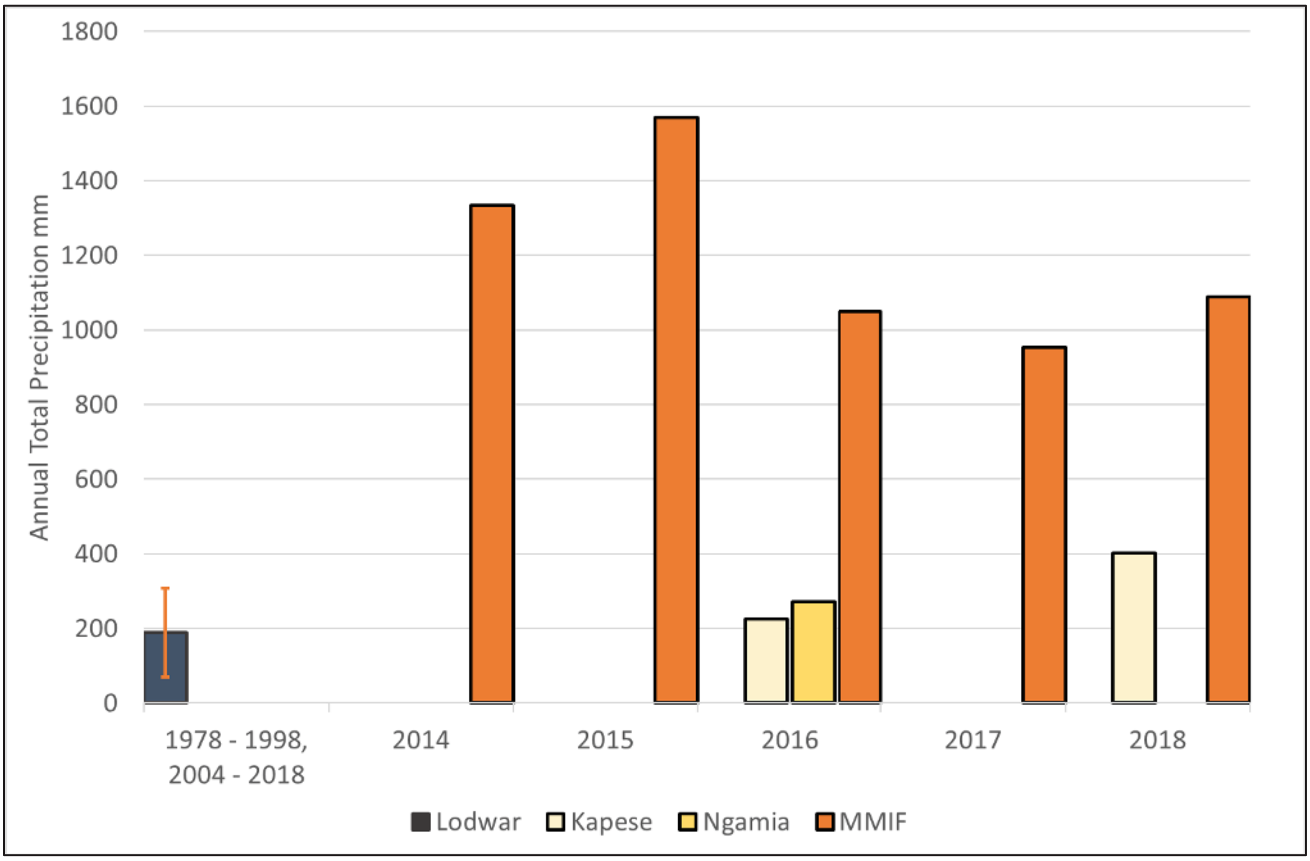


Figure 6.4-8: Total Annual Precipitation for Lodwar, Kapese and Ngami and MMIF Modelled Data

[3] annual figures only included where less than 35% of annual data was missing

Figure 6.4-9 displays the average annual temperature and standard deviation reported for Lodwar meteorological station for the time period 1990 to 2014 (Ashrae Handbook 2017) in comparison with annual temperatures at Kapese meteorological station in 2016 and 2018 and Ngamia meteorological station in 2016[4]. Also displayed is the MMIF predicted annual average temperature for 2014 to 2018. Annual average temperatures at Kapese and Ngamia in 2016 are comparable with the average annual temperature recorded at Lodwar between 1990 and 2014. Kapese meteorological station data indicates that 2018 was a slightly cooler year than 2016, however well within the standard deviation of the Lodwar average annual temperature 1990 to 2014. MMIF modelled data is also comparable with the data recorded at the meteorological stations at Kapese, Ngamia and Lodwar.

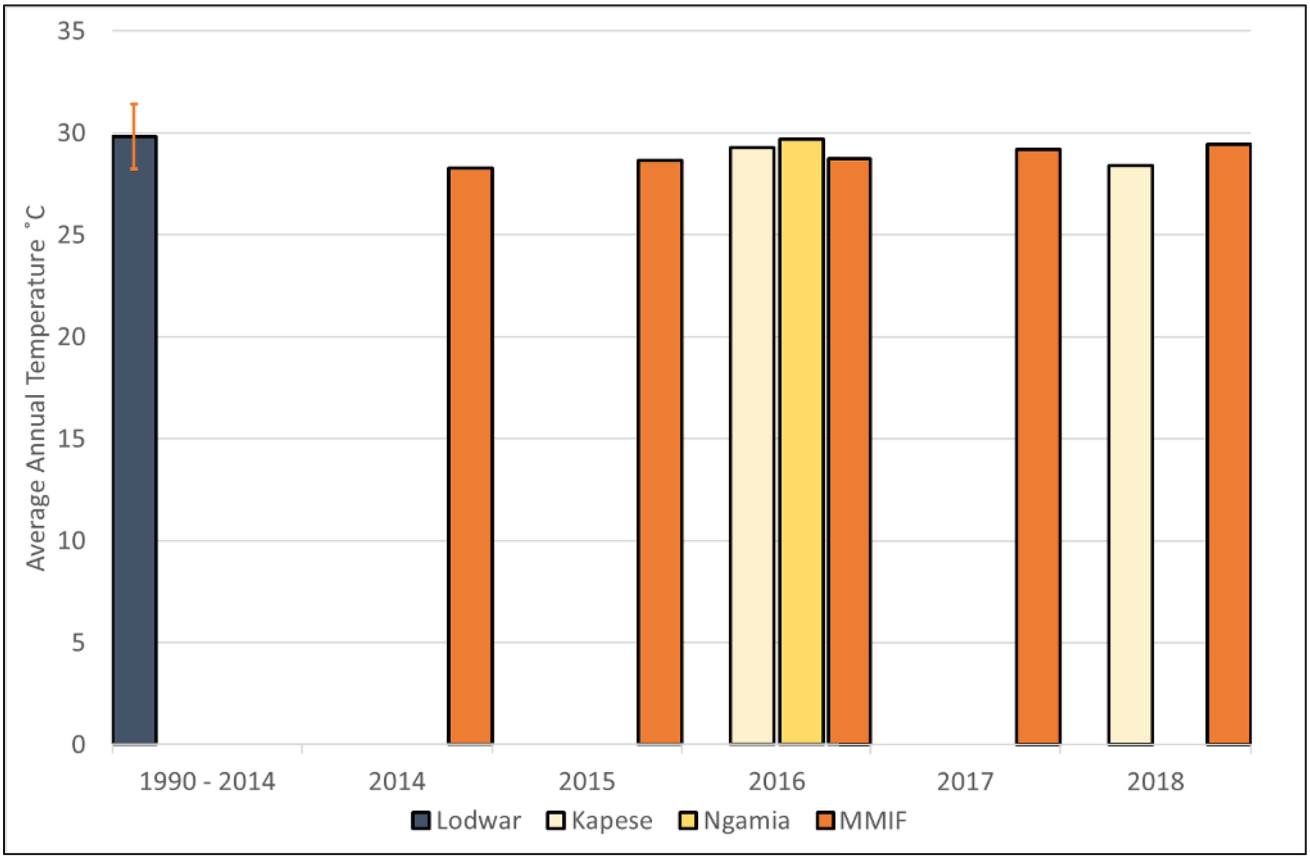


Figure 6.4-9: Annual Average Temperatures at Lodwar, Kapese and Ngamia and MMIF Modelled Data

6.4.5 Discussion - Baseline Data Gathering

The equatorial conditions in Turkana means that there is a very little annual variation in temperature. This is reflected in the high (>20°C) and stable monthly average, maximum and minimum temperatures recorded by the on-site meteorological stations in Kapese and Ngamia which are in good agreement with temperature measurements at Lodwar meteorological station as well as the MMIF modelled data (Figure 6.4-3). The warm desert climate in the AoI is also reflected in fairly low relative humidity encountered in Kapese and Ngamia during the majority of the year (Figure 6.4-4).

Most areas of equatorial eastern Africa have a double rain season between March and May and October to December as the inter-tropical convergence zone (ITCZ) passes over (Camberlin and Ookala, 2003; UK Met

[4] annual figures were only calculated for Kapese and Ngamia where less than 35% of annual data was missing

Office, 2011). The National Drought Management Authority (NDMA, 2019a) classifies the seasons in Kenya as follows:

- January to March – Dry Season;
- April to June – Long Rains;
- July to September – Dry Cool Season; and
- October to December – Short Rains.

Despite the generally dry conditions the ‘long rains’ of the rain season in April to June are well reflected in the peak in total precipitation and relative humidity occurring at Kapese and Ngamia as well as Lodwar during this time period (Figure 6.4-9 and Figure 6.4-9). The ‘long rains’ season coincides with the recorded maximum daily precipitation events at Kapese and Lodwar and the 1-hour intensity precipitation events at Kapese and Ngamia. There is also a secondary peak in precipitation in November during the short rains season at Kapese, Ngamia and Lodwar. The short rains season coincides with the recorded maximum daily precipitation event at Ngamia. The monthly maximum total precipitation compared to the monthly average received at Lodwar over a time period of 34 years indicates significant annual variation in the amount of rainfall received by the area. While the MMIF modelled data shows a similar annual precipitation pattern as Kapese, Ngamia and Lodwar, the modelled rainfall quantities are higher than those observed at the meteorological stations.

Average and maximum monthly wind speeds at Kapese and Ngamia are low (<3.5 m/s and <9 m/s, respectively) and do not exhibit any distinct seasonal variation. Average and maximum wind speeds at Lodwar are comparable to Kapese and Ngamia. A previous meteorological study based on Lodwar meteorological data (1957 – 2014, mixed averaging periods of 1 to12 hours) concluded that the wind climate at Lodwar is dominated by generally light easterly winds which are less than 4 m/s for approximately 50% of the time (HR Wallingford 2014). Based on the daily wind speed data 2008 to 2013 analysed for this assessment, wind speed is less than 4 m/s for approximately 33% of the time and less than 5 m/s for approximately 50% of the time. As the averaging periods of the wind speed data are different in both assessments the analyses results are not directly comparable. Results however indicate a similar wind speed regime found in both studies. Modelled MMIF data shows higher average wind speeds, and higher maximum wind speeds throughout the year.

Over equatorial eastern Africa two distinct monsoons are observed, the north-east and south-east monsoons (Okoola, 1999; UK Met Office, 2011). The north-east monsoons dominate during the Southern Hemisphere summer (December to February), while the south-east monsoons are observed during the Northern Hemisphere summer (June to August). Wind roses for Kapese, Ngamia and Lodwar as well as MMIF modelled data all indicate a prevalence of easterly winds (Figure 6.4-7). A slight shift in prevailing wind direction from east-north-east at Kapese to north-east at Ngamia may be related to local topography and the high grounds located approximately 10 km to the east of Ngamia. The Lodwar windrose is in agreement with a previous meteorological study that concluded that the prevailing wind direction at Lodwar is easterly or north-easterly, with winds from these directions occurring for over 75% of the time (HR Wallingford, 2014).

In summary, the data provided by the on-site meteorological stations reflect the local warm desert climate and is in general agreement with the secondary data from Lodwar meteorological station. Modelled MMIF data is in generally agreement with the meteorological station data however, the modelled data indicates higher precipitation than recorded at Kapese, Ngamia and Lodwar met stations throughout the year. Also, MMIF modelled monthly wind speeds are higher compared to wind speeds recorded at Kapese, Ngamia and Lodwar. The differences in actual monitoring data compared to MMIF modelled data may be the result of localised effects caused for example by local terrain, local land use or building structures in the surroundings of the meteorological stations.

6.4.6 Climate Change

6.4.6.1 Current Trends

Ambient Air Temperature

In Kenya, the mean annual temperature has increased by 1.0˚C since 1960 with an average rate of 0.21˚C per decade (McSweeney et al., 2010a). The decline of the Lewis Glacier on Mount Kenya which lost 40% of its mass since 1963 (MENR, 2002) is a visible indicator of the warming trend. Daily temperature observations indicate increasing trends in the frequency of hot days and hot nights with hot days or nights defined by the temperature exceeded on 10% of days or nights in the current climate of that region. Between 1960 and 2003, the number of hot days has increased in Kenya by 57 i.e. an additional 15.6% of days. Over the same time period, the number of hot nights increased by 113, i.e. an additional 31% of nights. Meanwhile the frequency of cold days and cold nights has significantly decreased by 16 (4.4%) and 42 (11.5%), respectively. Cold days or nights are defined as the temperature below which 10% of days or nights are recorded in current climate of that region or season (McSweeney et al., 2010a).

Precipitation

Parry et al. (2012) report changes in rainfall patterns being noticed in Kenya since the 1960 however, observations of rainfall across Kenya since 1960 do not show statistically significant trends (McSweeney et al., 2010a). Recent trends in precipitation patterns however indicate an increase in proportion of rainfall occurring in heavy events (McSweeney et al., 2010a). Further observations indicate a potential shift in monsoon patterns with a decline of rainfall during the spring long rains season and an increase of rainfall during the autumn short rains season (MENR, 2002).

Future Climate Projections

Future climate projection figures presented in this section are based on the United Nations Development Programme (UNDP) Climate Change Country Profile for Kenya (McSweeney et al., 2010b). Existing climate data has been used to generate a series of country-level studies of climate observations and the multi-model projections made available through the World Climate Research Programme Coupled Model Intercomparison Experiment, Phase 3 (WCRP CMIP3). The methodology underlying the analysis for each country profile is detailed in McSweeney et al. (2010b). The climate model projections are based on the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES). All projections detailed below represent anomalies relative to the mean climate of 1970 – 1990 (McSweeney et al., 2010a).

Ambient Air Temperature

The current trend in increasing annual mean temperatures is predicted to continue with a projected increase in Kenya of 1.0 ˚C to 2.8˚C by the 2060s and 1.3 ˚C to 4.5˚C by the 2090s. In the AoI, the projected median change in mean annual temperature under the SRES A2 scenario is 1.2˚C by the 2030s, 2.5 ˚C by the 2060s and 3.8 to 3.9 ˚C by the 2090s. (McSweeney et al., 2010a).

All projections indicate a further increase in the frequency of days and nights considered hot in the current climate coupled with a decrease in the frequency of days and nights considered cold in the current climate.

Cold days and nights are expected to progressively become less frequent and do not occur at all under the highest emissions scenarios by the 2090s (McSweeney et al., 2010a).

In the AoI, the projected annual median hot day frequency under the SRES A2 scenario is 29 to 36% by the 2060s and 45 to 61% by the 2090s. The projected annual median hot night frequency under the SRES A2 scenario is 52 to 54% by the 2060s and 86 to 89% by the 2090s. The projected median cold day frequency under the SRES A2 scenario is only 3% by the 2060s and only 1% by the 2090s for the AoI. The projected annual median cold night frequency is 0% by the 2060s (McSweeney et al., 2010a).

Precipitation

East Africa's seasonal rainfall can be strongly influenced by the El Niño-Southern Oscillation (ENSO), however model simulations show wide disagreements in projected changed in the amplitude of future events (Christensen et al., 2007). This contributes to the uncertainty in climate projections for Kenya, in particularly in the future inter-annual variability in the region (McSweeney et al., 2010a).

Projections reported by the UNDP Climate Change Country Profile for Kenya are consistent in indicating increases in annual rainfall in Kenya. The projected increase varies with a predicted maximum of +20 mm by the 2060s and plus (+)27 mm by the 2090s. In the AoI, the projected median change under the SRES A2 scenario in precipitation is 3 to 4 mm by the 2030s, 8 to 9 mm by the 2060s and 16 to 21 mm by the 2090s (McSweeney et al., 2010a).

Consistent with trends already observed in Kenya, models also project increases in the proportion of annual rainfall that falls in heavy rainfall events. In the AoI, the median projected change under the SRES A2 scenario in % rainfall falling in heavy events is 5 to 6% by the 2060s and 11 to 12% by the 2090s (McSweeney et al., 2010a).

In addition, 1-day and 5-day rainfall annual maxima increases by the 2090s of up to 25 mm in one-day events, and 32 mm in five-day events are projected by the models for Kenya (McSweeney et al., 2010a).

However, contrary to the results of the WCRP CMIP3 presented in the UNDP study, other studies indicate a decrease in future rainfall in Kenya. Funk et al. (2010) predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean.

Climate Change Summary

Current climate trends in Kenya show that average ambient air temperatures are increasing as are the number of hot days and nights occurring each year. Conversely, the number of cold days and cold nights are showing a declining trend. Based on the analysis presented in the UNPD Climate Change Country Profile for Kenya, climate model projections predict that these trends will continue and likely intensify over the coming decades in Kenya and in the AoI (McSweeney et al., 2010a).

Current climate trends in Kenya also indicate an increase in the proportion of rainfall occurring in heavy events (McSweeney et al., 2010a; Parry et al., 2012). Further observations indicate a potential shift in monsoon patterns with a decline of rainfall during the spring 'long rains' and an increase of rainfall during the autumn short rains season (MENR, 2002).

Uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Niño events. The latter strongly influence the seasonal rainfall in East Africa (McSweeney et al., 2010a). Projections presented in the UNPD Climate Change Country Profile for Kenya consistently indicate an increase in total annual rainfall both over Kenya and the AoI. In addition, the proportion of rain falling in heavy rainfall events is predicted to increase (McSweeney et al., 2010a). However, other studies predict a potential decrease in future rainfall in Kenya. Funk et al. (2010) for example predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean.

In summary, temperature change predictions due to climate change across different analyses are considered consistent, but changes to rainfall patterns and total rainfall are more complex to predict. The reviewed literature as summarised above suggest that design criteria should consider an increase in temperatures over the lifetime of the Project in the order of 2.5°C up to 2060 and an increase in heavy rainfall events, in the order of 33% increase in maximum daily rainfall events (20 mm increase on a maximum daily event of 59.2 mm).

6.5 Air Quality

Baseline data gathering is focused on the South Lokichar Basin within the AoI of the Project.

Primary data gathering has been completed at Kapese Camp (Osiris), Lokichar town (diffusion tube and deposited dust), Amosing 5 wellpad (diffusion tube, deposited dust and particulates), Ngamia 5/6 wellpad (diffusion tube, deposited dust and particulates), and Twiga wellpad (diffusion tube, deposited dust and particulates).

6.5.1 Key Pollutants

A summary for each key pollutant, data which has been gathered during the baseline period, is described in the following sections along with details of the specific risks to human health and the environment (WHO, 2017). The following presents the potential effects of key pollutants and justification for their inclusion in the baseline.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) typically arises via the oxidation of nitric oxide (NO) in air. The main effect of breathing NO_2 is the increased likelihood of respiratory problems. NO_2 is found to cause inflammation of the lungs and can reduce immunity to lung infections. This can cause respiratory problems such as wheezing.

Increased levels of NO_2 can affect people with asthma as it can cause more frequent attacks. Children with asthma and older people with heart disease are most at risk. Scientific studies have shown that symptoms of bronchitis and asthma in children increase in association with long-term exposure to NO_2 (WHO, 2005).

Sulphur Dioxide

Sulphur dioxide (SO_2) is the by-product of burning fuel that contains sulphur. Excessive exposure to elevated concentrations of SO_2 is known to affect the human respiratory system and inhibit the function of the lungs. Inflammation of the respiratory tract causes coughing, aggravation of asthma, chronic bronchitis, and makes people more prone to infections of the respiratory tract (WHO, 2005).

When SO_2 combines with water, it forms sulphuric acid (H_2SO_4); this is the main component of acid rain which can result in loss of plants and deforestation (WHO, 2005).

Ozone

Excessive or elevated ozone (O_3) levels in the air can have implications for human health. Ozone has the potential to cause breathing problems, trigger asthmatic attacks, reduce lung function, and cause lung diseases. Several European studies have reported that daily mortality rises by 0.3% and likelihood of heart diseases by 0.4%, per 10 µg/m^3 increase in O_3 exposure (WHO, 2005).

Volatile Organic Compounds

Volatile Organic Compounds (VOCs) include a variety of chemicals, some of which may have short and long-term adverse health effects. VOCs have the potential to be emitted from all aspects of oil and gas operations and although no direct assessment standards are available, baseline VOCs are monitored purely to establish baseline. No standards are available for assessing ambient VOCs to establish the quality or condition of a project baseline.

Benzene, toluene, ethylbenzene and xylene (BTEX) are the VOC species considered as a standard approach to ESIA baseline. There is only an air quality standard for total VOCs[5]. As there are no standards for the other VOCs, data is gathered to provide a baseline against which any change can be monitored during operations.

[5] In previous versions of the NEMA Air Quality regulations there was an annual standard for Benzene but this is no longer applicable

Deposited Dust

Deposited dust is generally not associated with human health issues but is considered a nuisance due to loss of amenity. Elevated dust levels may, however, affect visibility and thus cause a health and safety issue. Dust can also have effects on plants and their growth patterns. Deposited dust can settle on the surface of leaves and reduce the intake of sunlight, inhibiting the natural process of photosynthesis. This has the potential to result in stunted growth. Dependent on the source and quantity of deposited dust, it is also possible that dust fall can contaminate sensitive environments and affect the chemistry of sensitive soils.

Particulate Matter (PM_{10} and $PM_{2.5}$)

The health effects from particulate matter (PM_{10} and $PM_{2.5}$) can occur at levels of exposure currently being experienced by most urban and rural populations in both developed and developing countries. Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as lung cancer (WHO, 2005). Particulates are internationally recognised as harmful to human health and the wider environment.

In developing countries, exposure to pollutants from indoor combustion of solid fuels on open fires or in traditional stoves increases the risk of acute lower respiratory tract infections and associated mortality amongst young children. Indoor air pollution from solid fuel use is also a major contributing factor in the development of chronic obstructive pulmonary disease and lung cancer among adults. The mortality in cities with high levels of pollution is greater than that observed in relatively cleaner cities by 15 to 20%. Even in the European Union, average life expectancy is 8.6 months lower due to exposure to $PM_{2.5}$ produced by human activities (WHO, 2018).

6.5.2 Secondary Data

There is no known air quality data for the AoI other than the data gathered as part of the ESIA baseline primary data gathering.

Due to the lack of industry and sparse populations in Turkana and the area around the Turkwel Dam in West Pokot, anthropogenic sources of potential changes to air quality are minimal.

6.5.3 Primary Data

6.5.3.1 Methods

Golder monitored air quality at the following five locations across the AoI:

- Twiga-1 wellpad;
- Lokichar town;
- Kapese Camp;
- Amosing 5 wellpad; and
- Ngamia 5/6 wellpad.

Data is reported for each individual station alongside the average for each of the TAN locations. Figure 6.5-1 presents these locations.

Data was gathered from November 2015 to September 2016, July 2017, December 2017, December 2018 and March 2019 (see Section 6.5.4 for data acquisition).

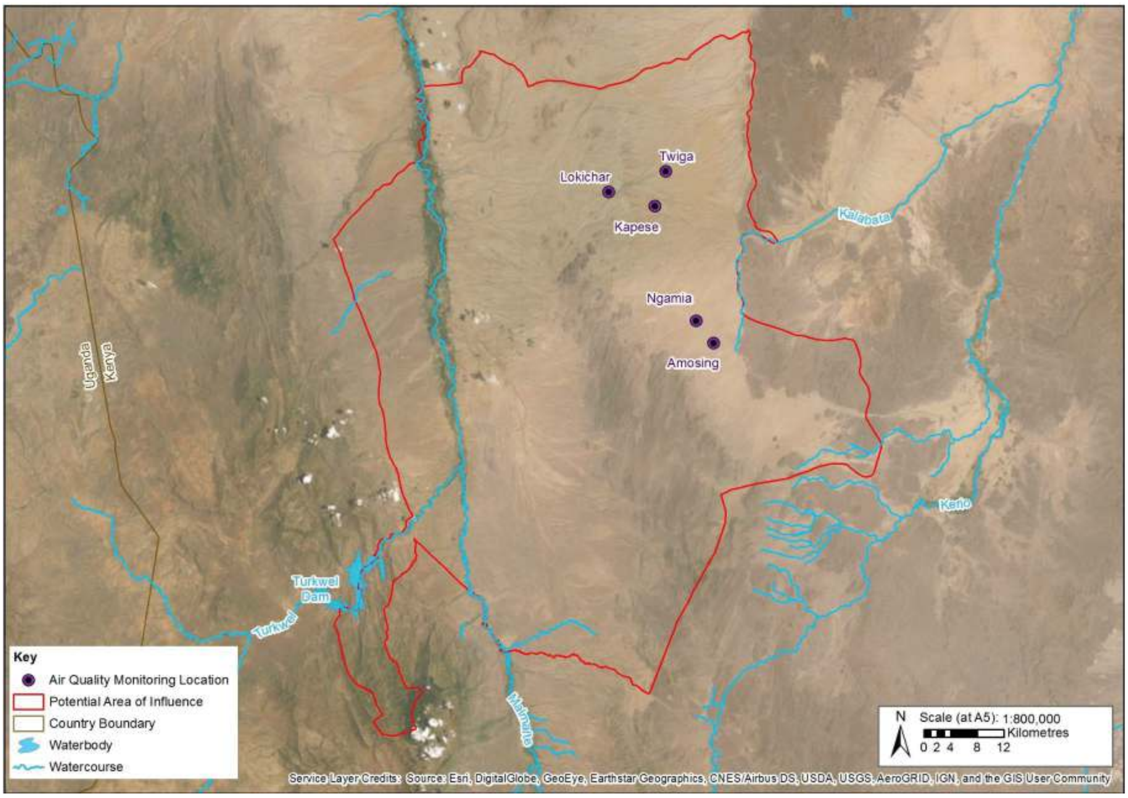


Figure 6.5-1: Air Quality Monitoring Locations

Diffusion Tubes

Substance specific diffusion tubes for NO_2, SO_2, O_3, and BTEX were deployed at the data gathering locations. The tubes were co-located with deposited dust gauges and placed at approximately 1.5 m above the ground level to sample within the average breathing zone of humans.

Passive diffusion tubes were exposed for approximately one-month intervals from November 2015 to September 2016. All samples were analysed by SGS Kenya Limited, located in Nairobi and results provided in $\mu g/m^3$. All VOC results were reported as being below the limit of detection, this lower detection limit has been reported in this assessment.

Deposited Dust

Deposited dust samples were collected on a monthly basis alongside the passive air quality tubes using the Frisbee type deposit dust gauge collection method (Figure 6.5-2) at the monitoring locations. As no international statutory assessment standards are available for this commonly utilised monitoring technique, gauges were deployed in accordance with the manufacturer's recommendations.

The gauges comprise a Frisbee type dust collection plate, connected to a rainwater collection vessel via a small tube. The gauge works by collecting ambient dust, which is deposited on the Frisbee plate and washed by rainwater through the tube into the collection vessel. The gauges were mounted on tripod stands and left at the monitoring locations for a period of approximately one month. Dust deposition analysis was also undertaken by SGS located in Kenya giving an average dust deposition rate in $mg/m^2/day$.

Figure 6.5-2: Deposited Dust Gauge, Diffusion Tubes and Noise Equipment Set Up for Data Gathering at Amosing 5

Particulate Matter

Fine particulate data gathering was undertaken at Kapese using a Turnkey Optical Scattering Instantaneous Respirable Indication Sensor (Osiris) particulate monitor. The Osiris unit simultaneously measured particulate matter sized from 1 µm (PM_1), 2.5 µm ($PM_{2.5}$) and 10 µm (PM_{10}). Time-averaged results were recorded by the monitor every 10 minutes and data was periodically downloaded from the equipment by local field technicians. The measured data covers the period November 2015 to November 2016. Particulate data gathering was also undertaken using Airmetrics MiniVol portable air samplers to measure particle matter sizes 10 µm (PM_{10}) and 2.5 µm ($PM_{2.5}$). Two individual units are run simultaneously to monitor both particle size fractions. At the end of the data gathering period, filters (which were pre-weighed prior to the monitoring period) were returned to the laboratory for analysis of the mass fraction. The gathered data covers a 24-hour monitoring period at Amosing, Ngamia and Kapese during December 2017 (although some data had to be discounted due to an insufficient monitoring duration), Amosing, Ngamia and Twiga during December 2018 (although the Amosing and Ngamia data were discounted due to a data error) and Amosing and Ngamia during March 2019. Due to project related elevated human activity at Kapese during the Osiris data gathering period, this data is not considered to be representative of the baseline for the area and although the results of the Osiris data gathering are presented below, the MiniVol data is considered to be representative of the Project background.

6.5.4 Data Acquisition

Data capture was generally successful although some data gaps occurred. Table 6.5-1 below summarises data collection during each month. Where data is missing it is for short periods only and does not impact the aim of establishing a long-term average for the baseline.

Table 6.5-1: Air Quality Data Collection by Month

Pollutant	Location	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016 [(a)]	Aug 2016	Sept 2016	Jul 2017	Dec 2017	Dec 2018	Mar 2019
NO_2	Amosing	Y	N	Y	Y	Y	Y	N	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Ngamia	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Twiiga	Y	N	Y	Y	Y	Y	Y	Y	n/a	N	Y	N	n/a	n/a	n/a
	Lokichar	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	Y	n/a	n/a	n/a
	Kapese	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	Y	n/a	n/a	n/a
SO_2	Amosing	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Ngamia	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Twiiga	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Lokichar	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	Y	n/a	n/a	n/a
	Kapese	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	Y	n/a	n/a	n/a
O_3	Amosing	Y	N	Y	Y	Y	Y	N	Y	n/a	N	Y	N	n/a	n/a	n/a
	Ngamia	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Twiiga	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Lokichar	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	Y	n/a	n/a	n/a
	Kapese	Y	N	Y	Y	Y	Y	Y	Y	n/a	Y	Y	Y	n/a	n/a	n/a

Pollutant	Location	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016 (a)	Aug 2016	Sept 2016	Jul 2017	Dec 2017	Dec 2018	Mar 2019
BTEX	Amosing	N	N	Y	N	N	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Ngamia	N	N	Y	N	N	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Twiiga	N	N	Y	N	N	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Lokichar	N	N	Y	N	N	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
	Kapese	N	N	Y	N	N	Y	Y	Y	n/a	Y	Y	N	n/a	n/a	n/a
PM_{10} &$PM_{2.5}$	Amosing	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N	Y(d)	N(c)	Y
	Ngamia	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N	Y(d)	N(c)	Y
	Twiiga	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N	N	Y	n/a
	Lokichar	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N(b)	N	n/a	n/a	n/a
	Kapese (e)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y(d)	n/a	n/a
Deposited Dust	Amosing	Y	N	Y	Y	N	N	N	N	n/a	N	N	N	N	n/a	n/a
	Ngamia	Y	N	Y	Y	Y	Y	Y	N	n/a	Y	Y	N	N	n/a	n/a
	Twiiga	Y	N	Y	Y	Y	Y	Y	N	n/a	Y	Y	N	N	n/a	n/a
	Lokichar	Y	N	Y	Y	Y	Y	Y	N	n/a	Y	Y	Y	Y	n/a	n/a
	Kapese	Y	N	Y	Y	Y	Y	Y	N	n/a	Y	Y	Y	Y	n/a	n/a

(a) Samples for June and August were deployed for a slightly extended period from 31 May to 12 July, and from 11 July to 23 August, therefore no data is specific to July;
(b) No particulate monitoring was undertaken during this monitoring period;
(c) Data discounted due to possible errors in the results;
(d) Some data discounted due to insufficient monitoring period; and
(e) Monitoring undertaken using the Osiris air monitoring device.

6.5.5 Results

The short-term air quality concentrations were calculated using the United Kingdom (UK) Department for Environment, Food and Rural Affairs (DEFRA) and UK Environment Agency (EA) methodology for calculating averaging periods (DEFRA & EA, 2016) and for the 10 minute average utilised by the Ministry of Environment, Ontario, Canada (2008) methodology. In the absence of any international methodology or guidance relating to this, the following assumptions were applied:

- The annual average concentration is taken as the mean of the monitored data;
- Hourly average concentration = the annual average concentration x 2;
- 24-hour average concentration = the hourly average concentration x 0.59;
- 8-hour average concentration = the hourly average concentration x 0.7;
- 15-minute average concentration = the hourly average concentration x 1.34; and
- 10-minute average concentration = the hourly average concentration x 1.65.

As an example, the monitored long-term average SO_2 concentration at Amosing for the monitoring period was 1.0 µg/m^3. The hourly average SO_2 concentration was estimated to be 2.0 µg/m^3 (i.e. 1.0 µg/m^3 x 2). Similarly, the SO_2 concentrations for the other average times were estimated as follows:

- 24-hour average concentration = 1.2 µg/m^3 (i.e. 2.0 µg/m^3 x 0.59); and
- 10-minute average concentration = 3.3 µg/m^3 (i.e. 2.0 µg/m^3 x 1.65).

Baseline average air quality concentrations for the monitored pollutants are provided for each of individual monitoring locations in Table 6.5-2 to Table 6.5-6. Concentrations in Table 6.5-7 are the average results from all monitoring locations which is deemed to be a representative baseline concentration for the AoI. Data is presented for the VOC species monitored and compared against the relevant Air Quality Standard (AQS). The percentage of the AQS is calculated from the full results, which have been reported in this assessment to one decimal place.

Table 6.5-2: Baseline Average Air Quality Concentrations for Pollutants Monitored at Amosing

	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.6	40	1.6
	24-hour[(c)]	0.8	188	0.4
	1-hour	1.3	200	0.6
SO_2	Annual	1.0	50	2.0
	24-hour[(c)]	1.2	20	5.8
	10-minute	3.3	500	0.7
O_3	Annual	29.8	- [(a)]	-
	8-hour	41.7	100	41.7
	1-hour	59.6	235	25.4

	Averaging Period	Concentration (µg/m³, unless stated)	AQS (µg/m³, unless stated)	Concentration as % of AQS
Benzene	Annual	2.1	- [a]	-
	24-hour[b] [c]	2.5	600	0.4
Toluene	Annual	2.3	- [a]	-
	24-hour[b] [c]	2.7	600	0.5
Ethylbenzene	Annual	2.5	- [a]	-
	24-hour[b] [c]	3.0	600	0.5
Xylene	Annual	2.4	- [a]	-
	24-hour[b] [c]	2.9	600	0.5
PM_{10} [d]	Annual	36.4	20	182.2
	24-hour	43	50	86
$PM_{2.5}$ [d]	Annual	17.8	10	178
	24-hour	21	25	84
Deposited Dust	24-hour	6.6	200 mg/m²/day	3.3

(a) No relevant AQS;
(b) Total VOC AQS;
(c) 3 exceedances of the AQS allowed; and
(d) Monitored using the MiniVol sampler.

Table 6.5-3: Baseline Average Air Quality Concentrations for Pollutants Monitored at Ngamia

	Averaging Period	Concentration (µg/m³, unless stated)	AQS (µg/m³, unless stated)	Concentration as % of AQS
NO_2	Annual	0.9	40	2.2
	24-hour[c]	1.0	188	0.6
	1-hour	1.8	200	0.9
SO_2	Annual	1.1	50	2.3
	24-hour[c]	1.4	20	6.8
	10-minute	3.8	500	0.8
O_3	Annual	26.7	- [a]	-
	8-hour	37.4	100	37.4
	1-hour	53.4	235	22.7
Benzene	Annual	2.1	- [a]	-

	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
	24-hour[(b) (c)]	2.5	600	0.4
Toluene	Annual	2.3	- [(a)]	-
	24-hour[(b) (c)]	2.7	600	0.5
Ethylbenzene	Annual	2.5	- [(a)]	-
	24-hour[(b) (c)]	3.0	600	0.5
Xylene	Annual	2.5	- [(a)]	-
	24-hour[(b) (c)]	2.9	600	0.5
PM_{10} [(d)]	Annual	26.3	20	131.4
	24-hour	31.0	50	62.0
$PM_{2.5}$ [(d)]	Annual	21.6	10	216.1
	24-hour	25.5	25	102.0
Deposited Dust	24-hour	93.1	200 mg/m^2/day	46.5

(a) No relevant AQS;
(b) Total VOC AQS;
(c) 3 exceedances of the AQS allowed; and
(d) Monitored using the MiniVol sampler.

Table 6.5-4: Baseline Average Air Quality Concentrations for Pollutants Monitored at Twiga

	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.4	40	0.9
	24-hour[(c)]	0.4	188	0.2
	1-hour	0.7	200	0.4
SO_2	Annual	0.8	50	1.6
	24-hour[(c)]	0.9	20	4.6
	10-minute	2.6	500	0.5
O_3	Annual	36.3	- [(a)]	-
	8-hour	50.9	100	50.9
	1-hour	72.7	235	30.9
Benzene	Annual	2.2	- [(a)]	-
	24-hour[(b) (c)]	2.5	600	0.4

	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
Toluene	Annual	2.3	- (a)	-
	24-hour(b) (c)	2.7	600	0.5
Ethylbenzene	Annual	2.5	- (a)	-
	24-hour(b) (c)	3.0	600	0.5
Xylene	Annual	2.5	- (a)	-
	24-hour(b) (c)	2.9	600	0.5
PM_{10} (d)	Annual	69.5	20	347.5
	24-hour	82.0	50	164.0
$PM_{2.5}$ (d)	Annual	34.7	10	347.5
	24-hour	41.0	25	164.0
Deposited Dust	24-hour	94.4	200 mg/m^2/day	47.2

(a) No relevant AQS;
(b) Total VOC AQS;
(c) 3 exceedances of the AQS allowed; and
(d) Monitored using the MiniVol sampler.

Table 6.5-5: Baseline Average Air Quality Concentrations for Pollutants Monitored at Lokichar

	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	2.0	40	5.0
	24-hour(c)	2.4	188	1.3
	1-hour	4.1	200	2.0
SO_2	Annual	1.3	50	2.7
	24-hour(c)	1.6	20	7.9
	10-minute	4.4	500	0.9
O_3	Annual	33.3	- (a)	-
	8-hour	46.6	100	46.6
	1-hour	66.6	235	28.3
Benzene	Annual	2.2	- (a)	-
	24-hour(b) (c)	2.5	600	0.4
Toluene	Annual	2.3	- (a)	-

	Averaging Period	Concentration (µg/m³, unless stated)	AQS (µg/m³, unless stated)	Concentration as % of AQS
	24-hour(b) (c)	2.7	600	0.5
Ethylbenzene	Annual	2.5	- (a)	-
	24-hour(b) (c)	3.0	600	0.5
Xylene	Annual	2.5	- (a)	-
	24-hour(b) (c)	2.9	600	0.5
PM_{10}(d)	Annual	-	20	-
	24-hour	-	50	-
$PM_{2.5}$(d)	Annual	-	10	-
	24-hour	-	25	-
TSP	Annual	34.5	140	24.6
	24-hour	40.7	200	20.3
Deposited Dust	24-hour	210.9	200 mg/m²/day	105.4

(a) No relevant AQS;
(b) Total VOC AQS;
(c) 3 exceedances of the AQS allowed; and
(d) No PM_{10} or $PM_{2.5}$ monitoring was undertaken at this location.

Table 6.5-6: Baseline Average Air Quality Concentrations for Pollutants Monitored at Kapese Camp

	Averaging Period	Concentration (µg/m³, unless stated)	AQS (µg/m³, unless stated)	Concentration as % of AQS
NO_2	Annual	1.0	40	2.4
	24-hour(c)	1.1	188	0.6
	1-hour	1.9	200	0.9
SO_2	Annual	0.6	50	1.2
	24-hour(c)	0.7	20	3.6
	10-minute	2.0	500	0.4
O_3	Annual	28.4	- (a)	-
	8-hour	46.6	100	39.7
	1-hour	66.6	235	24.1
Benzene	Annual	2.2	- (a)	-

	Averaging Period	Concentration (µg/m³, unless stated)	AQS (µg/m³, unless stated)	Concentration as % of AQS
	24-hour[b] [c]	2.5	600	0.4
Toluene	Annual	2.3	- [a]	-
	24-hour[b] [c]	2.7	600	0.5
Ethylbenzene	Annual	2.5	- [a]	-
	24-hour[b] [c]	3.0	600	0.5
Xylene	Annual	2.5	- [a]	-
	24-hour[b] [c]	2.9	600	0.5
PM_{10}[d]	Annual	21.7	20	108.6
	24-hour	25.6	50	51.2
$PM_{2.5}$[d]	Annual	5	10	49.9
	24-hour	5.9	25	23.6
Deposited Dust	24-hour	152.1	200 mg/m²/day	76.1

(a) No relevant AQS;
(b) Total VOC AQS; and
(c) 3 exceedances of the AQS allowed; and
(d) Monitored using the Osiris air monitoring device.

Table 6.5-7: Baseline Average Air Quality Concentrations for Pollutants at All Monitoring Locations

	Averaging Period	Concentration (µg/m³, unless stated)	AQS (µg/m³, unless stated)	Concentration as % of AQS
NO_2	Annual	1.0	40	2.4
	24-hour[c]	1.2	188	0.6
	1-hour	2.0	200	1.0
SO_2	Annual	1.0	50	1.9
	24-hour[c]	1.1	20	5.9
	10-minute	3.2	500	0.6
O_3	Annual	30.9	- [a]	
	8-hour	43.3	100	43.3
	1-hour	61.8	235	26.3

	Averaging Period	Concentration ($\mu g/m^3$, unless stated)	AQS ($\mu g/m^3$, unless stated)	Concentration as % of AQS
Benzene	Annual	2.1	- (a)	-
	24-hour (b) (c)	2.5	600	0.4
Toluene	Annual	2.3	- (a)	
	24-hour (b) (c)	2.7	600	0.5
Ethylbenzene	Annual	2.5	- (a)	
	24-hour (b) (c)	3.0	600	0.5
Xylene	Annual	2.5	- (a)	
	24-hour (b) (c)	2.9	600	0.5
PM_{10} (d)	Annual	48.1	20	240.7
	24-hour	56.8	50	113.6
$PM_{2.5}$ (d)	Annual	22.7	10	227.1
	24-hour	26.8	25	107.2
Deposited Dust	24-hour	111.4	200 $mg/m^2/day$	55.7

(a) No relevant AQS;
(b) Total VOC AQS;
(c) 3 exceedances of the AQS allowed; and
(d) Osiris data for Kapese not included in calculations due to high levels of human activity in the area during monitoring.

6.5.6 Discussion

NO_2

Concentrations at all the monitoring locations are low, compared to the AQS. Average concentrations are comparable, with annual average concentrations ranging from 0.4 $\mu g/m^3$ at Twiga to 2.0 $\mu g/m^3$ at Lokichar. The average of the TAN monitoring locations is 0.6 $\mu g/m^3$. The maximum concentration observed at any of the stations is 5.9 $\mu g/m^3$ at Lokichar and the minimum concentration observed was 0.1 $\mu g/m^3$.

The average concentrations observed at all stations are less than 5% of the standard for any of the relevant averaging periods. A plot of the data is included as Figure 6.5-3 below.

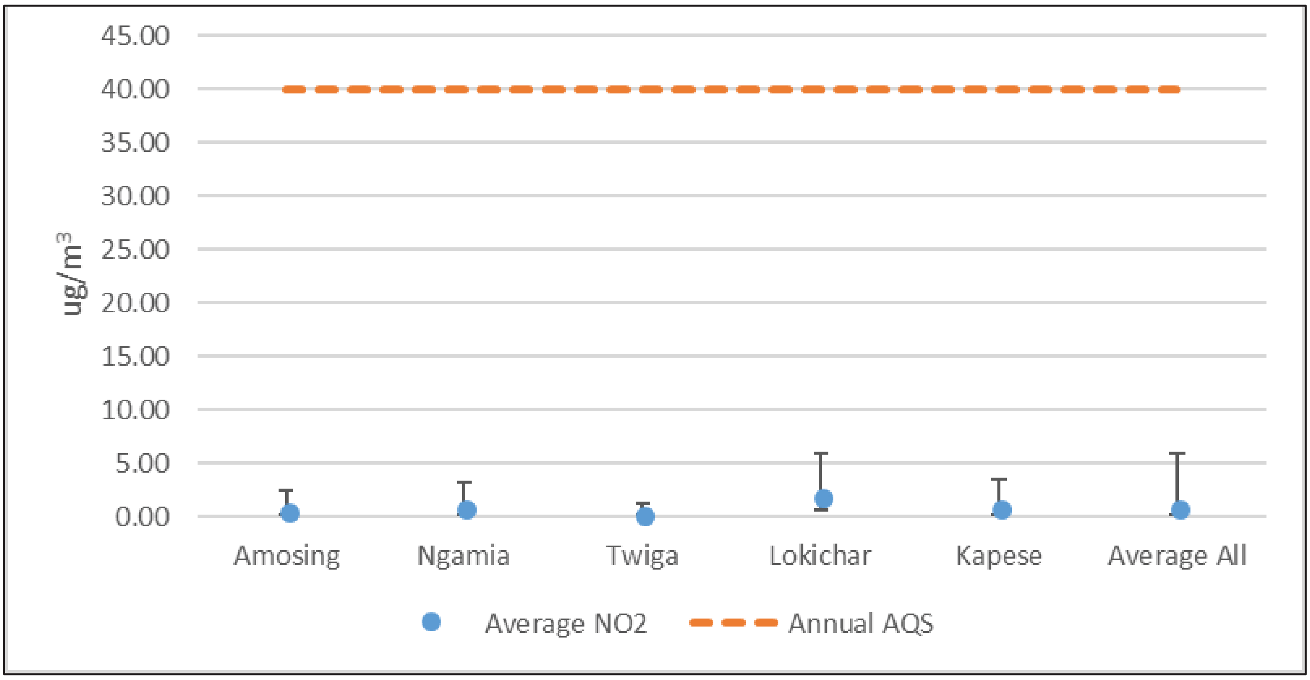


Figure 6.5-3: Annual Average Monitored NO_2 Concentrations (µg/m^3)

SO_2

Concentrations at all the monitored locations are low, compared to the AQS. Average concentrations are all omparable, with an annual average concentration ranging from of 0.7 µg/m^3 at Kapese to 1.5 µg/m^3 at Lokichar. The average of the TAN monitoring locations is 1.0 µg/m^3. The maximum concentration observed at any station is 8.1 µg/m^3 at Lokichar and the minimum concentration was 0.5 µg/m^3.

The average concentrations observed at all stations are less than 9% of the standard for any of the relevant averaging periods. A plot of the data is included as Figure 6.5-4.

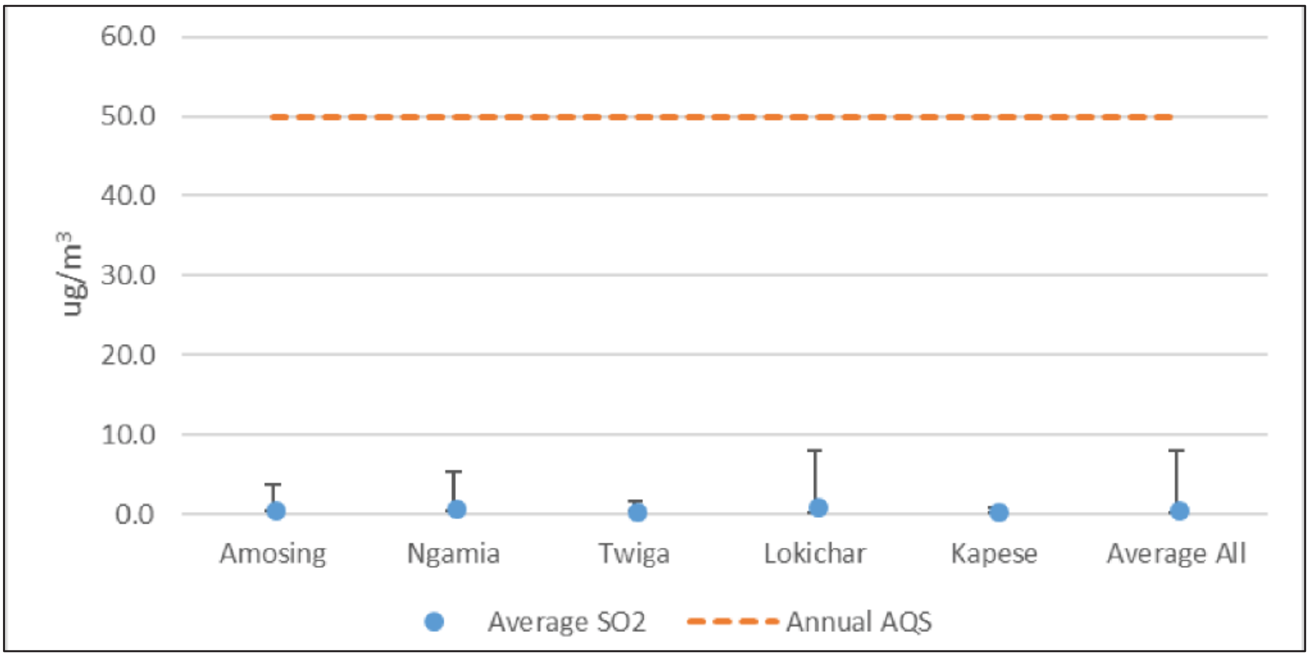


Figure 6.5-4: Annual Average Monitored SO_2 Concentrations (µg/m^3)

O_3

Concentrations are comparable at all monitoring locations, with annual average concentrations[6] ranging from 26.7 µg/m^3 at Ngamia to 36.4 µg/m^3 at Twiga. The average of the TAN monitoring locations is 31.0 µg/m^3. The maximum concentration observed at any station is 74.5 µg/m^3 at Twiga and the minimum concentration is 2.5 µg/m^3 at Amosing.

The average concentrations observed at all stations are less than 51% of the standard for any of the relevant averaging periods. A plot of the data is included as Figure 6.5-5 below.

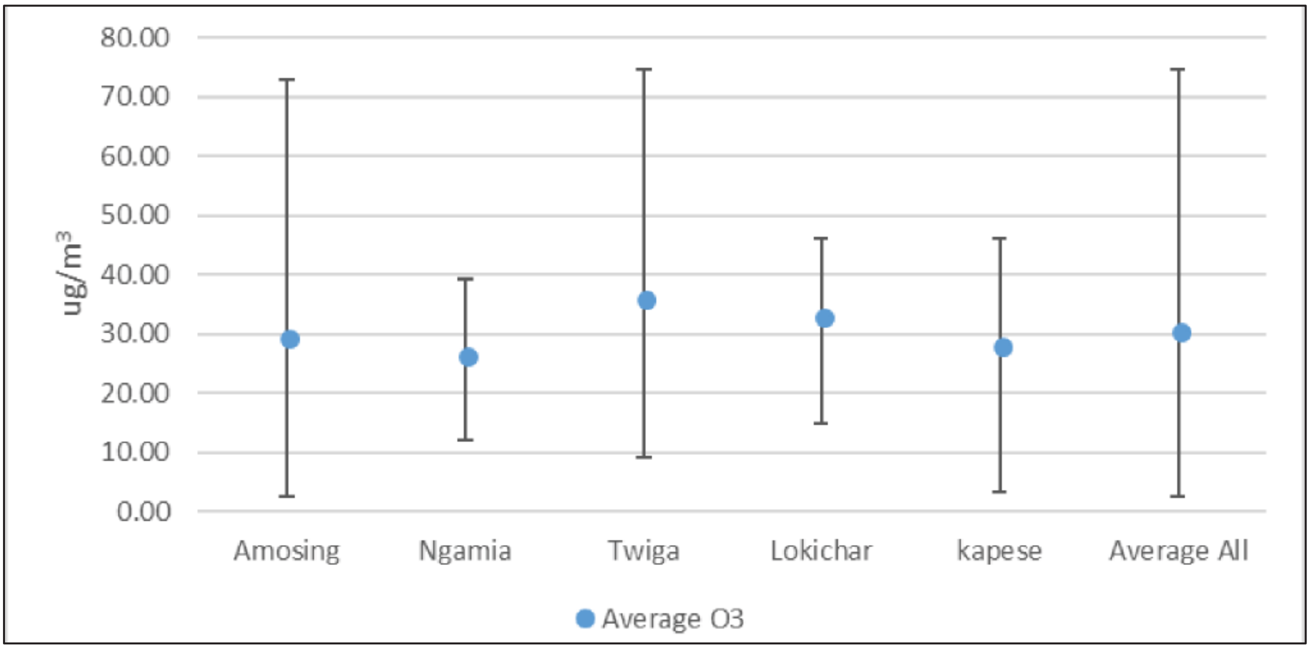


Figure 6.5-5: Annual Average Monitored O_3 Concentrations (µg/m^3)

BTEX

There are no AQS values for annual BTEX concentrations. There is a Kenyan AQS for 24-hour Total VOCs of 600 µg/m^3, which is the closest applicable standard, but this would include all VOC species cumulatively and is applicable for a different averaging period than presented for the baseline. Although there is no relevant annual AQS for BTEX, the baseline data allows for a comparison to be made with the operational phase of the Project.

Benzene

Concentrations are comparable at all monitoring locations, with annual average concentrations all below the lower limit of detection for the analysis method used. When using the lower limit of detection concentration, the average concentrations observed at all stations are less than 0.5% of the 24-hour total VOC standard. A plot of the data is included as Table 6.5-5 below.

[6] For O_3, there is no annual AQS. AQSs for O_3 are for 8hr and 1hr periods only.

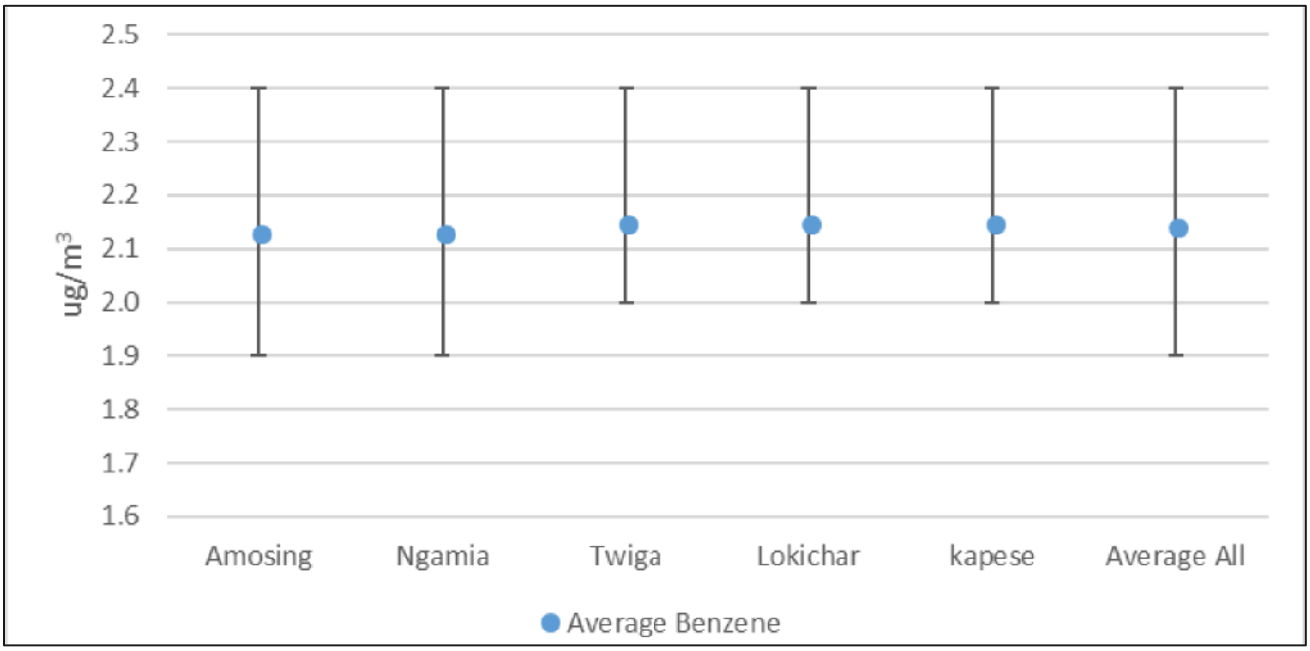


Figure 6.5-6: Annual Average Monitored Benzene Concentrations (µg/m³)

Toluene

Concentrations are comparable at all monitoring locations, with annual average concentrations all below the lower limit of detection for the analysis method used. Annual average concentrations are less than 0.5% of the 24-hour total VOC standard. A plot of the data is included as Table 6.5-7 below.

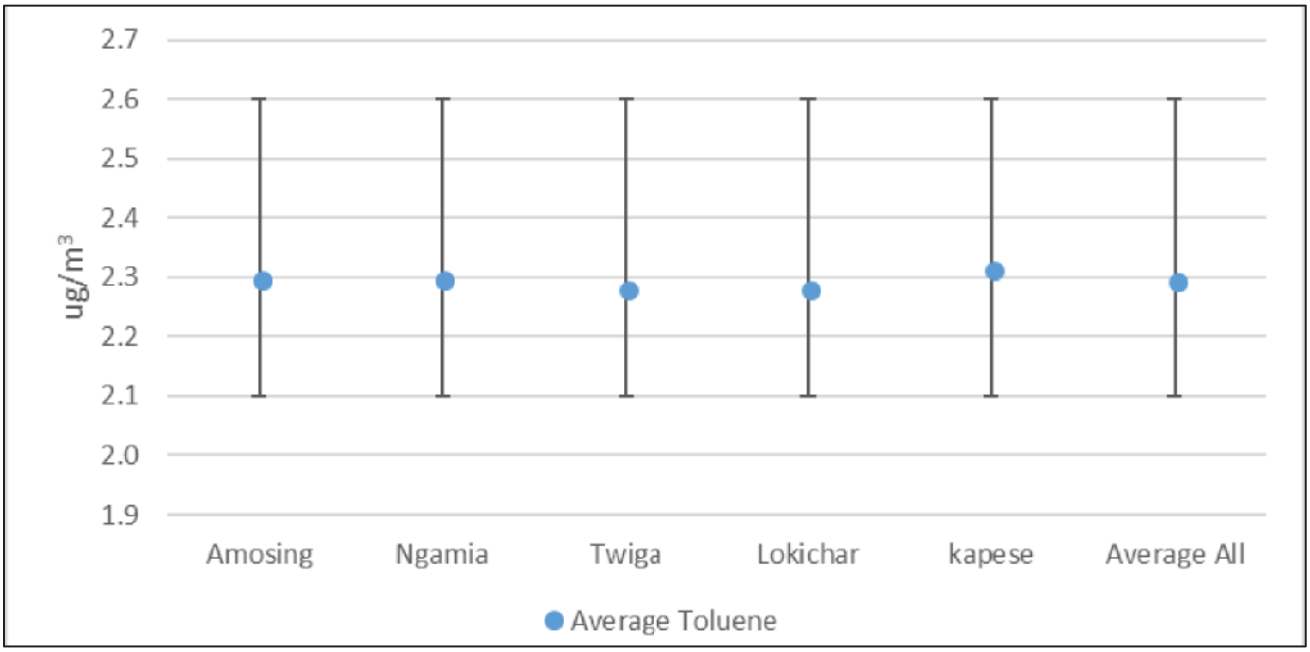


Figure 6.5-7: Annual Average Monitored Toluene Concentrations (µg/m³)

Ethylbenzene

Concentrations are comparable at all monitoring locations, with annual average concentrations all below the lower limit of detection for the analysis method used. Annual average concentrations are less than 0.5% of the 24-hour total VOC standard. A plot of the data is included as Figure 6.5-8 below.

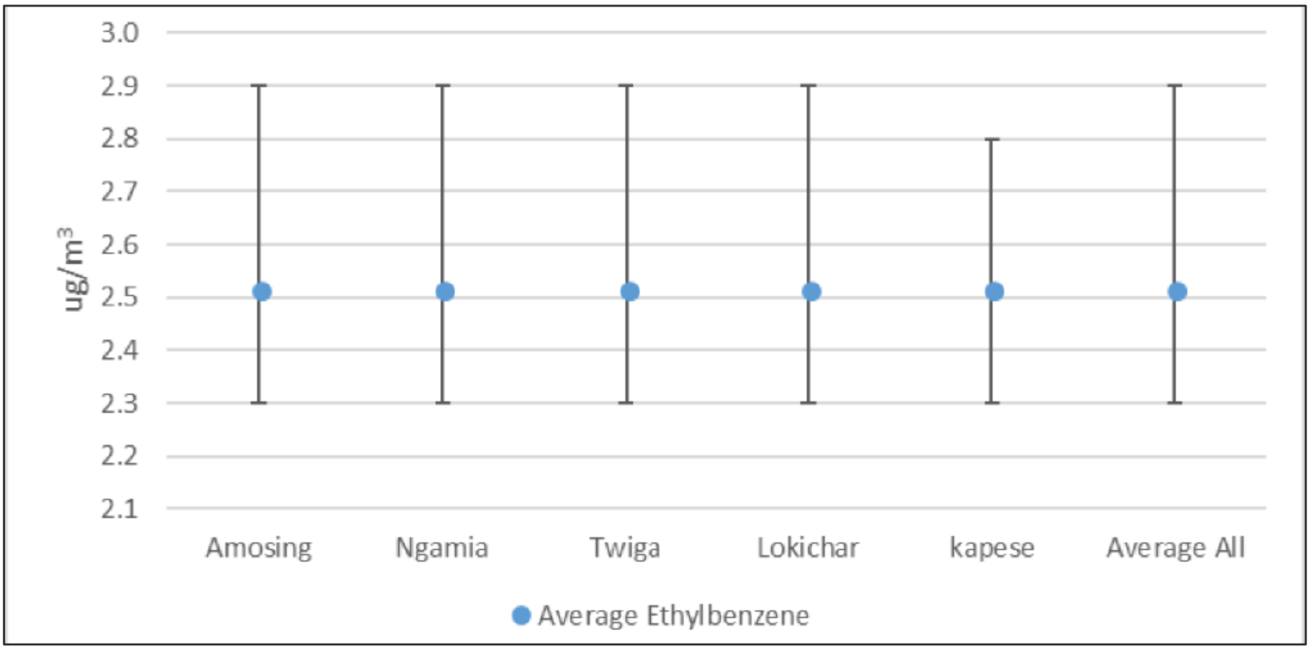


Figure 6.5-8: Annual Average Monitored Ethylbenzene Concentrations (µg/m³)

Xylene

Concentrations are comparable at all monitoring locations, with annual average concentrations all below the lower limit of detection for the analysis method used. Annual average concentrations are less than 0.5% of the 24-hour total VOC standard. A plot of the data is included as Figure 6.5-9 below.

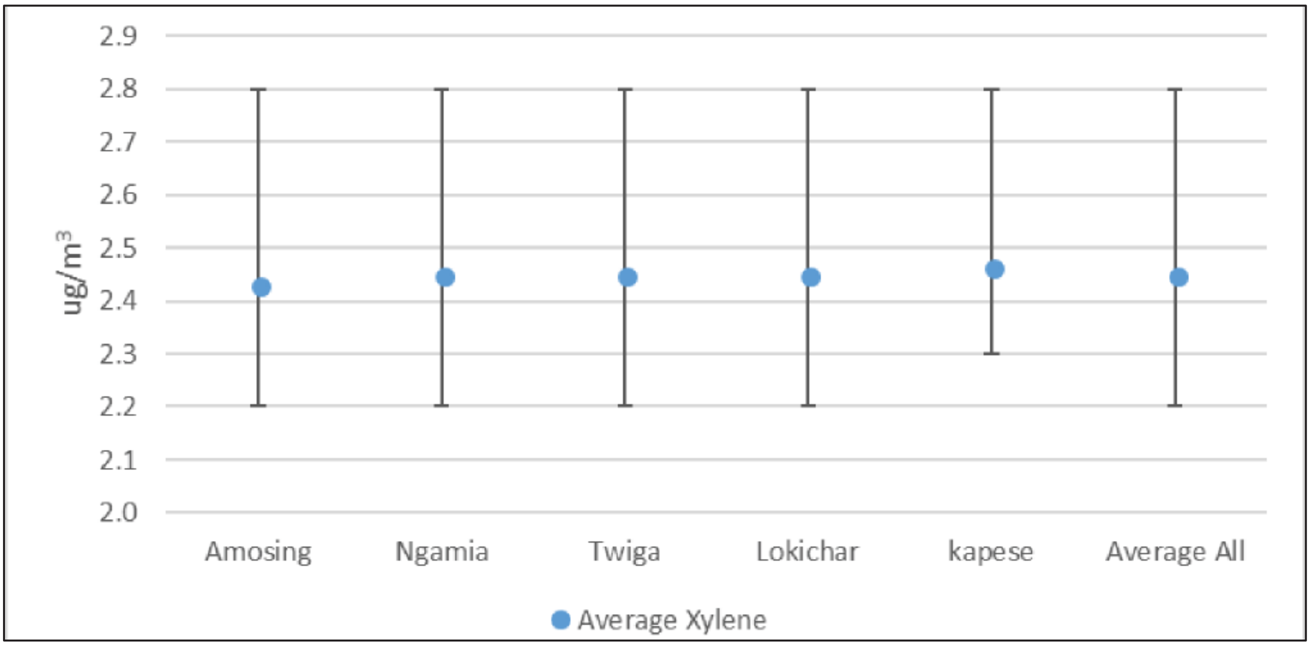


Figure 6.5-9: Annual Average Monitored Xylene Concentrations (µg/m³)

Total Suspended Particles/Total Particulate Matter

Concentrations were observed at the Kapese Camp with an average concentration of 34.5 µg/m³. The maximum concentration observed is 1,718 µg/m³ but the high concentrations are generally discrete events, which could include meteorological events (such as dust storms) and/or vehicle movements, which do not occur over extended time periods.

The average concentration is less than 30% of the standard for any of the relevant averaging periods. The minimum concentration recorded was 0.1 µg/m^3. A plot of the data is included as Figure 6.5-10 below.

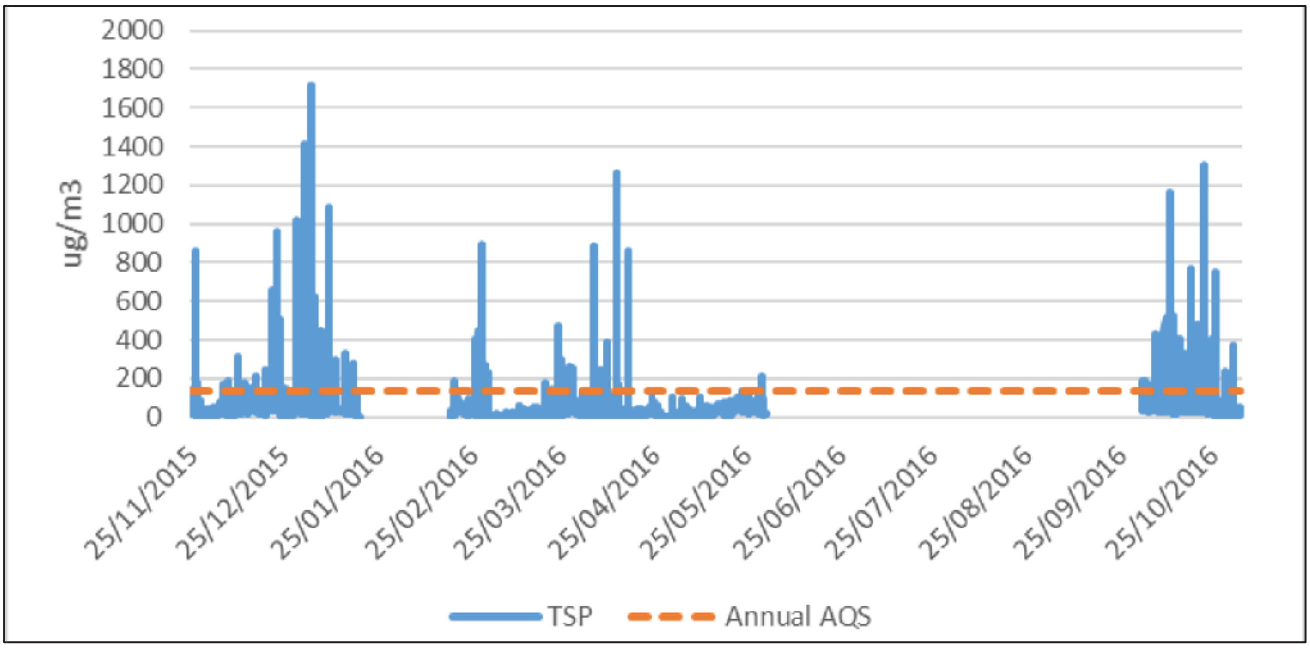


Figure 6.5-10: Osiris Monitored Total Suspended Particles (TSP) Concentrations at Kapese (µg/m^3)

PM_{10}

Data was gathered with an Osiris at the Kapese Camp with an observed annual average concentration of 21.7 µg/m^3. The maximum concentration recorded was 967 µg/m^3. The annual average concentration is approximately 109% of the AQS, although the 24-hour averaging period is approximately 50% of the AQS. The minimum concentration recorded was 0.1 µg/m^3. A plot of the data is included as Figure 6.5-11.

Concentrations were recorded for 24-hour periods using MiniVol samplers at the TAN locations and an average concentration of 56.8 µg/m^3 was observed. The maximum concentration observed was 97 µg/m^3 at Amosing during December 2017. The annual average concentration is approximately 240% of the AQS, although the 24-hour averaging period is approximately 114% of the AQS. The minimum concentration observed was 16 µg/m^3 at Ngamia during December 2017. A plot of the data is included as Figure 6.5-12.

With regard to the baseline for the annual average concentration being greater than the AQS (20 µg/m^3), the AQS is the IFC Guideline value, which is most stringent. The IFC also has interim targets 1, 2 and 3, which have standards of 70, 50 and 30 µg/m^3 respectively. These targets are seen as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high (WHO, 2005). The Kenyan standard for annual PM_{10} is 50 µg/m^3 at both the boundary and off site, which corresponds with the IFC interim target 2.

Elevated particle concentrations are likely to be related to the naturally dusty environment and meteorological events, such as periods of high wind speeds or periods of low precipitation. They could also be related to elevated source conditions in the area, including burning and exhaust emissions. During the 2015 to 2017 monitoring periods, Kapese camp was well established and contained multiple potential emissions sources. Similarly, during the later monitoring periods, the EOPS development was operational and was therefore a potential PM emission source.

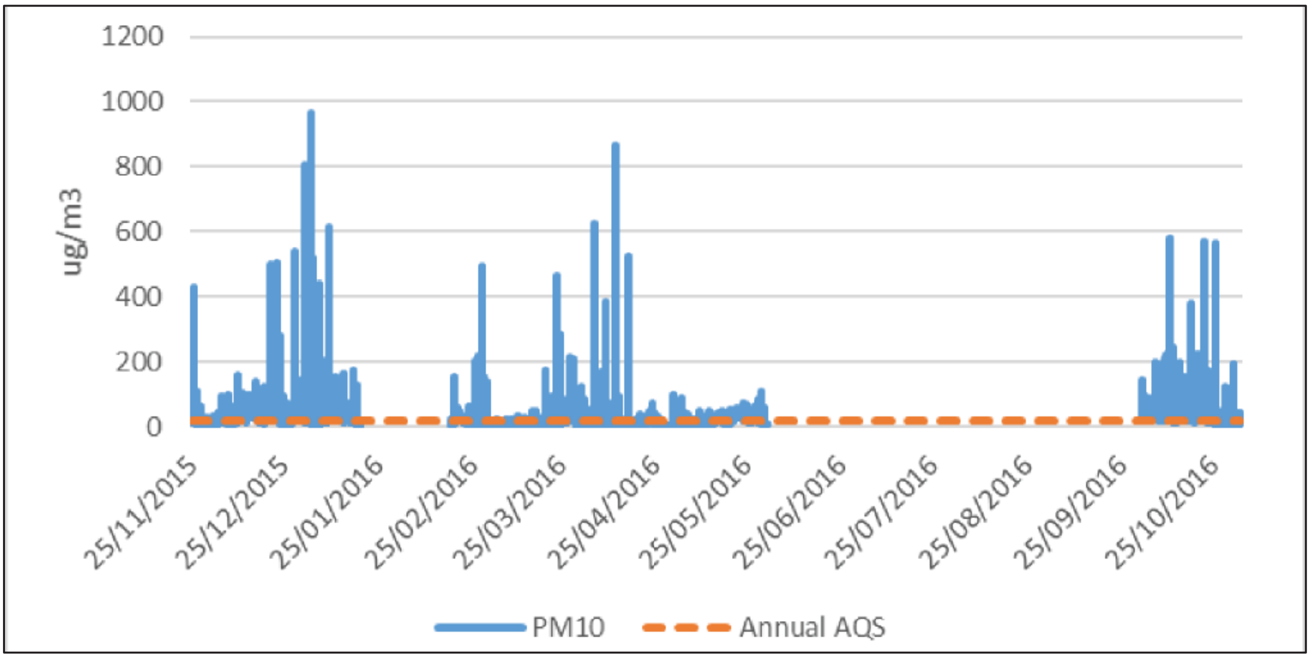


Figure 6.5-11: Osiris Monitored PM_{10} Concentrations at Kapese (µg/m³)

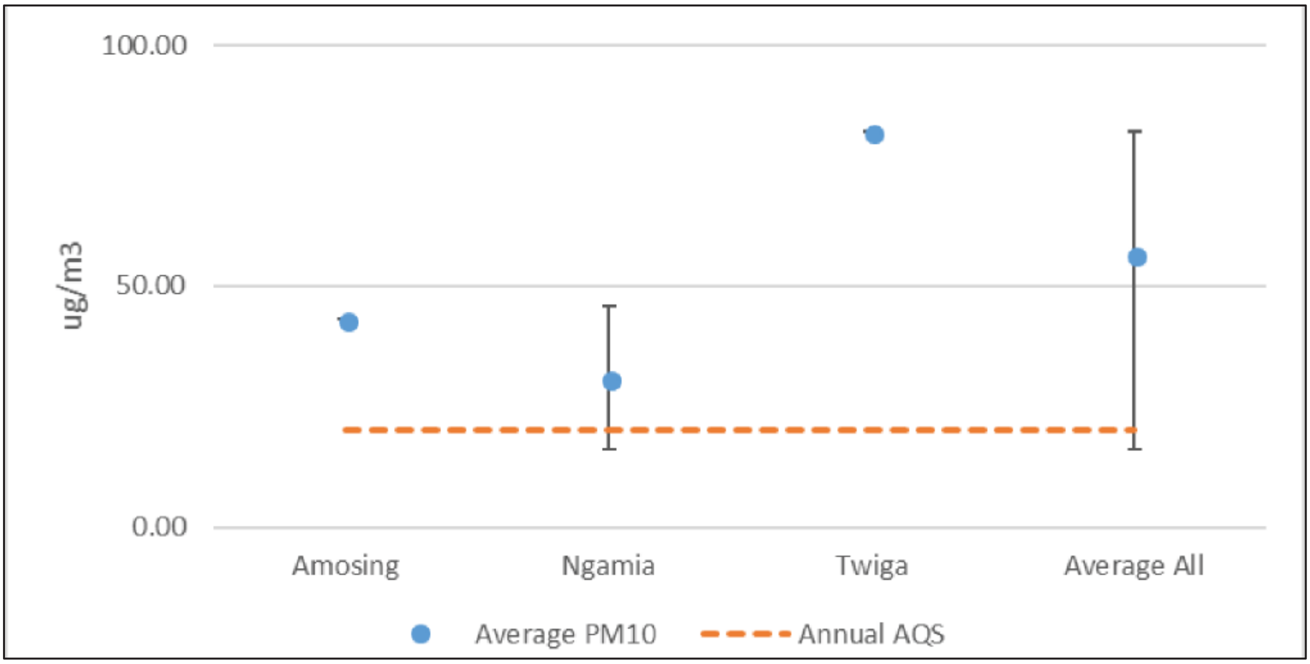


Figure 6.5-12: Annual Average MiniVol Monitored PM_{10} Concentrations (µg/m³)

$PM_{2.5}$

Data was gathered with an Osiris at the Kapese Camp with an observed annual average concentration of 5.0 µg/m³. The maximum concentration observed was 208 µg/m³. The annual average concentration w approximately 50% of the AQS, although the 24-hour averaging period is approximately 24% of the AQS. The minimum concentration recorded was 0.03 µg/m³. A plot of the data is included as Figure 6.5-13.

Data was gathered for 24-hour periods using MiniVol samplers at the TAN locations with an observed average concentration of 26.8 µg/m³. The maximum concentration recorded is 42 µg/m³ at Amosing during December 2017 and Ngamia during March 2019. The annual average concentration is approximately 227% of the AQS, although the 24-hour averaging period was approximately 107% of the AQS. The minimum concentration observed is 0 µg/m³ at Amosing during March 2019. A plot of the data is included as Figure 6.5-14.

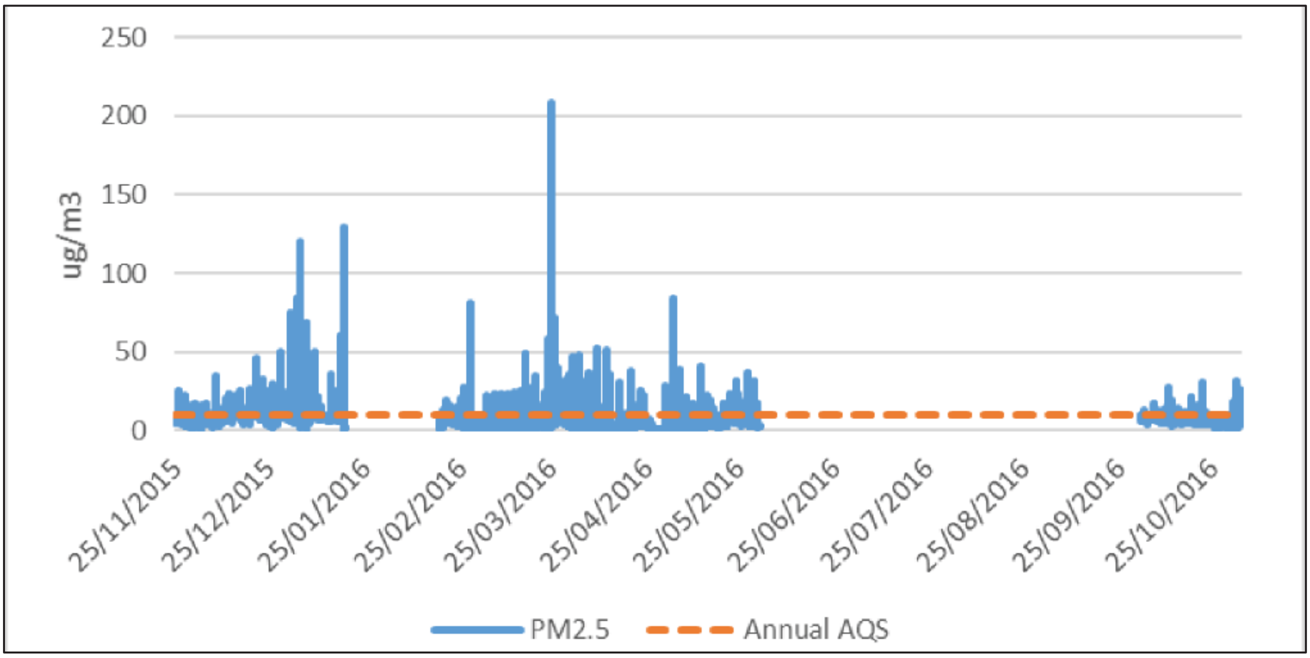


Figure 6.5-13: Osiris Monitored $PM_{2.5}$ Concentrations at Kapese (µg/m³)

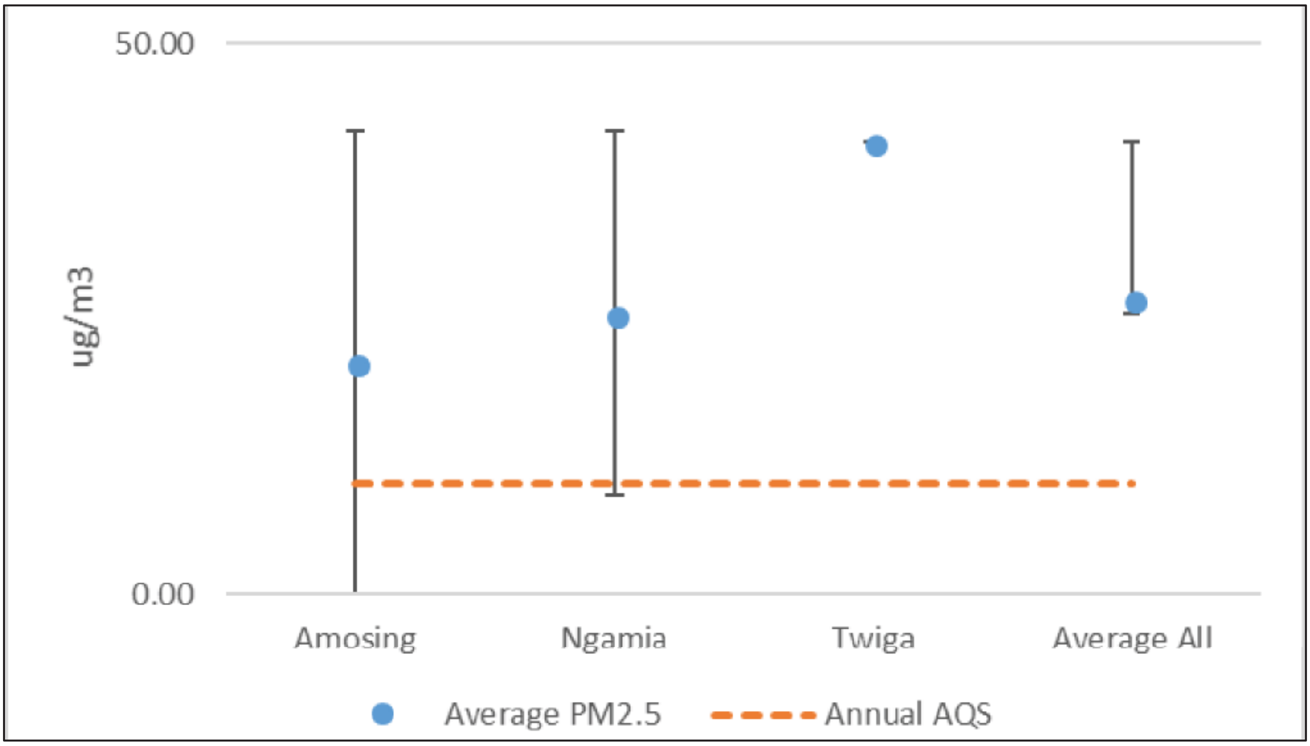


Figure 6.5-14: Annual Average MiniVol Monitored $PM_{2.5}$ Concentrations (µg/m³)

Deposited Dust

Concentrations are much lower at Amosing than the other monitored locations, with an average concentration of 7.0 mg/m^2/day recorded at Amosing increasing to 247 mg/m^2/day at Lokichar. It should be noted that Amosing only has a limited data set of 3 months, which will contribute to the lower concentrations. Unusually high deposited dust concentrations were monitored during August 2016 at all locations (particularly high at Kapese), and during March 2016 at Lokichar and Kapese, resulting in the high annual average observed at Lokichar. The average of the TAN monitoring locations is 80.0 mg/m^2/day. The maximum concentration observed at any station is 909 mg/m^2/day at Lokichar, which occurred during August 2016. The minimum concentration observed at any station is 0.3 mg/m^2/day at Ngamia.

The average concentrations observed at any location excluding Lokichar are less than 90% of the relevant standard of 200 mg/m^2/day. The average concentration at Lokichar exceeds the AQS by 23.3%, which can be attributed to the two months of particularly high concentrations mentioned above. A plot of the data is included as Figure 6.5-15 below.

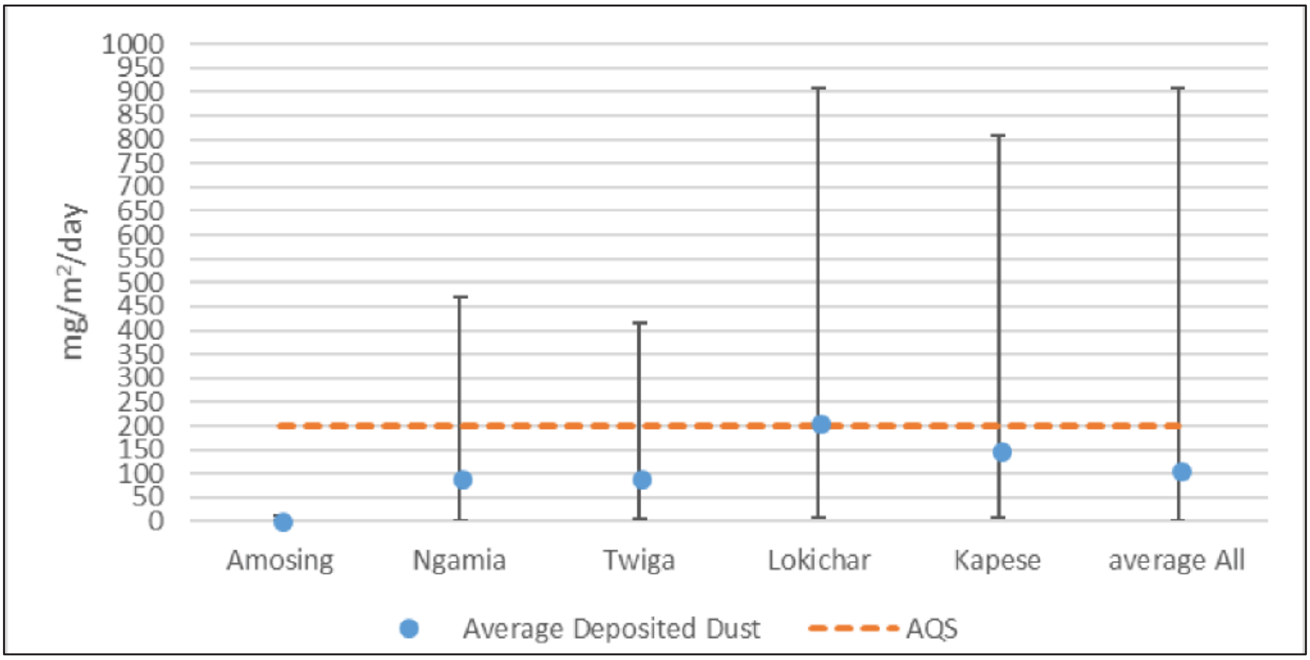


Figure 6.5-15: Daily Average Monitored Deposited Dust Concentrations (mg/m^2/day)

6.6 Noise and Vibration

Noise baseline data gathering was completed within the AoI during five field surveys between 2015 and 2019. The baseline noise data gathering locations were associated with potential receptors in the area where human activity is expected to occur.

No vibration data was gathered as part of the ESIA baseline. Due to the greenfield nature of the AoI, the baseline vibration is assumed to be negligible. The effects assessment of changes in vibration will be completed as a comparative change based on predicted changes in activity associated with the Project.

6.6.1 Noise Guidelines

Project standards for noise during the Project operations have been derived based upon a review of Kenyan regulations and standards (NEMA, 2009), the World Bank Group General EHS Guidelines (WBG EHS Guidelines; 2007), and consideration of the baseline environmental setting. A noise position paper prepared by Golder in November 2016 (Golder, 2016a) discusses both Kenyan regulations and standards and the WBG

EHS Guidelines. It recommends that the WBG EHS Guidelines should be applied to the Project as they allow the existing baseline to be taken into consideration. TKBV confirmed with NEMA, in a minuted meeting, that the WBG EHS Guidelines could be used as the Project standard for the Upstream projects. The WBG EHS Guidelines was used as the Project standard for the EOPS Phase II ESIA.

The receiving environment for the AoI is best categorised as Residential under the WBG EHS Guidelines. Therefore, the A-weighted one-hour equivalent sound level (L_{Aeq}) limit at receptors, represented by the baseline noise monitoring locations discussed below, is 55 dBA during the daytime (07:00 to 22:00) and 45 (A-weighted decibels) dBA during the night-time (22:00 to 07:00) during operations.

The WBG EHS Guidelines allows for either the sound level limits presented or a maximum increase in background levels of 3 dB at a given receptor location off-site. Since noise is expressed on a logarithmic scale (i.e., 45 decibels (dB) + 45 dB = 48 dB), the 3 dB maximum increase in background levels considers the option for one to produce no more noise than what already exists at a receptor.

6.6.2 Secondary Data

There is no known data for noise or vibration in the AoI other than the primary data gathered as part of the ESIA baseline data gathering associated with the Project.

6.6.3 Primary Data

6.6.3.1 Methods

Baseline noise levels were measured at the following five locations across the AoI:

- Lokichar;
- Twiga 1;
- Amosing 5;
- Ngamia 5/6; and
- Kapese Camp.

These noise monitoring locations[7] were selected to characterise the baseline noise environment at all identified sensitive receptors in the AoI.

The noise data gathering was designed in general accordance with the requirements of ISO 1996 Parts 1 and 2 (ISO, 2003; ISO, 2007), which provides guidance on the equipment to be used, conditions under which noise measurements should be undertaken, measurement parameters and appropriate siting of monitoring equipment.

Continuous, unattended noise monitoring was carried out at each noise monitoring location for a minimum 24- hour period, on five separate field visits: October 2015, January 2016, October 2016, December 2018, and March 2019. The exact location of noise monitoring set up considered security and accessibility. The noise monitoring locations are described in Table 6.6-1 below and presented in Figure 6.6-1.

Where necessary, noise monitoring was repeated at certain locations due to insufficient length of data collected (i.e., less than 24- hours) or where there appeared to be anomalous data.

[7] Data was also gathered from locations at Lomokamar and Ekales-2 in October 2015, however, due to the quality of the data collected, these results are not considered suitable for use in the baseline.

Table 6.6-1: Noise Monitoring Locations

Noise Monitoring Locations	Measurement Date					Representative Village	Latitude/Longitude [1]
	Oct-15	Jan-16	Oct-16	Dec-18	Mar-19		
Lokichar	√					Lokichar	Northing: 02º23'02.6" Easting: 35º38'41.8"
Twiga 1	√	√		√		Kapetatuk / Lomokamar	Northing: 02º24'24.1" Easting: 35º43'03.8"
Amosing 5	√	√	√		√	Lopuroto	Northing: 02º10'53.7" Easting: 35º47'01.9"
Ngamia 5/6			√	√		Kodekode	Northing: 02º12'42.0" Easting: 35º45'36.1"
Kapese Camp	√					Kapese Village	Northing: 02º21'51.8" Easting: 35º42'20.4"

[1] The latitude and longitude reported here were measured during the October 2015 field visit. Monitoring locations during subsequent visits were in the same general area but exact coordinates may have varied.

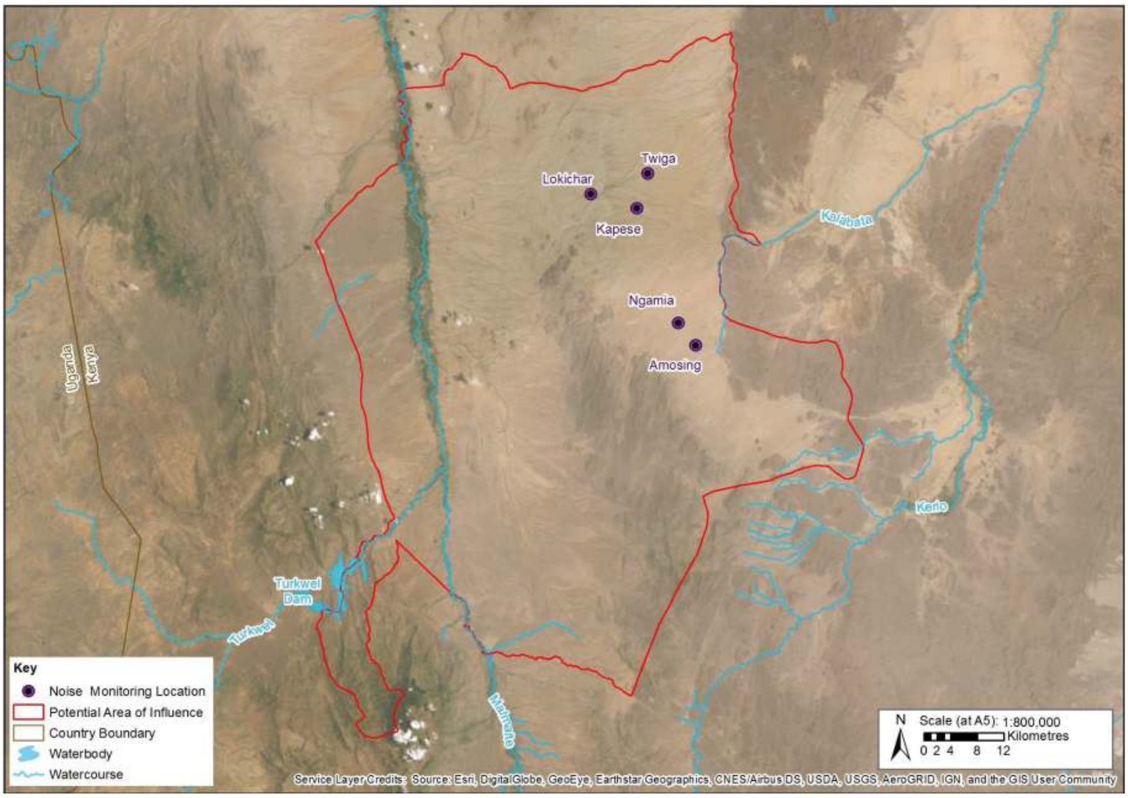


Figure 6.6-1: Noise Monitoring Locations

The sound level meters (SLMs) used for the noise monitoring program were a Larson Davis SoundExpert® LxT SLM and a Norsonic 140 SLM, both of which meet the International Electrotechnical Commission (IEC) Class 1 classification. The microphones were protected with an environmental windscreen and mounted at a height of approximately 1.5 m above ground level. The microphones were connected by cable to the SLMs which were housed in a weather-protected case. The SLMs were calibrated on-site before each measurement with a portable calibrator. The SLMs were within their required laboratory calibration period during the survey, as was the field calibrator. After each 24- hour measurement was complete, the equipment was removed from the respective location and the data were downloaded. Meteorological conditions were noted for each monitoring period, with measurements completed during periods when conditions were generally appropriate for measuring ambient noise levels. The "*noise floor*" of the SLMs, below which electronic "*noise*" in the instrument makes accurate measurement impossible, is approximately 20 dB.

The data collected at each location included either 1- minute, 10- minute, or 1- hour equivalent (L_{Aeq}) and statistical (L_{A90}) sound levels. The L_{Aeq} is the equivalent continuous sound level, which in a stated time and at a stated location, has the same energy as the time varying noise level. It is common practice to measure L_{Aeq} sound levels in order to obtain a representative average sound level. The L_{A90} is defined as the sound level exceeded for 90% of the time and is used as an indicator of the "ambient" noise level. Other parameters were collected and varied across the different location and site visits.

For the purposes of the noise assessment, the 1- minute or 10- minute data were aggregated to give hourly values as well as period averages for daytime and night-time, for comparison with Project standards.

6.6.4 Results

Throughout the noise monitoring periods and at all noise monitoring locations, temperatures were observed to be up to 38°C, and there was little or no precipitation and light winds. Therefore, meteorological conditions were not expected to have a significant effect on measured noise levels.

A summary of the noise monitoring results from the October 2015, January 2016, October 2016, December 2018 and March 2019 monitoring programs are provided in Table 6.6-2 to Table 6.6-6. During the noise monitoring programs, noise data was logged continuously on a one-minute, 10-minute or hourly basis, summarised and reported as statistical (L_{A90}) and equivalent levels (L_{Aeq}) over a one-hour time period. The noise levels presented in the tables below are for the daytime (07:00 to 22:00) and night-time periods (22:00 to 07:00), based on the one-hour data. Note that only equipment used in October 2015 had functionality to report L_{A90} on an interval basis.

In addition, the raw 1- minute, 10- minute, or 1- hour baseline noise monitoring data are presented in graphical form in Annex I.

Table 6.6-2: Lokichar Noise Monitoring Results

	One Hour L_{Aeq} (dBA)		One Hour L_{A90} (dBA)	
	Daytime	Nighttime	Daytime	Nighttime
October 2015				
Average	65.7	62.3	57.4	45.7
Minimum	51.3	42.2	37.5	24.9
Maximum	73.6	69.0	65.8	53.2

Table 6.6-3: Twiga 1 Noise Monitoring Results

	One Hour L_{Aeq} (dBA)		One Hour L_{A90} (dBA)	
	Daytime	Nighttime	Daytime	Nighttime
October 2015				
Average	39.6	40.3	34.8	38.3
Minimum	27.5	36.7	—[1]	34.9
Maximum	44.1	43.2	39.1	40.6
January 2016				
Average	44.5	46.4	42.1	45.0
Minimum	37.2	40.9	34.8	37.8
Maximum	48.9	47.9	47.5	46.6
December 2018				
Average	36.5	27.9	—	—
Minimum	33.3	—[a]	—	—
Maximum	41.1	33.8	—	—

[1] *Noise levels were at or below the approximate noise floor of the SLM.*

Table 6.6-4: Amosing 5 Noise Monitoring Results

	One Hour L_{Aeq} (dBA)		One Hour L_{A90} (dBA)	
	Daytime	Nighttime	Daytime	Nighttime
October 2015				
Average	65.7	67.8	56.2	53.9
Minimum	27.3	59.1	—[1]	30.7
Maximum	77.1	73.7	67.7	59.8
January 2016				
Average	46.2	34.4	—	—
Minimum	34.3	34.1	—	—
Maximum	53.5	35.1	—	—
October 2016				
Average	62.8	40.6	—	—
Minimum	34.5	33.4	—	—
Maximum	71.9	45.8	—	—

	One Hour L_{Aeq} (dBA)		One Hour L_{A90} (dBA)	
	Daytime	Nighttime	Daytime	Nighttime
March 2019				
Average	44.1	29.3	—	—
Minimum	25.4	20.7	—	—
Maximum	48.0	36.5	—	—

[1] *Noise levels were at or below the approximate noise floor of the SLM.*

Table 6.6-5: Ngamia-5/6 Noise Monitoring Results

	One Hour L_{Aeq} (dBA)		One Hour L_{A90} (dBA)	
	Daytime	Nighttime	Daytime	Nighttime
October 2016				
Average	59.9	43.4	—	—
Minimum	39.3	34.1	—	—
Maximum	65.8	47.3	—	—
December 2018				
Average	60.5	42.0	—	—
Minimum	31.0	27.8	—	—
Maximum	68.8	49.6	—	—

Table 6.6-6: Kapese Camp Noise Monitoring Results

	One Hour L_{Aeq} (dBA)		One Hour L_{A90} (dBA)	
	Daytime	Nighttime	Daytime	Nighttime
October 2015				
Average	55.0	30.0	32.5	24.3
Minimum	24.2	21.6	—[1]	—
Maximum	67.2	33.0	38.5	26.9

[1] *Noise levels were at or below the approximate noise floor of the SLM.*

6.6.5 Discussion

The measured minimum and average hourly L_{Aeq} that will be considered in the ESIA are summarised in Table 6.6-7 along with the limit values for residential receptors from the WBG EHS Guidelines . In cases where monitoring was repeated for a given monitoring location, the lowest average hourly measurement results will be used for the effects assessment to provide a more conservative assessment.

Measured baseline noise levels exceeding the limit values are presented in red bold text.

Table 6.6-7: Summary of Measured Baseline Noise Levels

Noise Monitoring Location	Monitoring Period	Minimum One Hour L_{Aeq} (dBA)		Average One Hour L_{Aeq} (dBA)	
		Daytime	Nighttime	Daytime	Nighttime
WBG EHS Guidelines Limit Value		55	45	55	45
Lokichar	October 2015	51.3	42.2	**65.7**	**62.3**
Twiga 1	December 2018	33.3	—[a]	36.5	27.9
Amosing 5	March 2019	25.4	20.7	44.1	29.3
Ngamia 5/6	December 2018	31.0	27.8	**60.5**	42.0
Kapese Camp	October 2015	24.2	21.6	55.0	30.0

[a] Noise levels were at or below the approximate noise floor of the SLM.
Note: Red bold text indicates where the measured noise level is greater than the limit value.

In general, the absence of natural noise sources, such as watercourse noise or wind induced vegetation noise, is noticeable in the AoI and contributes to the low measured noise levels. Similarly, the dispersed nature of settlements means that there are few concentrated areas of human noise. Measured noise levels were frequently at or near the noise floor of the equipment (~20 dBA) at several monitoring locations.

Higher daytime noise levels were recorded at all monitoring locations in comparison to night-time levels, which can generally be attributed to widespread activities during daylight hours, including vehicle traffic and human and livestock movements.

Lokichar data in Table 6.6-7 show that higher noise levels were recorded in the village of Lokichar, at which noise from human activities, including road traffic, human interaction and light engineering/construction activities, contributed to noise levels. Noise levels at Twiga 1 were influenced by occasional truck movements and waste collection activities from the nearby Twiga 2 site. Similarly, occasional truck movements were likely to influence noise levels recorded at Amosing 5. Ngamia 5/6 is located within 200 m of the Lokichar to Lokwamosing Road; traffic from this road likely contributed to the measured noise levels exceeding the WBG EHS Guidelines daytime limit. The Kapese Camp monitoring location was situated in the south-west corner of the compound, within 450 m of the site entrance, with associated vehicle movements likely resulting in higher daytime noise levels.

6.7 Water Quality

This section presents the available baseline information on water quality in the AoI. Due to the ephemeral nature of the surface water in the area, this section largely focusses on the information available on groundwater quality. Information on the physical hydrological setting within the AoI is presented in Section 6.7.

6.7.1 Secondary Data

The groundwater is unlikely to be saline because, since the onset of the formation of the Rift Valley in which the AoI is located, the region has been landlocked and sediment deposition has largely been fluvial or lacustrine in origin. The water trapped in pore spaces in the rocks is fresh (Price, 2014a). Solute concentrations in groundwater may be higher than expected in pure rainfall due to evaporation from the soil zone concentrating the solid content in the rainfall (and therefore the solid content of aquifer recharge) or by direct evaporation from groundwater where the water table is shallow (Price, 2014b). Most of the groundwater encountered during exploration for sources of injection water has been fresh, although some of the groundwater encountered in the volcanics is slightly brackish (Price, 2014a).

Not all groundwater is chemically safe for human consumption or pleasant to taste. The reasons for this may be natural or anthropogenic. Groundwater in Kenya is known to have, amongst other elements, high concentrations of arsenic, boron and fluoride originating from the natural geology that could be present in concentrations that are unacceptable for human consumption (Price, 2014b). For example, groundwater in the volcanic aquifers typically has low total dissolved solids and high bicarbonate, and the volcanic deposits of the EARS are rich in fluoride, which leads to high groundwater fluoride concentrations (BGS, 2018). The Lotikipi Alluvial Aquifer is very saline with conductivity measurements in some samples exceeding 8000 micro- Siemens per centimetre (μS/cm).

The results of water sampling and quality analysis have been collected and collated by TKBV for strategic water resources since 2014. These are groundwater wells used to source exploration supplies and supplement the water supply of local residents (see Section 8.0). The results of the laboratory analysis from these locations have been used to compile an understanding of the baseline groundwater quality in the AoI. The locations within the AoI and with groundwater quality data provided are Kengomo 1, Kengomo 2, East Lokichar WBHC, Ngamia East, Nakukulas 9, Nakukulas 10, Kaengakalalio C/Kaimegur B, Nabolei, ACS Tank Lokichar, Kaimegur BH, Ngamia II and Katilu Hand pump. These locations are shown on Figure 6.7-1.

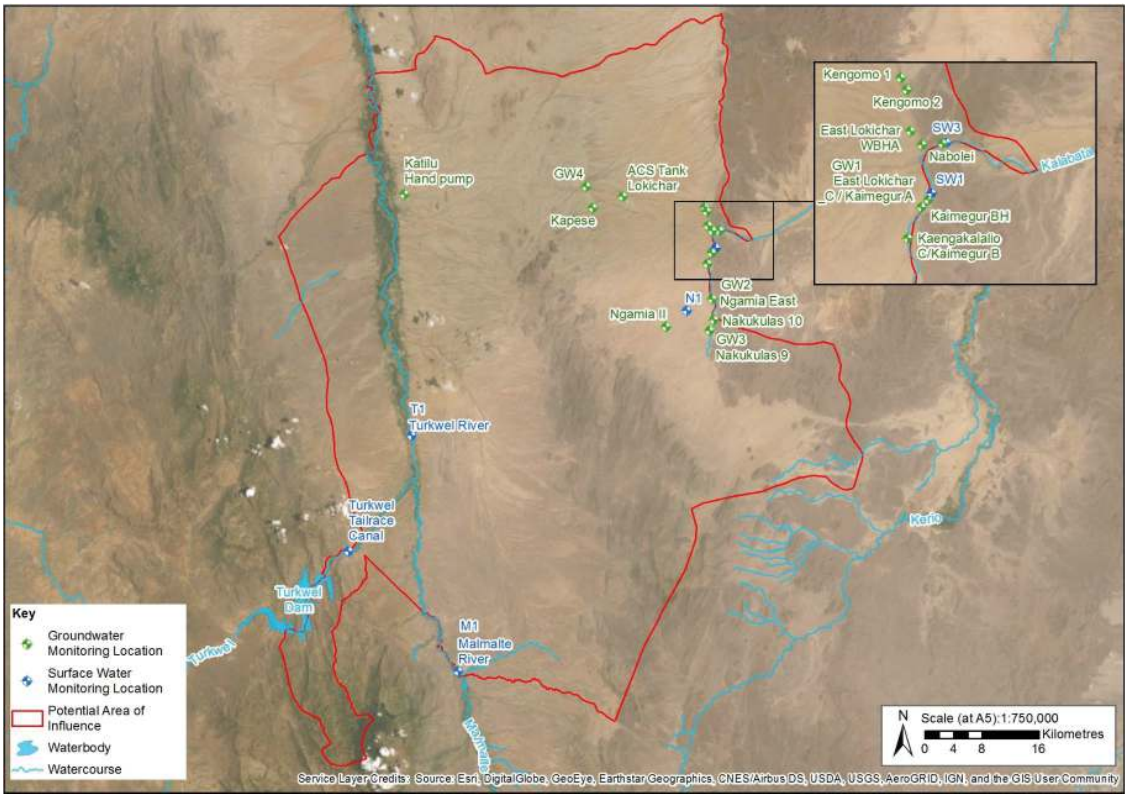


Figure 6.7-1: Groundwater and Surface Water Monitoring Locations

Golder has also taken groundwater samples from some of these locations. The whole water quality dataset has been combined and is discussed in Section 6.7.3.

Historical surface water quality sampling data from the Turkwel Reservoir was collected between 1973 and 1983 before the reservoir dam was constructed (TKBV, 2018a). This data is reproduced in Table 6.7-1. All concentrations are in milligrams per litre (mg/l) unless otherwise stated. The water in the reservoir is slightly alkaline, has a low Total dissolved solids (TDS) concentration, and has low major ion concentrations. In comparison to the Project drinking water standards (Annex I), iron concentrations are higher than the water quality standard.

A comparison to more recent primary data collection for the purposes of the Project development is presented in Section 6.7.3.

Table 6.7-1: Historical Turkwel Reservoir Water Quality Data (mg/l unless stated)

Parameter	Project Standard	1973 – 1975	1978	1983
pH (pH units)	6.5-8.5	7.9	7.8	8.0
Electrical Conductivity (mS/cm)	None	0.172	0.149	0.145
TDS	1000	Not measured	109.2	87.0
Calcium	150	17.3	16.8	18.0
Magnesium	100	4.2	5.3	3.5
Sodium	50	11.5	5.4	Not measured
Potassium	None	3.3	2.8	Not measured
Fluoride	1.5	0.4	1.1	0.4
Chloride	250	5.0	2.0	3.5
Alkalinity (as bicarbonate (HCO_3))	None	104.7	44.7	90.5
Hardness	300	62.7	Not measured	Not measured
Iron	0.3	0.6	Not measured	10.5
Silica (silicon dioxide as silicon (Si))	None	20	Not measured	Not measured

Additional historical data for pH (1998) and specific conductivity (1992 to 1995) are mentioned in the Tullow Technical Report 11 (TKBV, 2018a). These values are presented in comparison to the primary Turkwel Reservoir water quality field parameter data presented in Section 6.7.3.2.

6.7.2 Primary Data

6.7.2.1 Methods

Four field visits were undertaken by the Golder team (23 to 27 November 2015, 25 May 2016 to 01 June 2016, and 24 to 31 August 2016, 10 to 22 March 2019). The two 2016 field surveys were completed to cover the wet season and post-wet season.

Flow in surface watercourses across the AoI is ephemeral and watercourses are commonly dry. Therefore, all of the surface water quality sampling (except from the Malmalte River – location M1) was taken from near-surface groundwater in dry luggas, equivalent to that used as water resources for local communities.

6.7.2.1.1 Sampling for Laboratory Analysis – Groundwater and Surface Watercourses

As part of a wider scheme of groundwater monitoring that is undertaken by TKBV, Golder collected water quality samples from following groundwater wells:

- GW1 (same as Tullow location East Lokichar WBHC);
- GW2 (same as Tullow location Ngamia East);
- GW3 (same as Tullow location Nakukulas 9);
- GW4; and
- GW5.

The Golder surface water locations where samples were taken for laboratory analysis are as follows:

- SW1 – position on the southern lugga that drains the area of the Ngamia and Amosing and discharges into the Kalabata River;
- SW3 - position on the Kalabata River;
- N1 – located downstream of the Ngamia area; and
- M1 - Malmalte River, downstream of the Kainuk crossing[8].

The locations of these groundwater and surface water monitoring locations are shown on Figure 6.7-1. Method statements for sampling were original prepared and presented as part of the Work Plan for Baseline Study (Golder, 2015).

The following provides a summary of the four field trips during which the Golder team took water quality samples:

- 23 to 27 November 2015 – groundwater sampling was undertaken at GW1, GW2, GW3, GW4 and GW5. No surface water was present in the watercourses, so no samples were taken;
- 25 May 2016 to 1 June 2016 – groundwater sampling was undertaken at GW1, GW3 and GW5. No groundwater sample at GW2 was taken as the pump was being removed. A surface water sample was collected from SW3 and also from a hand dug well at SW1, but all other surface water quality monitoring locations were dry;
- 24 to 31 August 2016 – groundwater sampling was undertaken at GW1, GW3, GW4 and GW5. No surface water was present in the watercourses, so no samples were taken; and
- 25 March 2019 – surface water sample from the Malmalte river just downstream of the Kainuk crossing.

6.7.2.1.2 Sampling for Laboratory Analysis – Water Bodies

Five Turkwel Dam and Reservoir water samples were taken by TKBV between May 2018 and December 2018 for laboratory analysis. These samples represent the water in the Turkwel Reservoir near the outflow. Water samples have also been taken regularly from the reservoir tailrace during the period June 2015 to January 2018. These samples are taken from the footbridge located downstream of the tailrace and are obtained using a 1 litre

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[8] It was intended to take the sample from close to the confluence of the Malmalte/Turkwel Rivers, but the sample had to be taken at a location close to Kainuk due to security concerns.

bottle that is submerged by hand into the flowing water. These samples represent the discharge from the power generation process after the water from the Turkwel Reservoir has passed through the turbines.

6.7.2.1.3 Laboratory Analysis and Quality Assurance

The Golder water samples gathered in 2015, 2016 and in March 2019 were collected in labelled bottles and stored in dedicated sample refrigerators before being sent to the (ISO accredited) SGS laboratory in Nairobi.

The analysis parameters and detection limits requested by Golder are included in Annex I. These included major ions, metals, hydrocarbons and sanitary parameters such as coliforms, all of which were selected in order to characterise the baseline chemistry of the water environment and include indicators that could be at risk of release during accidents during operations.

During the 2015 to 2016 campaigns, a combination of field blanks, trip blanks and duplicate samples were used for quality assurance purposes. These samples were also sent to the laboratory for analysis. A field blank is de-ionised water that is exposed to the sampling equipment in the field and handled in the same manner as the actual sample to provide information on the potential for contamination of samples during handling. The trip blank is de-ionised water that is prepared in a bottle at the laboratory and sealed. This sample remains unopened throughout the monitoring visit and is used to understand the potential for contamination of samples resulting from preparation, transport and storage activities. Duplicates are second samples taken from one of the monitoring locations and are used to understand the precision of the field technique and laboratory analysis.

The water samples that were taken from the Turkwel Reservoir and the tailrace by TKBV were sent for laboratory analysis at a Tullow-approved laboratory (TKBV, 2018b).

6.7.2.1.4 Field Parameter Measurements – Groundwater and Surface Watercourses

The water quality sampling undertaken by the Golder team at each of the data gathering locations included recording field parameters (e.g. pH, electrical conductivity, total dissolved solids, dissolved oxygen, temperature and oxidation reduction potential) using a handheld multi-parameter water quality meter. Method statements prepared to provide instruction on taking field parameter measurements were original prepared and presented as part of the Work Plan for Baseline Study (Golder, 2015).

Field parameter measurements were also made on the Malmalte River (M1) by Golder as part of biodiversity fieldwork campaigns in September 2018 (Golder, 2018c) and on 17 March 2019, plus at the Turkwel river downstream of the confluence with the Malmalte (T1) on 13 March 2019.

6.7.2.1.5 Field Parameter Measurements – Water Bodies

TKBV undertook water quality field parameter measurements at the Turkwel Reservoir in October 2016 and October 2017 as part of water supply option survey work (TKBV, 2018a). The reservoir survey work was undertaken by boat between the power station intake at the dam and the uppermost extent of the reservoir near Pinou Gorge (TKBV, 2018b). The locations are presented in TKBV 2018a.

Measurements of turbidity in the Turkwel Reservoir were made as part of the TKBV study (TKBV, 2018a) using two methods; one using a Secchi disc that was lowered into the water until it could no longer be seen and that depth was recorded; and a second using a YSI optical turbidity sensor.

Temperature, dissolved oxygen chlorophyll, blue-green algae[9], dissolved organic matter, pH and specific conductivity were also measured using the YSI sonde, which was lowered through the water to collect a vertical profile of measurements between the surface and the reservoir bed. The YSI sonde was calibrated in the field prior to use and daily quality checks were undertaken using YSI's recommended procedures (TKBV, 2018b).

[9] Not presented in this baseline

6.7.2.2 Results

The laboratory certificates for the analyses undertaken on groundwater and surface water samples taken by Golder are presented in Annex I. The results of the field parameter measurements are also included in Annex I in the form of a summary document

The full results of laboratory analysis undertaken on groundwater and surface water samples taken by TKBV at its strategic groundwater monitoring locations and in the Turkwel Reservoir and tailrace are presented in Annex I, as provided to Golder.

In order to present summary information on the water quality at key monitoring locations in the AoI and compare the results to water quality standards, a series of data and statistics tables have been prepared and are also presented in Annex I. The locations where groundwater and/or surface water concentrations exceed the Project water quality standards in at least one sample from a location are shown on Drawings 6.7-1 to 6.7-4.

6.7.3 Discussion

6.7.3.1 Laboratory Analysis

Summary statistics of the laboratory results for each of the groundwater and surface water sampling locations are presented in Annex I. A comparison to the Project water quality standards has also been undertaken and values greater than the Project standards are highlighted in red in Annex I. The Project standards were developed and presented by Golder (Annex I). National Kenyan standards have been selected, where available; followed by internationally recognised guidelines where national standards are not defined. Where more than one standard is available for the same parameter the more stringent value has been selected.

In general water quality across the AoI can be described as good with no inexplicable exceedances of the Project water quality standards. There are some influences of the natural environment (high concentrations of sodium and fluoride). There is some evidence of sources of human or animal waste.

Groundwater

The laboratory water quality analysis results show that groundwater has a pH close to neutral and typically ranges from around 7 to 8.5. The pH values are mainly within the range of the standard (>6.5 and <8.5), but there are occasional pH values greater than 8.5 measured in samples taken from, GW2 (Ngamia East), GW5, GW3 (Nakukulas 9), Kengakalalio C (Kaimegur B), Kengomo 2 and Kaimegur BH.

Electrical conductivity values typically range from around 0.4 mS/cm to 1.5 mS/cm. Higher electrical conductivity measurements between 1.5 mS/cm and 4 mS/cm were measured in samples taken from GW3 (Nakukulas 9), Kengomo 1, Kengomo 2, Kengakalalio C (Kaimegur B), Nabolei BH and Katilu hand pump. The higher electrical conductivity measurements are mainly, but not exclusively, from deeper boreholes such as Kengomo 1 and Kengomo 2.

Metal concentrations in groundwater are often below the laboratory Limit of Detection (LoD). Metals where all concentrations in all samples from all monitoring locations were below the LoD include beryllium, cadmium, mercury and nickel. When analysed for, boron (either as boron or as boric acid), vanadium, zinc and strontium were most commonly detected at concentrations greater than the LoD (in approximately a third of samples analysed). Aluminium, arsenic, barium, chromium, copper, manganese, iron and selenium were also detected at concentrations greater than the LoD, but in a lower proportion of samples taken. Most metal concentrations are below the selected water quality standards. Occasional exceedance of the Project water quality standards for aluminium, boron (as boric acid or as boron), copper, iron, manganese, selenium and zinc.

The concentrations of major ions are generally below the Project water quality standards. Sodium concentrations are commonly elevated compared to the Project standard of 50 mg/l at all monitoring locations, which is likely to result from natural interactions between water and the geology. Fluoride concentrations are also elevated compared to the Project standard of 1.5 mg/l in some samples from most locations, but elevated concentration have been measured most often in samples taken from GW3 (Nakukulas 9), Kengomo 1, Kengomo 2, Kengakalalio C (Kaimegur B), Nabolei, Kaimegur BH and Katilu hand pump. Occasional exceedances of the chloride standard are also shown in the results from samples taken from Nakukulas 9, GW5, Kengomo 2 and Nabolei. Most samples from Kengomo 1 had chloride concentrations exceeding the Project water quality standard of 250 mg/l.

Nitrate (as NO_3), nitrite, ammonia and phosphate are commonly measured at concentrations above the Project water quality standards and may originate from soils or contact with sources such as human or animal waste.

Concentrations of TDS are high compared to the quality standard in samples taken from GW3 (Nakukulas 9), Kengakalalio C (Kaimegur B), Kengomo 1, Kengomo 2, Nabolei and Katilu hand pump.

Polycyclic aromatic hydrocarbons (PAHs) naphthalene, fluorine and phenanthrene were detected in groundwater occasionally at concentrations above the limit of detection when analysed for in GW1 (Lokichar East WBHC), GW3 (Nakukulas 9) and GW5, but not at GW2 (Ngamia East). The concentrations were typically at or just above the LoD of 0.01 mg/l.

Other hydrocarbon concentrations are also mainly below the LoD. The total petroleum hydrocarbon (TPH) concentration has occasionally been greater than the LoD of 0.01 mg/l. TPH has been detected once out of two samples taken from the boreholes at GW1 (East Lokichar WBHC), GW3 (Nakukulas 9), GW4 and GW5. Benzene and toluene have been detected at concentrations greater than the LoD once out of three samples at GW1 (East Lokichar WBHC) and GW3 (Nakukulas 9), and once out of two samples taken at GW4. Toluene has been detected once out of three samples taken from GW5. All of these detected concentrations occurred as part of the same analysis undertaken on samples from 29 or 30 August 2016 and could represent slight contamination during sampling or laboratory analysis.

Total coliform counts, where measured, are usually greater than the LoD and greater than the faecal coliforms count in the sample from the same location at the same time.

Surface Watercourses

Due to the ephemeral nature of the watercourses and the opportunistic method of sampling, only two surface water samples were taken from the AoI by Golderin 2016; one from SW3 and one from near surface groundwater in a shallow hole dug at SW1. The results can be summarised as follows:

- No concentration above the LoDs were detected for aluminium, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel or selenium. Barium, boron and zinc measured concentrations are below the Project water quality standards;
- The laboratory analyses indicate that the water quality standards for ammonia and total suspended solids were exceeded in the sample taken from SW3, and that ammonia and fluoride concentrations were higher than the standards in the sample taken from SW1;
- Naphthalene was detected at a concentration of 4 mg/l at SW3 and pyrene was detected at a concentration of 0.03 mg/l at SW1. No other hydrocarbons were detected in either sample; and
- The coliform count (total and faecal) for surface water is higher than that for groundwater.

The laboratory analysis results for the surface water sample taken from the Malmalte River near Kainuk in 2019 show that arsenic, beryllium, boron, cadmium, chromium, copper, lead, manganese, nickel, selenium and zinc were not detected at concentrations above the LoD. Other metals were detected with concentrations typically below the Project water quality standards. The exception to this is aluminium, which had a concentration of 0.199 mg/l, which is slightly above the Project water quality standard of 0.1 mg/l. Ammonia and total suspended solids concentrations also exceeded the Project water quality standards. No hydrocarbons were detected at concentrations above the LoD.

Surface Water Bodies

Water in the Turkwel Reservoir has occasional exceedances of the Project water quality standards with respect to concentrations of selenium, aluminium, ammonia (as N), nitrite and phosphate. Arsenic, boron (as boric acid), bromate (as BrO_3), cadmium, chromium, cyanide, copper, lead, lithium, mercury, manganese, nickel and zinc concentrations were not detected above the laboratory LoD. Concentrations of all other parameters analysed were below the Project water quality standards or there is no standard to make a comparison with. The pH of the reservoir water ranged between 7.5 and 8.4, which is similar to the field parameter pH values discussed in Section 6.7.3.2.

Water samples taken from the Turkwel Dam tailrace show that the tailrace water quality is generally similar to the reservoir water quality. As with the reservoir water, arsenic, chromium, cyanide, lead, lithium, mercury and nickel concentrations were also not detected above the laboratory LoD. In addition, selenium was also not detected at concentrations above the laboratory LoD. The pH of the tailrace water is slightly more acidic than the reservoir water (6.65 to 8.02).

Concentrations of sodium, sulphate and alkalinity are higher in the tailrace water samples, and boron (as boric acid), bromate, cadmium, copper, manganese and zinc were all detected above the laboratory LoD in the tailrace water when they were not detected in the reservoir water. However, cadmium and copper were only detected in the tailrace water on one occasion out of 19 samples, so the results may represent anomalous outliers.

Occasion exceedances of the Project water quality standard for iron (total), boron (as boric acid), aluminium, ammonia (as N), nitrite, fluoride, sodium and phosphate were measured in the Turkwel tailrace samples.

No analysis of coliforms, TPH or PAH was undertaken on the samples from the Turkwel Reservoir or the Turkwel Dam tailrace.

6.7.3.2 Field Parameters

Groundwater

A summary of the groundwater field parameter results collected between November 2015 and August 2016 is presented in Table 6.7-2. The complete dataset is included in Annex I.

Table 6.7-2: Summary of Groundwater Field Parameter Measurements

Parameter	Locations				
	GW1	GW2	GW3	GW4	GW5
Temperature (°C)	34.5 to 39.1	34.7	34.7 to 35.2	29.7 to 31.6	33.1 to 34.5
Dissolved Oxygen (%)	16	10.7	31	34.1	23.7
Dissolved Oxygen (mg/l or ppm)	1.15 to 5.51	0.7	1.9 to 3.66	2	1.65 to 3.11
pH	7.73 to 7.95	7.96	7.7 to 8.92	6.6 to 8.59	7.34 to 7.41
Oxidation Redox Potential (mV)	-172.1 to +81.9	-203.9	-166.8 to +62	-120.7	-141.5 to +149.3
Conductivity (µS/cm)	721 to 955	1317	1248 to 1663	525 to 890	924 to 1083
Total Dissolved Solids (mg/l)	360	-	625	263	465

- No measurement made

The field parameter measurements indicate that groundwater has a typical temperature of around 30°C to 35°C.

The pH of groundwater (12 samples in total) ranges from 6.6 (GW4, November 2015) to 8.92 (GW3 August 2016), but it should be noted that the locations from which measurements at either end of this range were taken also gave pH measurements closer to neutral on other monitoring visits.

The electrical conductivity of groundwater ranges between 0.525 mS/cm (GW4, November 2015) and 1.663 mS/cm (GW3, November 2015). Where samples have been taken from the same location at different times of the year, there is little similarity in the results indicating this parameter is quite variable. There are no clear temporal trends in electrical conductivity over the three monitoring rounds.

The dissolved oxygen concentrations measured in groundwater range from 0.7 mg/l (GW2, November 2015) to 5.51 mg/l (GW1, May/June 2016). The values indicate that the water is not completely saturated, but that the water is also not anoxic[10]. The dissolved oxygen concentrations were higher in May/June during the wet season (3.11 mg/l to 5.51 mg/l) than in November (0.7 mg/l to 2 mg/l).

The Oxygen Redox Potential (ORP) measurements in groundwater range from -203.9 millivolts (mV) (GW2, November 2015) to +149.3 mV (GW5, May/June 2016). The ORP measures the capacity of a solution to either release or accept electrons from chemical reactions. All of the measurements made in November 2015 were negative (i.e. indicate a reducing environment) and all of the measurements in May/June (during the wet season) were positive (i.e. indicating an oxidising environment).

TDS was measured in August 2016. The results range from 263 mg/l (GW4) to 625 mg/l (GW3). These results are within the range expected for fresh water.

[10] Depleted of dissolved oxygen

Surface Watercourses

The field parameter results for the surface water monitoring locations are shown in Table 6.7-3. The complete dataset is included in Annex I.

Table 6.7-3: Summary of Surface Water Field Parameter Measurements

Parameter	Locations			
	SW1	SW3	T1	M1
Temperature (° C)	30.1	28.7	23.0	23.3 to 27.2
Dissolved Oxygen (mg/l or ppm)	2.02	5.02	7.06	6.82 to 7.73
pH	7.37	7.85	7.07	6.81 to 8.67
Oxygen Redox Potential (mV)	77.6	62.3	+191.4	+187.4
Conductivity (µS/cm)	575	273.5	19.8	19.2 to 200

The field parameter measurements indicate that surface water in the South Lokichar Basin also has a typical temperature of around 30°C to 35°C.

The pH of surface water (from two samples taken in May/June 2016 in South Lokichar) ranges from 7.37 to 7.85. As the pH of rainwater is typically slightly acidic, the natural pH is likely to reflect contact with soils/sediments.

Electrical conductivity ranges between 0.274 mS/cm and 0.575 mS/cm in surface water samples. The lower of the two measurements came from water at the surface, whereas the higher of the two came from a sample taken from just below the surface at SW1. Typically, surface water that has come from rainfall will have a lower electrical conductivity that groundwater, which has been in contact with soils/sediments that can increase the presence of dissolved material that conducts electrical current; therefore, these results are as expected.

Dissolved oxygen in the surface water samples ranges from 2.02 to 5.02 mg/l (1 ppm = 1 mg/l).

ORP was measured in November 2015 and May/June 2016. The results in surface water (May/June 2016 only) range from +62.3 mV to +77.6 mV.

The field parameter measurements and observations made on the Malmalte River in September 2018 (Golder, 2018c) and in March 2019, and the measurements taken from the Turkwel River in March 2019 were similar to other surface water measurements in South Lokichar and were as follows:

- pH ranged from 6.81 to 8.67;
- Electrical conductivity ranged from 0.0192 mS/cm to 0.20 mS/cm;
- Dissolved Oxygen ranged from 6.82 ppm to 7.73 mg/l (1 ppm = 1 mg/l);
- Temperature range from 23.3°C to 27.2°C;
- The ORP value was positive (i.e. indicating an oxidising environment); and
- Turbidity was observed to be high.

Surface Water Reservoir

Annex I presents the results of the physical and chemical field parameter measurements (i.e. turbidity, temperature, dissolved oxygen, dissolved organic matter, pH and specific conductivity) collected during the TKBV Turkwel Reservoir water quality survey.

It is stated in the Tullow Technical Report 11 (Tullow, 2018a) that turbidity typically increased with depth, but varied less with depth nearest the dam. It is also stated that the highest turbidity readings were measured at locations where narrowing in the shape of the reservoir causes higher flow velocities.

The 2016 survey results indicate that water temperature in the Turkwel Reservoir was warmer at the Pinou Gorge end and coolest near the dam wall (Tullow, 2018a). The depth profiles show most temperatures were around 25^{o}C to 27.5 ^{o}C at the surface and then reduce to a similar temperature of approximately 24.5 ^{o}C at around 30 m below the surface of the reservoir.

The 2016 survey results indicate that dissolved oxygen concentration in the Turkwel Reservoir near surface are more saturated with oxygen and concentrations reduce with depth and towards zero at the base of the reservoir.

The pH measurements taken in 2016 (TKBV, 2018a) and in 2017 (TKBV, 2018a) show a reduction in pH with depth. The pH is alkaline at the surface (around 8.5 to 9.5), which is slight above the Project standard of 6.5 to 8.5, and closer to neutral at depth (around 7.5). It is stated in TTKBV Technical Report 11 (TKBV, 2018a) that these values are similar to the values collected during a study in 1998 where the median pH ranged from 7.1 to 8.7. These concentrations are also similar to the historical pH values presented in Table 6.7-1 from 1973 to 1983, which ranged from 7.8 to 8.0.

Conductivity represents the conductance in the water, which is a function of the dissolved salt content. Conductivity varies with temperature, so is commonly normalised to a specific conductivity at 25^{o}C. The specific conductivity in the Turkwel Reservoir in 2016 (TKBV, 2018a) did not vary notably with depth and typically was around 180 μS/cm to 190 μS/cm (0.18 to 0.19 mS/cm). The 2017 survey measurements (TKBV, 2018a) show similar results that typically range from around 170 μS/cm to 180 μS/cm (0.17 to 0.18 mS/cm). The historical measurements presented in Table 6.7-1 are of a similar order (0.145 mS/cm to 0.172 mS/cm).

6.8 Water Quantity

6.8.1 Secondary Baseline Data Gathering

6.8.1.1 Hydrological Setting

Rainfall

The AoI is located in an area where precipitation predominantly occurs in two rainy/wet seasons that are typically during April to June (the long rains season) and October to December (the short rains season). Much of the rain falls during the long rains. Rainfall for the remainder of the year is typically low and the area is often at risk of serious drought conditions. A summary of the rainfall information in the region is presented below and discussion in more detail in Section 6.4).

Precipitation data from Lodwar meteorological station has been used to inform the baseline. Lodwar meteorological station is situated at an elevation of 523 masl approximately 85 km north of Lokichar. The Lodwar meteorological station monthly total rainfall data averaged over 34 years indicates a peak around April/May. The maximum daily precipitation at Lodwar was 182.9 mm on 21 June 1991. There is high variability in monthly rainfall on a year to year basis (Section 6.4).

In addition, two meteorological stations were installed by a TKBV contractor between December 2015 and January 2016 at Kapese Camp and the existing Ngamia 8 wellpad.

Precipitation increases with altitude by about 60 mm per 100 m altitude gain (Price, 2016). Evapotranspiration decreases with altitude and mean annual evapotranspiration has been measured at Kabarnet as 1,934 mm and at Lokori as 3,999 mm (Price, 2016).

Catchments and Drainage

An overview of the hydrological setting of Kenya (Food and Agriculture Organisation (FAO), 2018) indicates that most of Kenya's water originates from its five "*water towers*": Mau Forest Complex, Aberdare range, Mount Kenya, Mount Elgon and the Cherengani Hills. They are the largest montane forests in the country and form the upper catchments of most of the main rivers in Kenya. There are six main catchments in the country, used as units for water resources management:

- Lake Victoria North Basin Area (LVNBA) that covers 3.0% of the country;
- Lake Victoria South Basin Area (LVSBA) that covers 5.0% of the country;
- Rift Valley Basin Area (RVBA), which includes the inland lakes and covers 22.5% of the country;
- Athi Basin Area (ABA) that stretches up to the coast and covers 11.5% of the country;
- Tana Basin Area (TBA) that covers 21.7% of the country; and
- Ewaso Ng'iro North Catchment Area (ENNBA) that covers 36.3% of the country.

A map of the catchment areas is shown in Figure 6.8-1 (WRA, 2018).

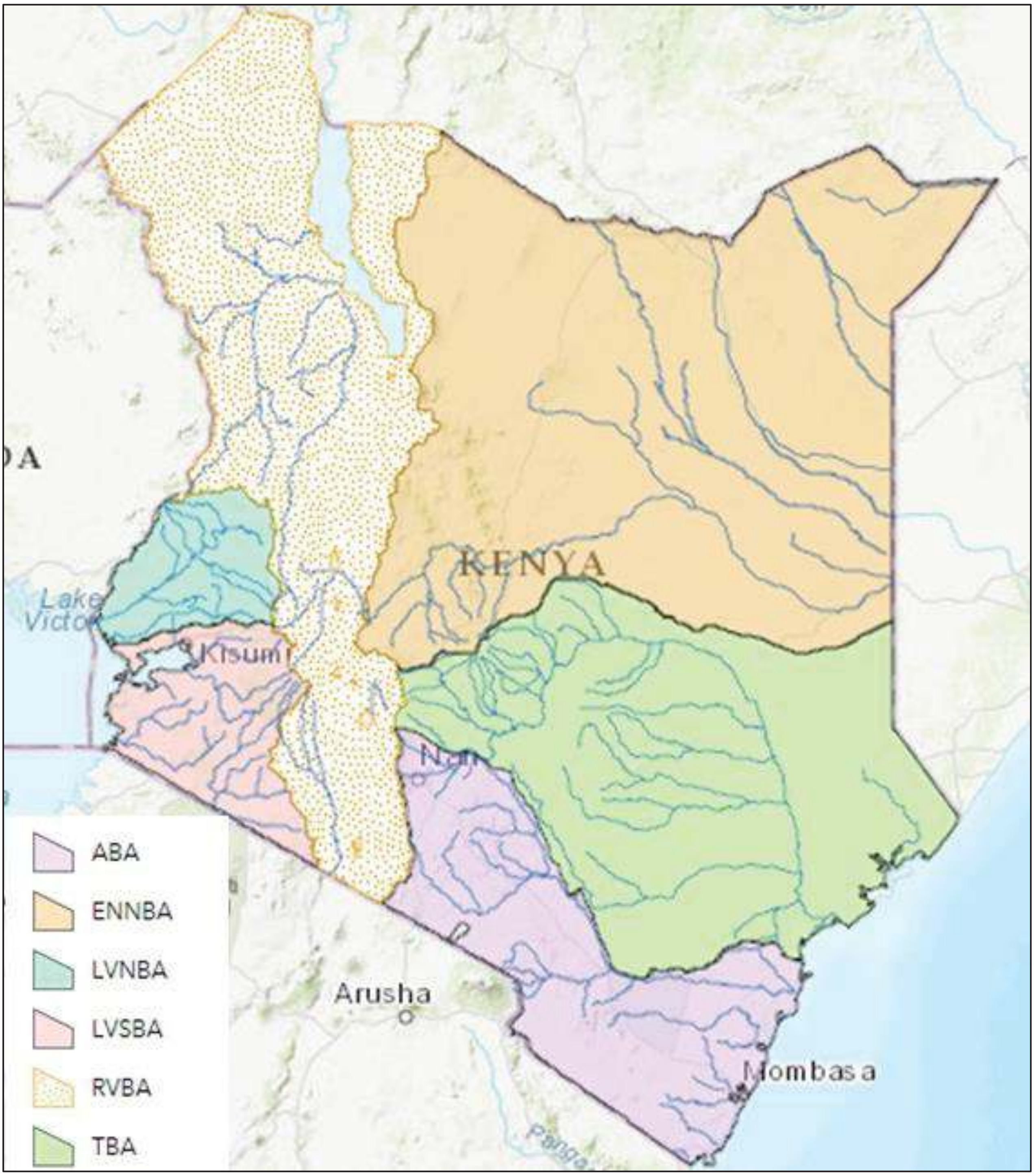

Figure 6.8-1: Main Catchments of Kenya (Source: WRA, 2018)

The AoI is located in the RVBA, partly in the Kalabata catchment and partly in the Turkwel catchment. The Kalabata water course is a sub-catchment of the Kerio basin. The catchment divide is presented in Figure 6.8-1. The Kerio and the Turkwel both ultimately discharge to Lake Turkana. Drainage in the AoI is dominated by a dendritic network of ephemeral streams that converge into larger channels (luggas) and drain towards the north-east or the west. The luggas that drain to north-east drain towards the Kalabata River (also ephemeral), which then flows to the north along the western edge of an outcrop of Miocene volcanics (the Auwerwer Volcanics). Near Loperot, the Kalabata turns eastwards and exits the South Lokichar Basin flowing towards the Kerio Valley and then flows northwards as the Kerio River.

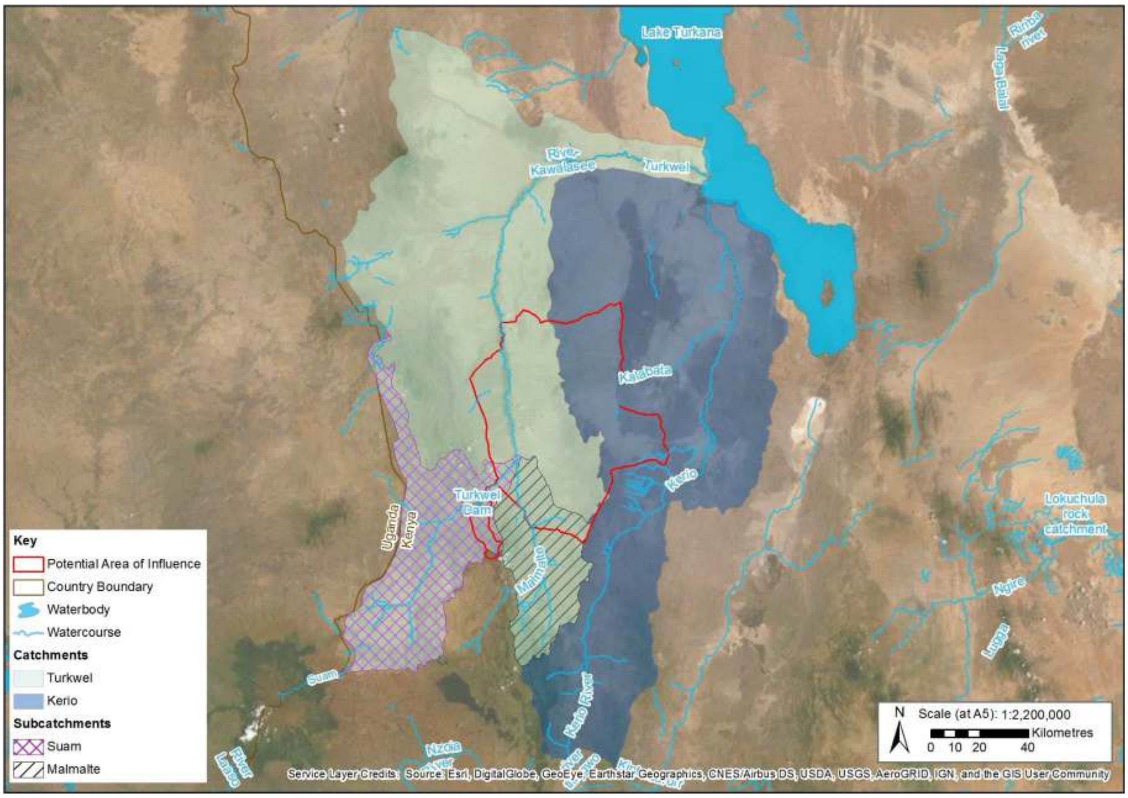

Figure 6.8-2: Kalabata and Turkwel Catchments

The Malmalte River (also known as Wei-Wei in its upstream reaches) is one of the main rivers in the Turkwel catchment. It derives its waters from Cherangany Hills and winds downwards to meet the Turkwel River approximately 25 km downstream of the Turkwel Gorge Reservoir. The Turkwel River then flows north then east and discharges into Lake Turkana. The luggas in the AoI that drain to the west drain towards the Turkwel River. Flow to the Turkwel River downstream of the Turkwel Gorge Reservoir, but upstream of the confluence with the Malmalte, is controlled by discharges from the reservoir, which are discussed further in Section 6.8.3. The main flow into the Turkwel Gorge Reservoir valley comes from the Suam River, which originates from Mount Elgon.

The drainage luggas in the Kalabata catchment are typically sandy and shallow, and the main channels are typically clear of vegetation with some vegetation along the banks (Worley Parsons Consulting, 2015a). There is flood attenuation capacity as the channels are shallow and there are wide flat plains with depressions where water can collect (Worley Parsons Consulting, 2015a). Some hydrological and flood risk modelling has been undertaken (Worley Parsons Consulting, 2015b).

The Turkwel River and the Kerio River provide the rest of the flow input to Lake Turkana. The inflow from the Kalabata River via the Kerio River to Lake Turkana is relatively minor compared to other sources. Lake Turkana has an area of approximately 7,000 km^2. The Omo River, which flows in from Ethiopia, has a catchment of approximately 74,000 km^2. It provides approximately 55% of the drainage basin area that feeds Lake Turkana and around 90% of the flow into it (Atkins, 2014). The inputs to Lake Turkana vary seasonally, but these variations have been tempered by dams; particularly on the River Omo (Avery, 2013). There are no surface water outflows from Lake Turkana as evaporative losses balance inflow (Atkins, 2014), meaning the entire region forms an endorreic catchment i.e. one which does not ultimately discharge to the sea.

With respect to transboundary matters, the FAO stated in 2015 that Kenya, together with nine other Nile riparian countries, is a member of the Nile Basin Initiative (NBI) (FAO, 2015). There is no cooperation framework between NBI member countries that border Lake Turkana. The absence of cooperative management leads to tensions, for example Ethiopia constructing dams that impact the water inflow to Lake Turkana.

Aquifers, Aquifer Properties and Recharge

As shown in Figure 6.8-3 (Hydrogeology of Kenya: BGS, 2018), the main hydrogeological environments in the surface geology in Kenya are volcanic or basement in the inland areas and tend to be more unconsolidated materials or intergranular and fractured sedimentary rocks towards the coast. The flow and storage characteristics are typically fracture dominated in the inland area's basement and volcanic areas and intergranular towards the coast. Aquifer productive (yields) are typically low to moderate, but some un or semi-consolidated aquifers towards the coast can yield higher volumes of water.

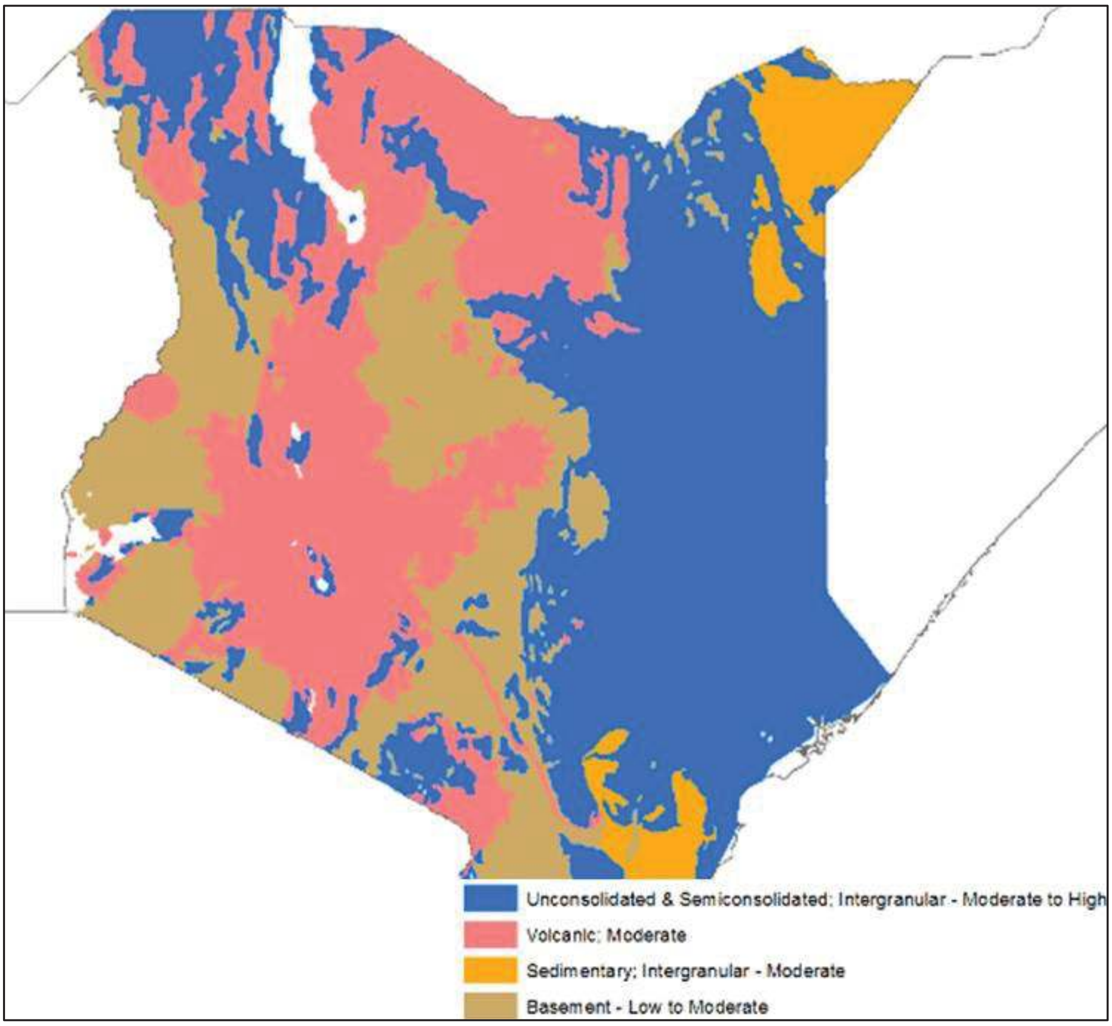

Figure 6.8-3: Main Hydrogeological Environments in Kenya

In the RVBA there are the Kerio Volcanics, which are classified as a poor aquifer[11] (WRA, 2018). Other Tertiary Volcanics in the Turkana region are also typically classified as poor aquifers. The basement rocks are also classified as a poor aquifer. There are basement rocks at depth in the AoI, and these are not known to be used for water supply. Although poor aquifers may have low yields and moderate-to-poor quality, they might have local supply potential.

In the RVBA there are also the Lodwar Alluvial Aquifer, which is classified as a special aquifer[12] and the Lotikipi Valley Aquifer, which is classified as a minor aquifer[13] (WRA, 2018). These are located in Turkana County to the west of Lake Turkana, and north of the potential AoI. The deeper saline Lotikipi Basin Aquifer may represent fossil water and receive limited, or no, recharge from the surface. This may also be the case for the Lodwar Basin Aquifer, except where the aquifer system is near the surface and more alluvial because these aquifers could receive input from precipitation and river recharge (Olago, 2018). These potential aquifers are not currently known to be exploited for water supply and there are no similar known resources at depth beneath the AoI. Recharge occurs to both by direct rainfall infiltration and, to the Lodwar aquifer by leakage from the Turkwel River. Turkana Tertiary sediments are also classified as minor aquifers.

[11] The WRA defines a ‘poor aquifer’ as being a low- to negligible-yield aquifer system with moderate to poor water quality.

[12] The WRA defines ‘special aquifers’ because of their importance as aquifers.

[13] The WRA defines a ‘minor aquifer’ as a moderate-yield aquifer system with variable water quality.

In the AoI, there are alluvial (unconsolidated sedimentary) and volcanic (igneous) aquifers that can provide water supplies of varying yields. The alluvial sands and sediments can have high groundwater potential where dominated by coarse grained sediments (sand and gravel), but elsewhere, groundwater potential is typically limited.

Water wells have been drilled during the exploration works and the hydraulic property information determined from pumping tests and presented in Price (2016) and Unknown (2014) are summarised in Table 6.8-1. The most productive wells come from those that encounter the sandy sedimentary interflow deposits; those wells that only intersected the lavas have been found to be unproductive (Price, 2016).

Table 6.8-1: Summary of Aquifer Hydraulic Properties (Source: Unknown, 2014; Price, 2016)

Deposit/Aquifer	Description	Test Location	Transmissivity	Yield
Sediments (Plio-Holocene)	Not provided	Ngamia 4	No data presented	<1 m^3/hr
Kerio River Gravels	Sands and gravels	Unknown	Unknown	Up to 50 m^3/hr
Auwerwer Volcanics (Miocene)	Basalt lava flows with interflow units of clay, silt, sand and occasional gravels and cobbles (water mainly from sedimentary interflow units 5 m to 20 m thick)	East Lokichar	<1 m^2/d	Approx. 8 m^3/hr to 12 m^3/hr, (max.= 23 m^3/hr)
		Lokwii	>750 m^2/d	
		Geometric Mean (excluding Lokwii)	~10 m^2/d	

The rate of groundwater flow in the sedimentary interflow units of the Auwerwer Volcanics has been estimated in Price (2016) to be supported by infiltration of 1 mm/yr to 2 mm/yr.

Recharge to the alluvial aquifers is typically local and occurs by direct rainfall. There is also some recharge from infiltration by leakage from the rivers. A study published in 2013 (Radar Technologies International, 2013) looked at the potential groundwater resources in northern and central Turkana County. The findings presented recharge values of 10% to 20% of rainfall. The average effective precipitation (i.e. the precipitation that is not lost by evaporation or transpiration) is estimated in Price (2016) to be less than 20 mm/yr (which is ~8% of annual average rainfall). However, TKBV (2015a) questioned this and proposed literature values for arid and semi-arid regions range from 0.1% to 5% of long-term average rainfall to be more appropriate.

6.8.1.2 Groundwater Elevations and Flow Directions

There is little reliable long-term groundwater monitoring data available in the South Lokichar Basin. This is because most existing boreholes that are used as monitoring wells are also production wells, so obtaining reliable data is often not possible because production would have to be stopped for data collection to allow groundwater levels to re-equilibrate (WRA, 2018). The Water Resources Situation Report for 2017/2018 (WRA, 2018) states that exploratory boreholes have been installed in a range of places including the Turkana aquifer at Loperot, Lokichar, Lopur, Meyan and Kapsor. However, no data are available.

Groundwater was typically encountered during water study drilling (Unknown, 2014) at depths between 20 m and 40 mbgl. From the limited data available, an attempt was made in Price (2016) to contour the water levels in the shallow aquifer units using the maximum levels recorded for each well. The results of that exercise showed that groundwater flow is predominantly north-eastwards towards the Kerio Valley and Lake Turkana, but there was insufficient data to indicate whether there is groundwater discharge to the Kerio River.

Measurements of the hydraulic gradient between various locations indicated a range of 0.0026 to 0.0076 (Price, 2016).

Water levels in the units below the Auwerwer Shales were also estimated in Price (2016) using data derived from measurements in oil exploration or appraisal wells. The results indicate that the piezometric head in the central Lokichar area is around 600 masl. The groundwater flow direction in the deeper volcanic units is also towards the north-east towards the Kerio Valley and Lake Turkana (Price, 2016).

6.8.1.3 Flooding

The NDMA (2019a) produce monthly drought early warning bulletins, information on flood events and a summary of water sources in Turkana County and West Pokot. Flood event details included in the monthly drought reports for February 2018 to January 2019 are summarised in Table 6.8-2. The summary information indicates that the rains in April and May 2018 caused widespread flooding.

Table 6.8-2: Summary of Turkana Water Resource Information

Month (Year)	Flood Event Information from NDMA Monthly Drought Reports (Turkana)	Flood Event Information from NDMA Monthly Drought Reports (West Pokot)
February (2018) to March (2018)	No flood events reported.	No flood events reported
April (2018)	Flooding reported in Turkana Central, Turkana West, Turkana South and Lomia. Villages affected include: Napetet, Soweto, Nabute, Borabuyong, Ng'iitakito, Nanam-Kadingding, Ngikwatiak, Nasinyono, Lomidat, Lokangae, Pokotom, Ngogoloki, Letea, Kalobeyei, Katilia, Lokichar, Naoyatira, Ng'inokakim, Kaputir Kalapata, Kalemgorok, Kaitese, Kabulokol, Lorugum, Lobei, Lokiriama, Atesiro, Naremit, Ngamakolol, Nakatiyan, and Nakejuakal Impacts included river bank erosion.	Floods in Wei Wei and Runo. Impacts on crops. Landslides reported.
May (2018)	Areas in the county such as Kalemgorok, Lokichar, Lodwar and Kainuk experienced massive flooding	Floods reported along River Kanyangareng. Loss of top soil reported.
June (2018) to July (2018)	No flood events reported.	No flood events reported.
August (2018)	No flood events reported. However, food and non-food interventions reported for flood affected populations in Lodwar.	No flood events reported.
September (2018) to January (2019)	No flood events reported.	No flood events reported.

6.8.1.4 Regional Water Use

Kenya relies on both surface water resources and on groundwater. Dependence on groundwater is highest in rural areas and in the coastal zone, but urban areas also rely on groundwater (BGS, 2018). Surface water sources include perennial or seasonal rivers and streams (luggas), lakes, springs, oases and dammed reservoirs. Groundwater sources below the surface might be accessed through boreholes or hand-dug wells (including those dug into river beds during the dry season).

The Kenya Groundwater Governance Case Study (World Bank, 2011) presents data on water resource availability in each of the main catchments in Kenya. The statistics are reproduced in Table 6.8-3. The AoI is located in the Rift Valley Catchment.

Table 6.8-3: Catchment Water Resources Availability

Catchment	Area (km^2)	Surface Water (10^6 m^3/yr)	Groundwater (10^6 m^3/yr)
Rift Valley	130,452	2,784	126
Tana	126,026	3,744	147
Ewaso Ng'iro	210,226	339	142

According to the 2014 Kenya Demographic and Health Survey Atlas (KNBS, 2016), access to an improved drinking water source is varied, as shown in Figure 6.8-4. Improved water sources include piped water; a public tap/standpipe or borehole; a protected well or protected spring water; rainwater; and bottled water. Within the AoI, access to safe drinking water is reported to be between 28% and 48%.

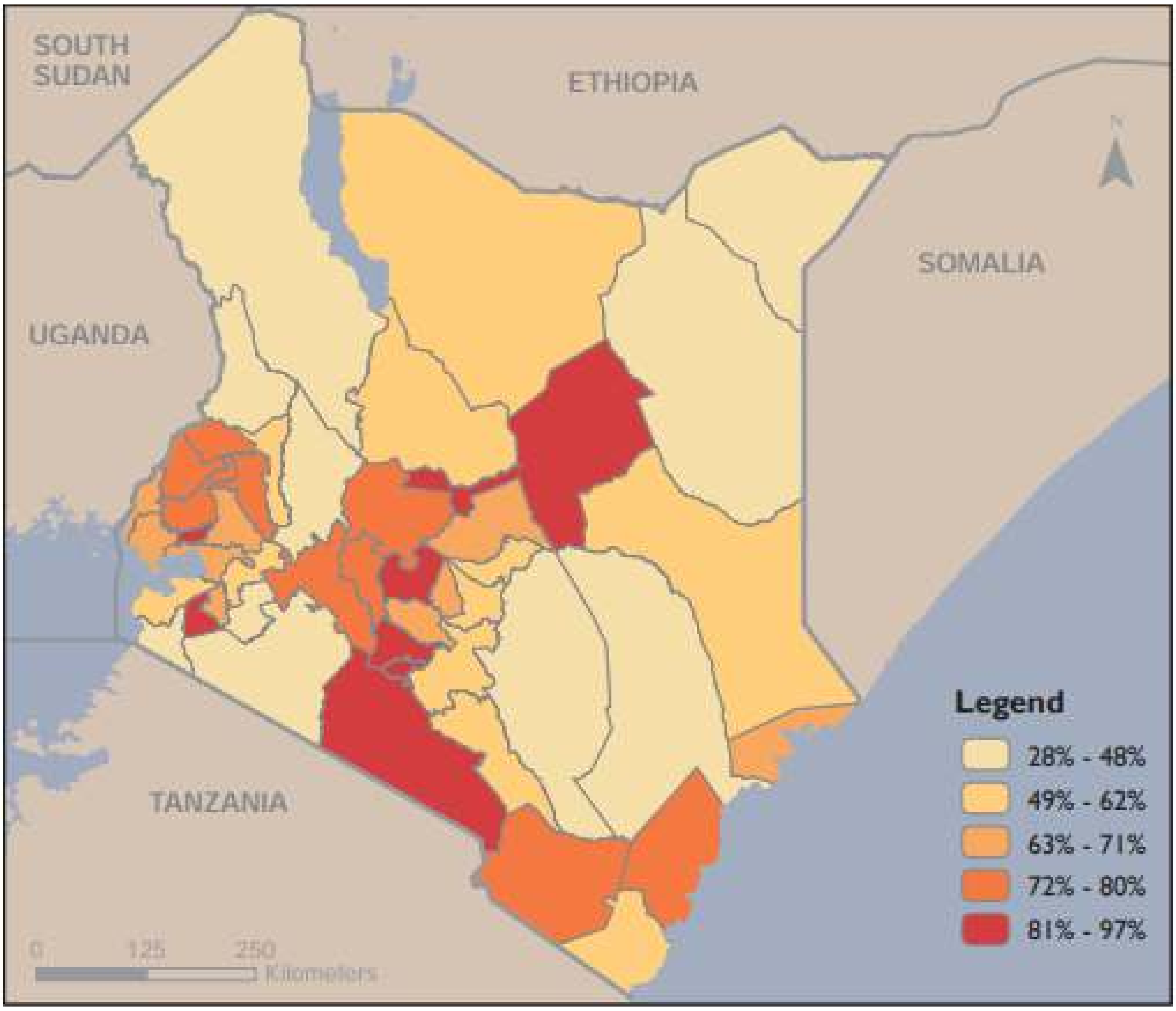

Figure 6.8-4: Access to Improved drinking water in Kenya (2014/15)

The NDMA (2019a) produces monthly drought early warning bulletins that include a summary of water sources in Turkana County and West Pokot. The summaries for February 2018 to January 2019 indicate that a range of water sources are used for domestic supply and for livestock, including rivers, springs, lakes, pans and dams, river wells, shallow wells and boreholes. The summary reports also indicate that surface water sources are the main source of supply during the rainy season and boreholes are used more when surface supply availability declines. The overview of water resource comments included in the monthly drought reports are summarised in Table 6.8-4.

Table 6.8-4: Summary of Turkana and West Pokot Water Resource Information

Month (Year)	Water Resource Information from NDMA Monthly Drought Reports (Turkana)	Water Resource Information from NDMA Monthly Drought Reports (West Pokot)
February (2018)	Water needs were met mainly through use of boreholes, rivers and traditional river wells (normal for February).	Main water sources used were boreholes, pans/dams and rivers. Recharge to water supplies dropped due to lack of rainfall. Sources normal for this time of year.
March (2018)	Boreholes and rivers are usually the main sources of water at such a time of the year. Boreholes, rivers and shallow wells sufficed in meeting household water requirements. The water level in open water sources rose slightly due to rainfall in the previous month.	Main water sources used were pans/dams, boreholes and traditional river wells. Adequate rainfall received that recharged sources. Sources normal for this time of year.
April (2018)	Household water needs were met through use of boreholes and rivers Most open water sources such as water pans and dams recharged to full capacity due to above normal rainfall.	Main water sources used were traditional river wells, boreholes and pans/dams. Sufficient rainfall to recharge sources. Sources normal for this time of year.
May (2018)	Most households utilised boreholes and rivers to meet water needs. Overflow was witnessed across most open water sources such as water pans and dams due to rainfall.	Main water sources used were traditional river wells, boreholes and pans/dams. Good rainfall that recharged sources. Water levels high for rivers and boreholes due to good recharge in previous months. Sources normal for this time of year.
June (2018)	Boreholes and traditional water wells were the main supply sources. Most open water sources such as water pans and dams were full to capacity.	Main water sources used were rivers, pans/dams and traditional river wells. Recharge to sources reported as being stable. Sources normal for this time of year.
July (2018)	Boreholes, traditional river wells and shallow wells use as main sources of water. Most water pans were 50 to 75% full	Main water sources used were traditional river wells, boreholes and pans/dams. Good recharge of sources due to significant rains. Sources normal for this time of year.
August (2018)	Households mainly relied on boreholes, traditional water wells and shallow wells for water supplies. Most open water sources had poor water levels. Water quantity reported as normal.	Main water sources used were rivers, pans/dams and boreholes. Recharge to sources reported as stable due to steady rainfall. Sources normal for this time of year.

Month (Year)	Water Resource Information from NDMA Monthly Drought Reports (Turkana)	Water Resource Information from NDMA Monthly Drought Reports (West Pokot)
September (2018)	Boreholes, rivers and shallow wells were the main sources of water. Strategic water pans availability deteriorating and only 25% full	Main water sources used were pans/dams, boreholes and rivers. Poor rainfall lead to decreased recharge of sources. Sources normal for this time of year.
October (2018)	Boreholes and traditional water wells were the main supply sources due to reduction in river water availability. Most water pans dry or below 25% capacity.	Main water sources used were pans/dams, boreholes and traditional river wells. Good recharge of sources due to significant rains. Sources normal for this time of year.
November (2018)	Boreholes, shallow wells and traditional water wells were used as the main sources of water. Rivers would normally be the main source of supply in November. No seasonal water flow in seasonal rivers resulted in traditional river wells depths being greater than usual at this time of year (3 m instead of 1 m). Over 75% of water pans were dry.	Main water sources used were traditional pans/dams, boreholes and rivers. Good recharge of sources due to significant rains in previous month. Sources normal for this time of year.
December (2018)	Boreholes, shallow wells and traditional water wells were used as the main sources of water. Limited seasonal water flow in rivers – unusual for December. No open pan use as rainfall had not recharged them.	Main water sources used boreholes, dams/pans and traditional river wells. Poor rainfall lead to decreased recharge of sources. Sources normal for this time of year.
January (2019)	Boreholes, shallow wells and traditional water wells were used as the main sources of water. Limited seasonal water flow in rivers – unusual for January. Traditional river well depths increased to 3 to 4 m. Reduced flow noted in the Kerio and Turkwel Rivers and no flow in seasonal rivers. Low open pan use as over 75% were dry.	Main water sources used boreholes, rivers, dams/pans and traditional river wells. Poor rainfall lead to decreased recharge of sources. Sources normal for this time of year.

Figure 6.8-5 presents a plot of the change in percentage of water use that each water source provided in Turkana for the period February 2018 to January 2019. The same information for West Pokot is presented in Figure 6.8-6. This data has been collated from information presented in the NDMA monthly drought early warning bulletins. The graphs show that when the rivers flows are reduced, and the pans dry up due to reduced rainfall, boreholes and shallow wells become the main sources of water.

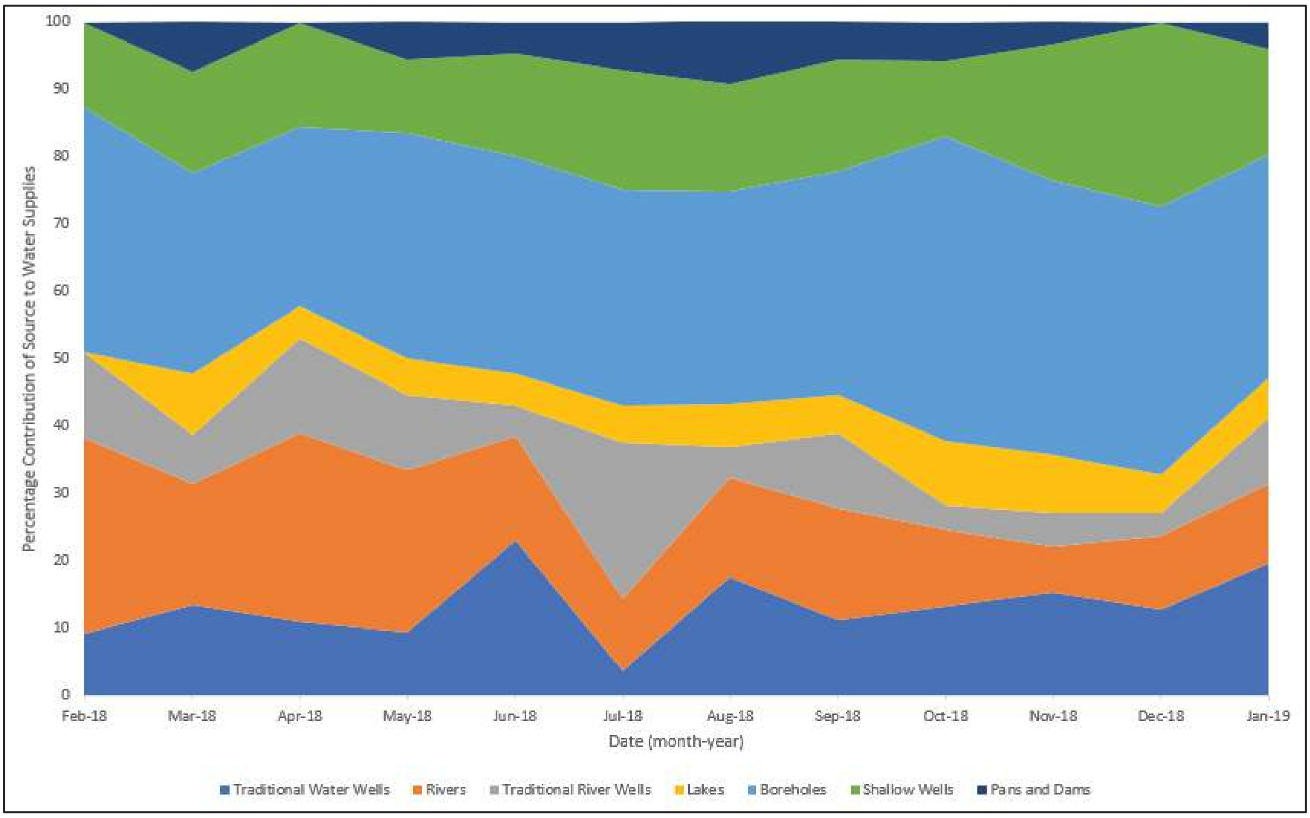

Figure 6.8-5: Turkana Water Resource Sources 2018-2019 (NDMA)

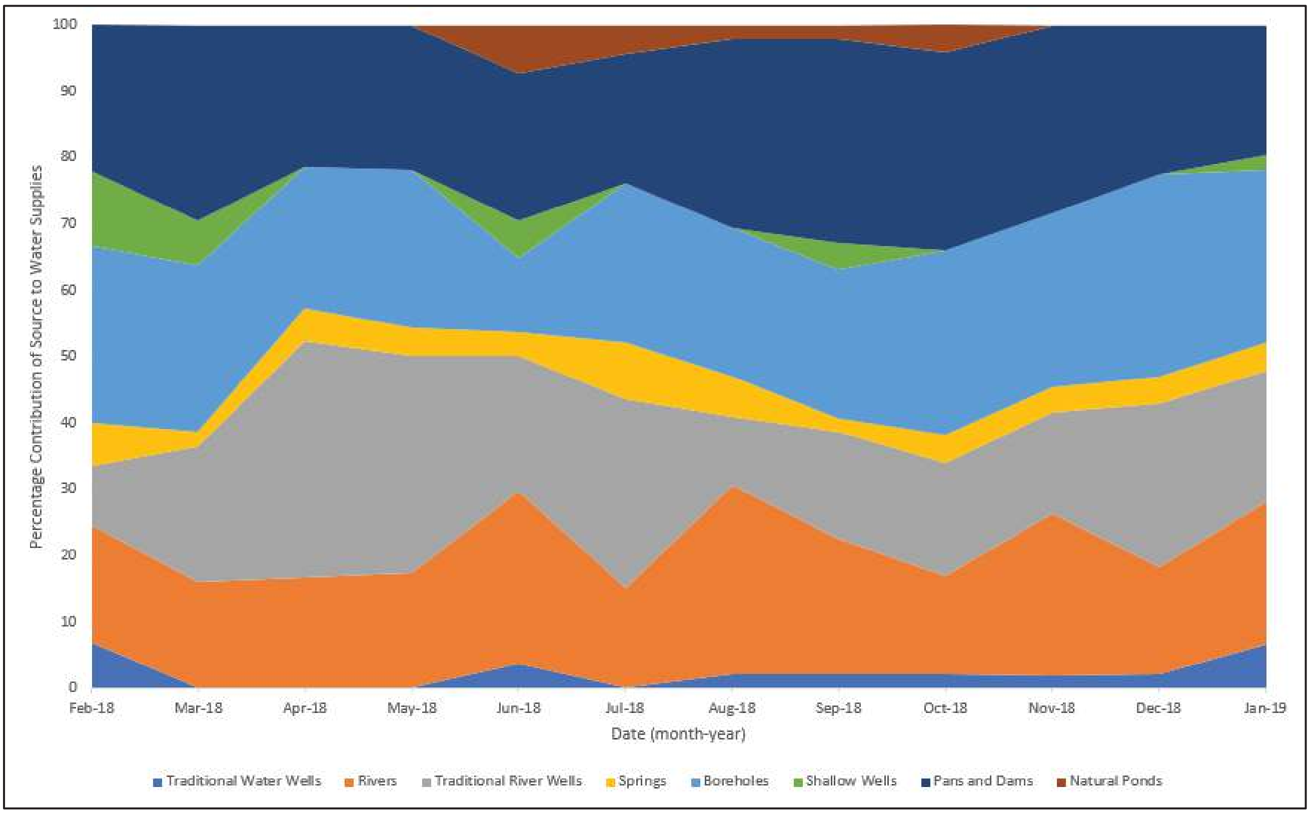

Figure 6.8-6: West Pokot Water Resource Sources 2018-2019 (NDMA)

6.8.1.5 Local Water Use

Lodwar Town draws its water supply entirely from boreholes near the banks of the Turkwel River. Lodwar's annual water supply demand for 2017 was 0.116 m^3/s (TKBV, 2018c). Based on a 6% per annum growth, future water supply demand was estimated to be 0.247 m^3/s.

Historically, the water sources in the local grazing lands were provided by surface water pans and shallow lugga wells during the wet season (TKBV, 2015b). These dried up fairly rapidly after the rains stopped and people had to walk further to access alternative supplies. Between 2012 and 2014, TKBV initiated a regular supply of water for local communities from tanks positioned at 23 locations (Tullow Oil, 2015b), which are used for watering livestock, potable and non-potable supplies. These TKBV supplied community water points are mainly filled by tankering or piped supply from some of a series of WRMA-permitted abstraction boreholes (Ngamia East, East Lokichar, Nakukulas 9, Nakukulas 10, Kengomo 1, Kengomo 2, Nabolei, Ekunyuk and Ewoi – see Figure 6.8-7).

In summary, demand from the supply wells was approximately 650 m^3/d in 2014 (TKBV, 2014), approximately 500 m^3/d in 2015 (TKBV, 2015c). Of the total volumes abstracted from the Tullow abstraction wells, the volume that was used to augment the local community supplies was about 70 m^3/d between July 2014 and December 2015 and 100 m^3/d between January 2016 and November 2016.

The distances travelled from the communities to sources of water typically ranged from 0.5 km to 15 km (TKBV, 2015b). Prior to TKBV's provision of water resources to local communities, community water supplies tended to come from hand dug wells in luggas and hand pumped wells installed by NGOs.

In addition to augmenting local water supplies, TKBV used the water from the boreholes for exploration drilling, civil engineering requirements (e.g. road and wellpad construction) and field camps. The water was mainly piped from the wells; the pipeline network in 2016 is shown as blue lines in Figure 6.8-7. Additional, permitted water abstraction for specific exploration operations was occasionally drawn in from other water sources. The source of the water was groundwater from shallow aquifers predominantly along river valleys and the edge of the volcanic deposits.

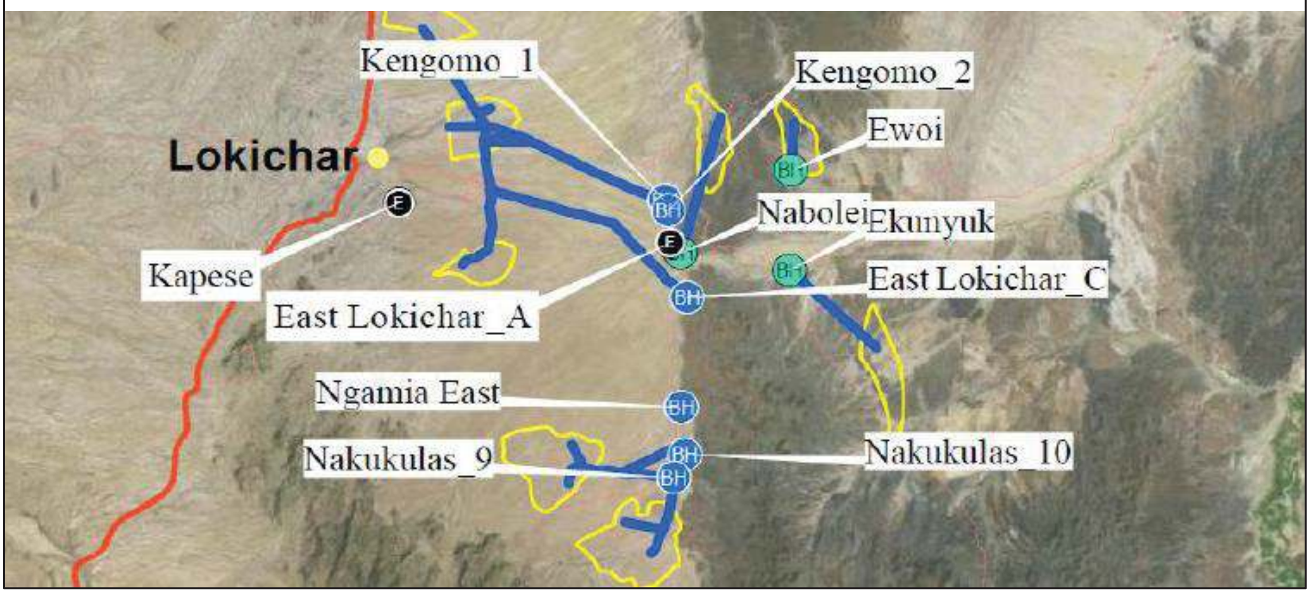

Figure 6.8-7: Tullow Production Boreholes and Distribution Pipelines (Source: TKBV, 2016a)

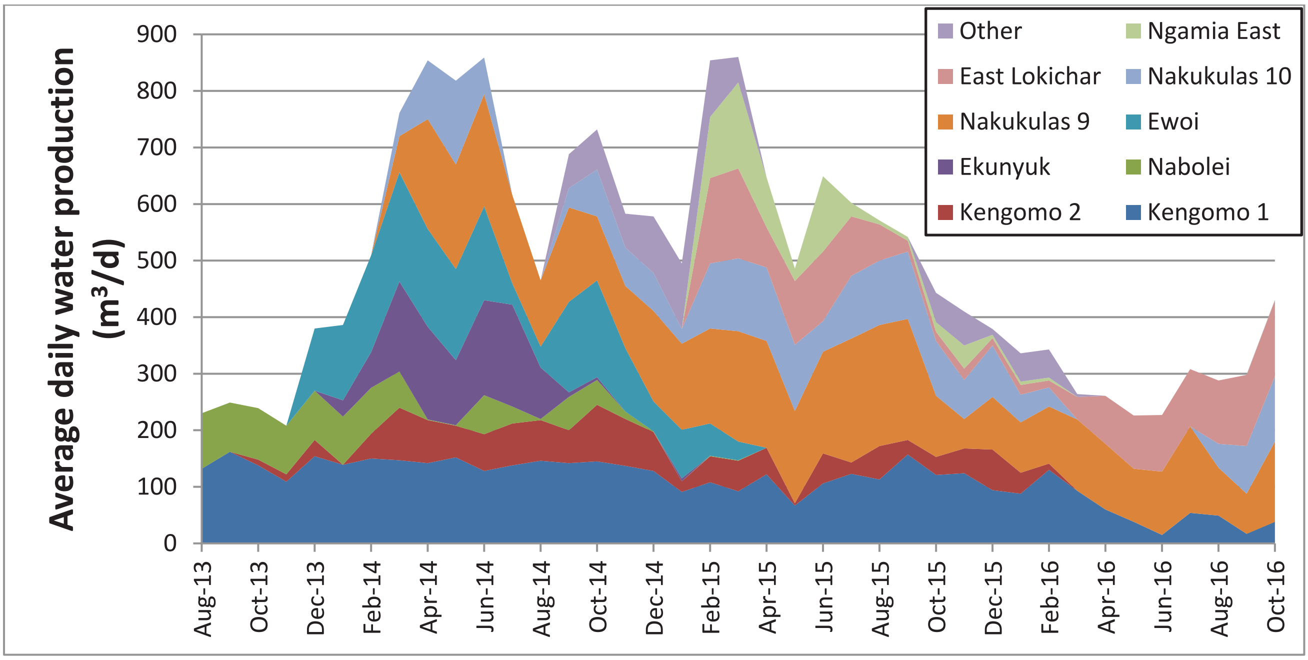

Figure 6.8-8: Tullow Borehole Production Profile (TKBV, 2016a)[14]

6.8.2 Primary Baseline Data Gathering Methods

Primary data to inform the baseline water quantity section has been gathered by Golder or provided by TKBV or its contractors. This includes precipitation data, infiltration tests, groundwater level monitoring and surface water flow monitoring. Details about the method used are presented in the sub-sections below. Results are presented in Section 6.8.3.

Field trips by Golder to collect data from infiltration tests, groundwater level monitoring and surface water flow monitoring (see subsection below for method details) were completed during the following periods:

- 23 to 27 November 2015;
- 25 May 2016 to 01 June 2016; and
- 24 to 31 August 2016.

6.8.2.1 Meteorological and Hydrological Setting

For the collection of meteorological data, to provide baseline hydrological information regarding precipitation, two meteorological stations were supplied by Campbell Scientific and installed by a TKBV contractor between December 2015 and January 2016:

- Kapese met station located at Kapese Integrated Support Base accommodation unit at an altitude of approximately 700 masl; and
- Ngamia met station at Ngamia 8 wellpad at an altitude of approximately 730 masl.

Meteorological parameters were recorded on an hourly basis at each station and have been provided to Golder by TKBV. Golder has calculated and plotted total precipitation from the monthly total sum. Only months with less than 35% of missing data were included in the analysis (Section 6.4).

[14] Data post October 2016 was not available for inclusion at the time the assessment was undertaken

6.8.2.2 Infiltration Tests

Field infiltration rate tests were undertaken by Golder between 29 and 31 May 2016. The infiltration tests were completed using a double open ring infiltrometer and comprised falling head tests where the time taken for the water level within the infiltrometer to drop was recorded until a constant value (or a change of <10%) was measured. Tests were performed at five sites; the locations of which are illustrated in Figure 6.8-9 and presented in Table 6.8-5.

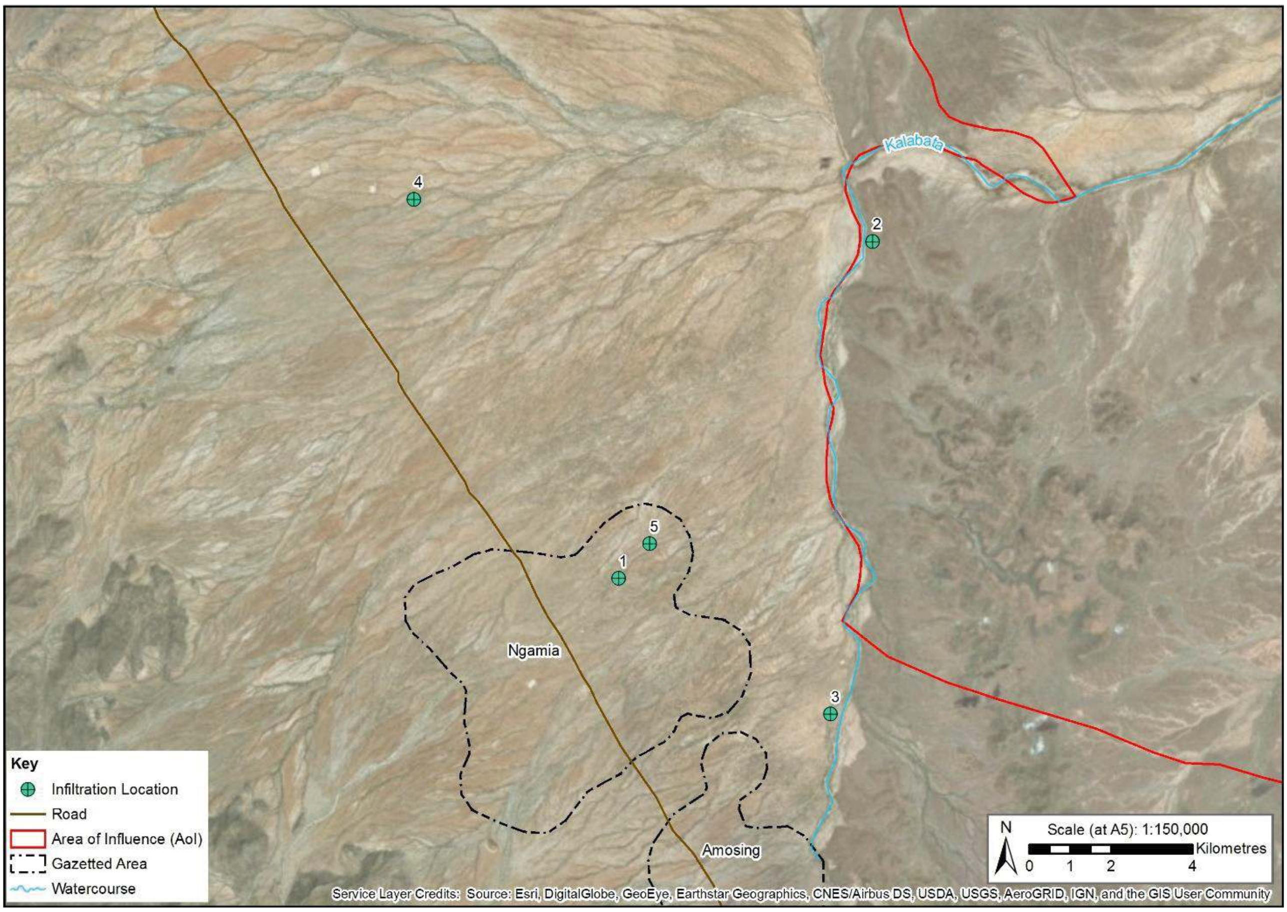

Figure 6.8-9: Location of Infiltration Test Sites

Table 6.8-5: Infiltrometer Test Coordinates

Test Location	Latitude	Longitude
Field test 1	2°13'59.91"N	35°46'11.75"E
Field test 2	2°18'28.40"N	35°49'33.90"E
Field test 3	2°12'11.19"N	35°48'59.92"E
Field test 4	2°19'2.93"N	35°43'29.56"E
Field test 5	2°14'27.43"N	35°46'36.29"E

6.8.2.3 Groundwater Level Monitoring

Groundwater level data taken from boreholes during 2015 and 2016 are available from TKBV. Measurements of the depth to groundwater have been taken at sporadic intervals and converted to elevations. Some locations have had Troll® water level monitoring devices placed in them for some of that period to remotely record water levels at specified intervals. A summary of the available data is presented in Table 6.8-6. Comment is also included in the table as to the selection of data used to inform this baseline.

Table 6.8-6: Summary of Available Groundwater Level Monitoring Data (Source: TKBV)

Location	Dip Data Available (date range)	Troll ® Data Available (date range)	Comment
Nakukalas 9 (also referred to as Golder monitoring location GW3)	Yes (January 2015 to October 2015)	Yes (26 June 2016 to 11 October 2016)	Located in AoI. Location included in baseline summary.
Nakukulas 10	Yes (January 2015 to October 2015)	No datalogger installed.	Located in AoI. Location included in baseline summary.
Ngamia East (also referred to as Golder monitoring location GW2)	Yes (January 2015 to October 2015)	Yes (29 September 2005 to 7 November 2015) (26 June 2016 to 31 October 2016)	Located in AoI. Location included in baseline summary.
East Lokichar A 1S	Yes (January 2015 to October 2015)	Yes (31 May 2015 to 5 November 2015) (26 June 2016 to 10 October 2016)	A cluster of monitoring locations in the AoI that are referred to with the prefix "*East Lokichar*". East Lokichar has a surveyed location, is a production well and Golder groundwater quality monitoring location GW1 (Section 6.8). Groundwater elevations in the other wells are similar. Location East Lokichar only will be included in baseline summary.
East Lokichar A 2A	Yes (May 2015 to September 2015)	Yes (1 June 2015 to 17 June 2015) (26 June 2016 to 9 August 2016)	
East Lokichar (also referred to as East Lokichar C 2A)	Yes (March 2015 to November 2015) (October 2016)	Yes (26 June 2016 to 10 October 2016)	
East Lokichar Piezo A	Yes (January 2015 to November 2015)	Yes (16 March 2015 to 2 November 2015)	
East Lokichar Piezo B	Yes (January 2015 to November 2015)	Yes (22 March 2015 to 2 November 2015)	
Nabolei	Yes (January 2015 to July 2015)	Yes (23 May 2015 to 21 July 2015)	Located approximately 0.6 km north of the AoI. Location included in baseline summary.
Kengomo 1	Yes (January 2015 to October 2015)	Yes (1 June 2015 to 18 September 2015) (26 June 2016 to 9 August 2016)	Located approximately 4 km north of the AoI – dip and logger data available. Location included in baseline summary.
Kengomo 2	Yes (January 2015 to October 2015)	No datalogger installed.	Located approximately 3.5 km north of the AoI – less data than Kengomo 1 and dip data only. Location not included in baseline summary.

Location	Dip Data Available (date range)	Troll ® Data Available (date range)	Comment
Ekunyuk	Yes (January 2015 to June 2015)	Yes (1 June 2015 to 6 July 2015)	Located approximately 5.5 km east of the AoI. Location included in baseline summary.
Ewoi	Yes (January 2015 to June 2015)	Yes (2 June 2015 to 15 June 2015)	Located approximately 9 km northeast of the AoI. Location included in baseline summary to enable groundwater flow direction.
Lokwii	Yes (September 2015)	Yes (15 September 2015 to 8 August 2016)	Located outside the AoI over 30 km to the south-east. Data not included in baseline.
Turkwel East (also referred to as Turkwel Lodwar East, Turkwel East AA or Loreng'elup)	Yes (July 2015 and September 2015)	Yes (27 July 2015 to 30 October 2015) (28 July 2016 to 27 October 2016)	Located outside the AoI over 90 km to the north. Data not included in baseline.
Epir	Yes (January 2015 and September 2015)	Yes (24 September 2015 to 30 October 2015) (27 August 2016 to 27 October 2016)	Located over 70 km north-east of the AoI. Data not included in baseline.
Engomo	Yes (January 2015 to February 2015)	No datalogger installed.	Located over 200 km to the north. Limited data availability. Data not included in baseline.
Kapese	Yes (May 2015 to October 2015)	Yes (26 May 2015 to 5 November 2015) (26 June 2016 to 10 October 2016)	Located approximately 10 km north-west of the AoI. Location included in baseline summary to enable groundwater flow direction.

6.8.2.4 Surface Water Flow Monitoring (Kalabata Catchment)

Surface water flow monitoring was undertaken using continuous water level data collection using pressure transducers (level loggers) and estimated ratings relationships based on site observations of watercourse bed properties and surveyed cross sections of the ephemeral watercourse. The continuous monitoring locations were selected based on sites where uniform, in-bank flows could occur and were positioned to provide representative baseline data across the wider development area.

The field teams were prepared for manual surface water flow measurements, however due to the response of the catchments to rainfall and the unpredictable and infrequent rains no opportunistic flow measurements were made during the field visits.

Surface water level loggers were deployed at SW1, SW2 and SW3 in November 2015 with the aim of capturing flows in the March/April 2016 wet season. At the same time as the level loggers were deployed, the channel cross sections were surveyed at these three locations and at N1. The survey cross sections are included in Annex I.

Level and flow data were acquired, with varying success, within or downstream of the AoI at the locations presented in Table 6.8-7.

Table 6.8-7: Surface Water Monitoring Locations Relevant to the Potential AOI

Location	Latitude	Longitude	Flow Monitoring	Comment
SW1	2° 18' 27.8"" N	35° 49' 27.4"" E	Level Logger (Rugged Troll 200)	Level logger lost - no data available.
SW2	2° 19' 43.7"" N	35° 49' 37.3"" E	Level Logger (Rugged Troll 200)	Level logger lost - no data available.
SW3	2° 19' 48.6"" N	35° 49' 50.5"" E	Level Logger (Rugged Troll 200)	Some level logger data available.
N1	2° 13' 42.8"" N	35° 47' 16.4"" E	Hand measurements	Location dry on all occasions visited.
Barometric Logger*	2° 21' 43.7"" N	35° 43' 14.1"" E	Not applicable	-

** The level loggers record pressure. The pressure data was downloaded and corrected for atmospheric changes using data downloaded from a barometric pressure logger installed at a nearby location at a similar altitude. The atmospheric compensated pressure data was then converted to a water level*

The surveyed channel sections were used to assess the hydraulic capacity of the channel at the monitoring locations using the United States Army Corps of Engineers ‘Hydraulic Engineering Center River Analysis System’ (HECRAS). The section details were built into a model of the system. The model assumed a Manning’s “n” coefficient value of 0.03 for the main lugga channels and 0.045 for the overbank areas. Modelled flow, the level data and surveyed cross section information was then used to develop a rating curve to understand the relationship between water level in the channel and flow to be able to convert the corrected level logger data to channel flows. The HECRAS sections are presented in Annex I. The ratings curve developed for SW3 is presented in Figure 6.8-10.

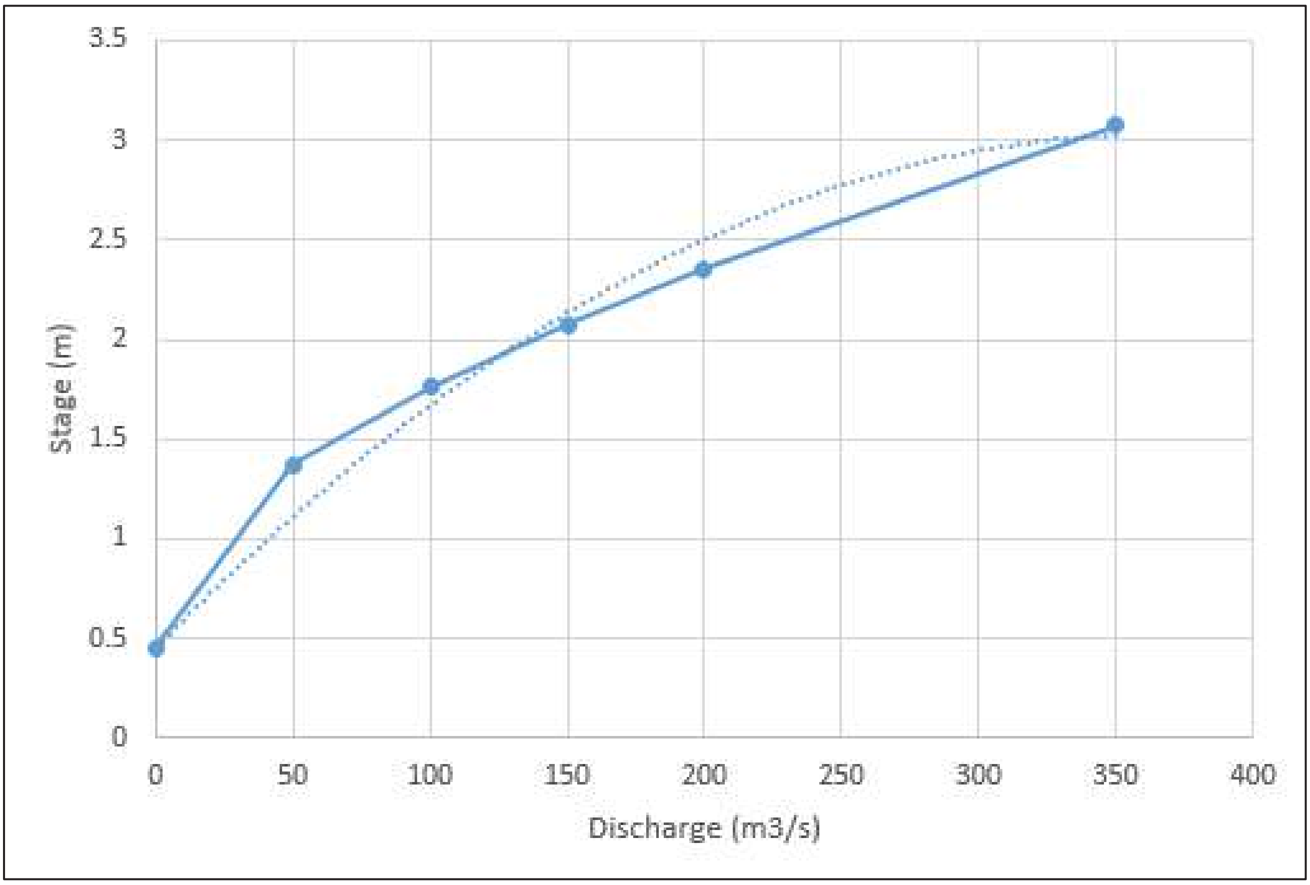

Figure 6.8-10: SW3 Rating Curve

6.8.2.5 Surface Water Flow Monitoring (Turkwel Catchment)

In 2018 TKBV initiated spot flow measurements on the Malmalte and Turkwel Rivers using Acoustic Doppler Current Profiler (ADCP) flow measurement equipment and current meter flow gauging to gather a series of snapshots of flow at several locations in the Turkwel catchment.

6.8.2.6 Turkwel Reservoir Monitoring

A series of reports have been prepared for or by TKBV with regard to a water supply for the Project. The information presented in these reports includes data on the Turkwel reservoir. The following reports have been used to inform this baseline with respect to reservoir levels and discharges:

- Strategic Water Supply for Development, Paper 9: Selection of Preferred Option. Richard Boak, January 2016;
- Strategic Water Supply for Development, Paper 10: Optimum Intake Location at Turkwel Dam. Richard Boak and Dr. Sean Avery, December 2016;
- Strategic Water Supply for Development, Report 11: Turkwel Reservoir Water Quality. Sean Avery and Richard Boak, November 2018;
- Strategic Water Supply for Development – Turkwel Dam Option, Turkwel Reservoir Water Quality. Sean Avery, October 2018; and
- Strategic Water Supply for Development – Turkwel Dam Option, The South Lokichar Development and Other Water Demands: An Objective Perspective and Way Forward. Sean Avery, October 2018.

The methods used to collect the data are presented in detail in those documents, they include bathymetric (water-depth) surveys of the Turkwel Reservoir in 2016 and 2017.

6.8.2.7 Water Users

In 2018 a hydro-census was undertaken by TKBV to identify water points in other parts of the AoI. The census lead to the creation of a dataset that identifies a mixture of water points that are in use, have been test wells, or have been abandoned.

Field data was also collected as part of the Health Baseline studies undertaken for the LLCOP project. Information was collected from water users in communities about the typical source of water used for different purposes, and in which season that supply was available. It was not typically possible for community members to locate the sources used on a map, so information on point locations was not collected.

6.8.3 Results

6.8.3.1 Meteorological and Hydrological Setting

During the monitoring period at the Kapese meteorological station, monthly total precipitation varied between 0.9 mm in February and 90.4 mm in May. The maximum daily precipitation was 59.2 mm, which was recorded on 4 June 2018. The maximum intensity precipitation (1-hour total) was 34.4 mm/hr, which was recorded on 12 May 2016 at 03:00.

The monthly total precipitation at Ngamia met station varied between 4.0 mm in September and 110.6 mm in May. The maximum daily precipitation was 44.2 mm, which was recorded on 07 November 2017. The maximum intensity precipitation (1-hour total) was 39.8 mm/hr, which was recorded on 21 June 2016 at 15:00.

The monthly total precipitation (Section 6.4) at both stations strongly varies over the year, and within years and between locations. Total precipitation at Kapese and Ngamia follow similar patterns with a distinct peak around April and May. Maximum daily and intensity precipitation events also mostly occur around this time.

In Golder (2018a), it is observed that numerous incised luggas are present in the area within the Lonopakeyu Hills from south of Lokichar to the A1 road between Lokichar and Kalemngorok. Shallow luggas, located throughout the AoI are ephemeral watercourses, which only flow during heavy rain events.

Observations of flow in the Malmalte River made during the rainy season show the river experiences a lot of flooding and a high sediment load from the catchment (Golder, 2018a). The deposition rate of sand in luggas with low slope gradients is high, with sand levels in some nearly the same height as the banks. In sloping or steep areas, however, luggas are deeply cut by erosion (e.g. within the Lonopakeyu Hills). An important characteristic of luggas is that they store water in deep profile soils and in the sandy deposits in the channel. Whilst lighter rains may not result in surface flow in luggas, they will recharge groundwater flow along the channel.

The Turkwel River channel between the Turkwel Reservoir and Lake Turkana is wide and sandy (TKBV, 2018c). Flows downstream of the Turkwel Reservoir Dam are managed by consistent reservoir discharges, which are augmented by seasonal flow for the Malmalte.

6.8.3.2 Infiltration Tests

The infiltration rates obtained by analysing the results of the infiltration tests are presented in Table 6.8-8. It should be noted that field tests 3 and 5 were ceased before a constant infiltration rate was reached, so the infiltration rates presented are approximate.

Table 6.8-8: Measured and Calculated Soil Infiltration Rate Test Results

Field test	Measured value	Calculated value	
	Infiltration rate (cm/min)	Infiltration rate (cm/min)	Saturated vertical hydraulic conductivity (cm/min)
Field test 1	0.291	0.350	0.449 (8 x 10^{-5} m/s)
Field test 2	0.065	0.063	0.049 (8.3 x 10^{-6} m/s)
Field test 3	Approx. 0.7	0.663*	0.154* (2.6 x 10^{-5} m/s)
Field test 4	0.320	0.322	0.459* (7.7 x 10^{-5} m/s)
Field test 5	Approx. 0.33	0.377*	0.565* (9.4 x 10^{-5} m/s)

** the calculated value is indicative as the infiltration rate was not fully stabilised before the test was finished.*

6.8.3.3 Groundwater Level Monitoring

The depth to groundwater for the selected locations have been plotted and are presented in Annex I. Using the reference elevations of these monitoring locations, the dip measurements have also been converted to elevations and are presented on a graph in Annex I.

It should be noted that pumping has taken place from Ngamia East, Nakukulas 9, Nakukulas 10, Kengomo 1, and East Lokichar; therefore, the groundwater levels on some occasions will be affected by this. It should also be noted that the geology in the area comprises complex and varying layers, which the monitoring wells have commonly been screened; therefore, no attempts has been made to separate the water level monitoring data into groups specific to a single stratum.

The dip measurements (excluding those taken when pumping is known to have been taking place) indicate that groundwater is typically encountered within 5 m to 20 mbgl. The dip to groundwater at Kapese is around 30 mbgl (~698 masl). The difference in depth to groundwater from other locations, is likely to be due to the monitoring location being positioned at a higher elevation in the east of the basin. The groundwater elevations are in the north-west at Ewoi, Ekunyuk and Nabolei (~590 to 600 masl). This indicates groundwater flow is towards the north-east. The groundwater elevation does not vary notably over time.

A graph of the groundwater elevations determined from the level logger data are presented in Annex I. These data are highly variable and clearly show a range of groundwater elevations at some of the locations that represent groundwater lows (typically during the day when pumping is taking place) and groundwater highs (typically during the night when pumps are switched off). These data suggest that the resting groundwater elevations at the pumped wells are around 660 masl at Nakukulas 9,615 masl at Kengomo 1, and 620 masl at East Lokichar. The highest and lowest groundwater elevations are the same as the manual dip measurements (indicating the general direction of groundwater flow is towards the north-east) and there are no clear seasonal variations in the dataset. A contour plot of an area in the South Lokichar Basin, for the period 15 to 17 June 2015 (the narrowest date period with the most groundwater elevation data), is presented in Figure 6.8-11. This Figure only presents contours in the area where reliable groundwater elevation data is available over a short time period and does not cover the whole AoI. Figure 6.8-11 indicates an estimated regional gradient in this area of 0.0053, which falls within the range of gradients estimated in Price (2016) (0.0026 to 0.0076).

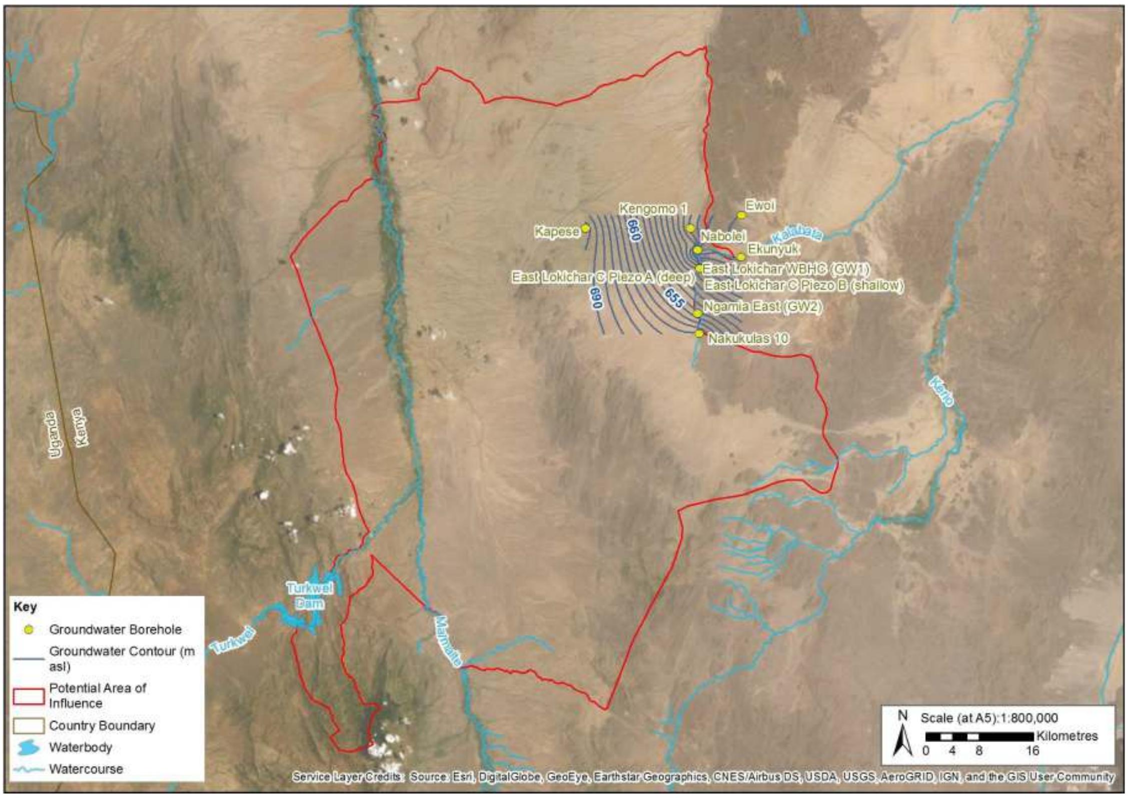

Figure 6.8-11: Groundwater Contour for the South Lokichar Area

Groundwater levels in alluvial deposits adjacent to surface watercourses may be at or near the ground surface. Near the Malmalte River crossing, some clearer areas of vegetation were noted (Golder, 2018a) that are consistent with shallow groundwater or fluvial flooding (i.e. areas of bare earth and or lush "*grass*" growth). Adjacent to the settlement of Kalemngorok, just south of the crossing of the braided River Kharinyang (Alluvial deposits), there was a significant area of ponded water, which could represent high groundwater levels adjacent to the watercourse.

6.8.3.4 Flood Level Estimation

Flood debris can (in the absence of other information) be associated to the last highest flood flow at a river section. Using the ratings curve from the HECRAS model discussed in Section 6.8.2.4 and field observations of the maximum elevation of flood debris, the flood flow velocity required to generate flow debris at a certain elevation can be estimated.

Using the observed flood debris elevation at SW1 of 634.2 masl and the ratings curve developed for that monitoring location, the estimated flood flow along the Kalabata is approximately 150 m^3/s. The HECRAS modelling also indicates that the velocity would be 1.6 m/s during this size event, which is in agreement with the expected flood flow given the low gradient of the channel invert.

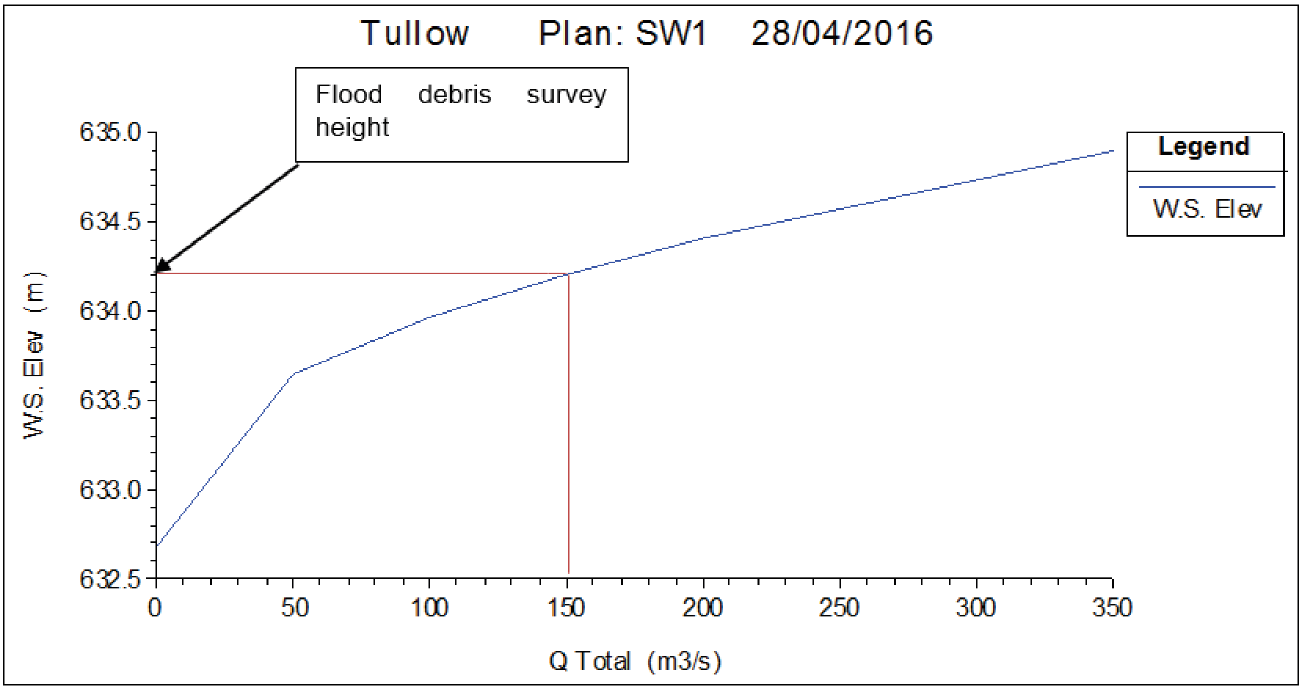

Figure 6.8-12: Predicted Flood Flow Using SW1 Rating Curve

6.8.3.5 Surface Water Flow Monitoring (Kalabata Catchment)

This section presents a summary of the key surface water flow monitoring results.

The field work undertaken between 25 May 2016 and 1 June 2016 found that that level loggers at the locations SW1 and SW2 could not be located and were most likely to have been washed away. The level logger at SW3 was located and data for the period 26 November 2015 to 28 May 2016 was downloaded. Monitoring location SW3 was revisited and data for the period 26 November 2015 to 29 August 2016 was also downloaded. This provided the only surface water data available for the baseline. Figure 6.8-13 presents the pressure data that was captured, and highlights flow events associated with the wet season.

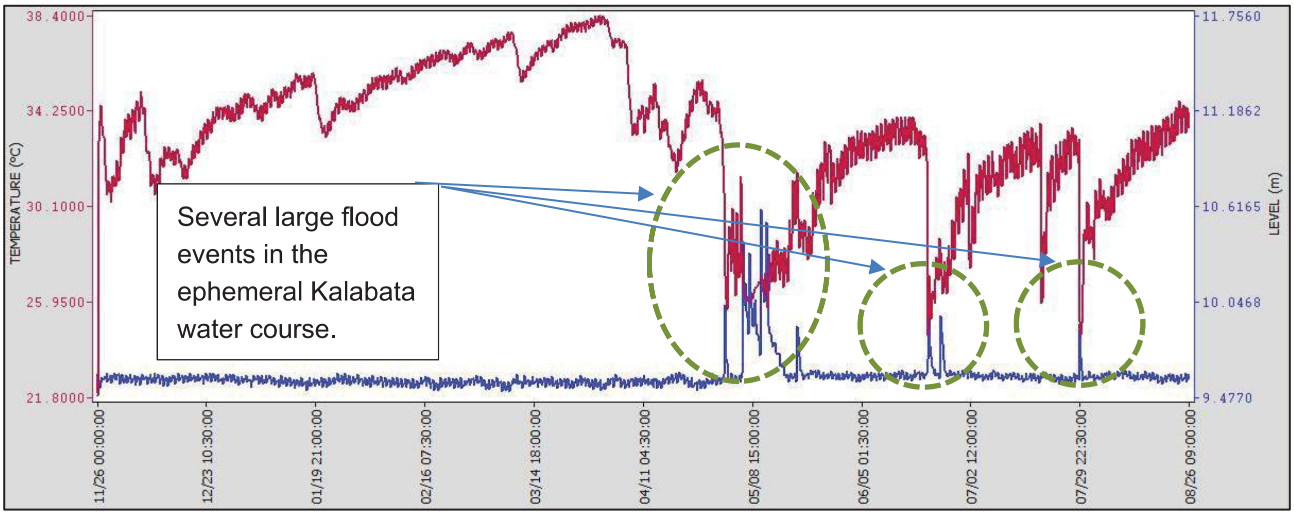

Figure 6.8-13: SW3 – Watercourse Level Data (26 November 2015 to August 2016)

The pressure data downloaded from the level logger at location SW3 has been compensated for atmospheric pressure changes and converted to flow using the ratings curve (Figure 6.8-14). The flow data has then been compared to rainfall data from a monitoring station at Ngamia in Figure 6.8-14. The graph focusses on the data collected over the period when the majority of the rainfall occurred (i.e. April and May 2016). The graph shows that there is a fairly consistent response between rainfall and the data recorded at SW3.

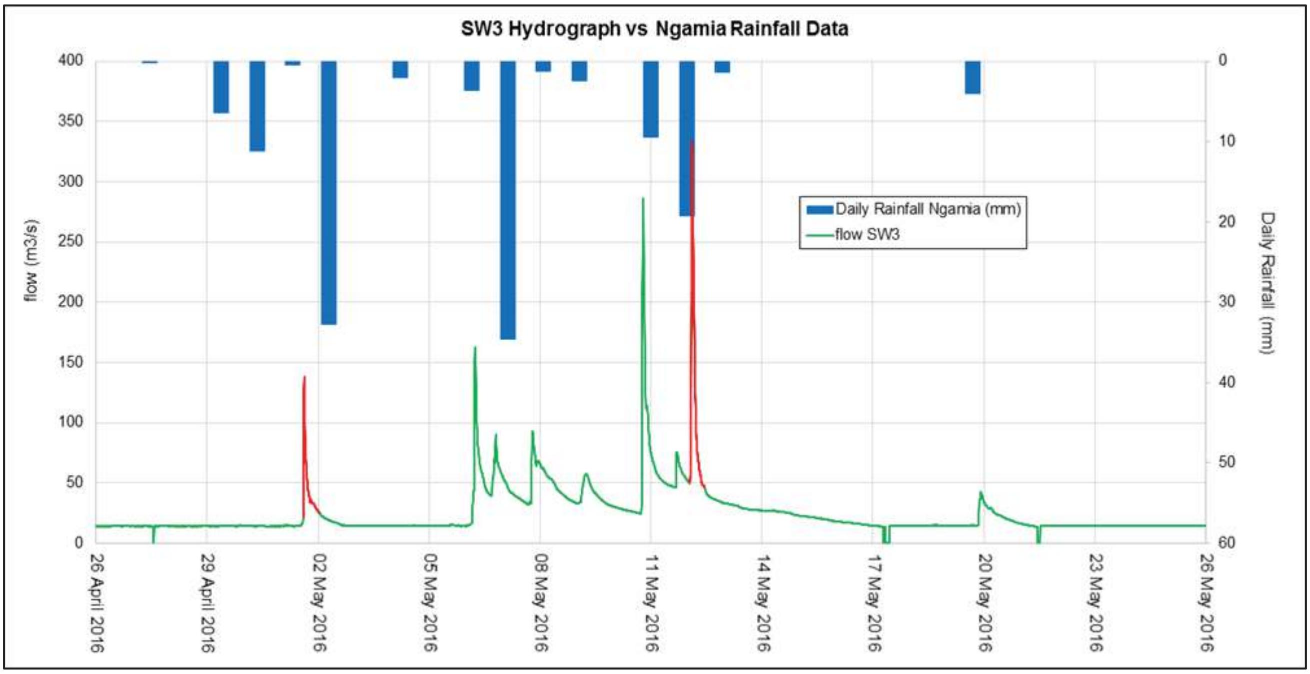

Figure 6.8-14: SW3 – Calculated Flow Comparison to Rainfall Recorded at Ngamia

The hydrological response of the Kalabata catchment (area estimated as 468 km^2) has been characterised using the two most distinct events that were recorded at SW3 (1 May 2016 and 12 May 2016 shown in red on Figure 6.8-14) and have a clear association with large daily rainfall events recorded on the Ngamia rainfall gauge, which is located within the same catchment. Run-off coefficients for the catchment have been calculated using the hydrographs on 1 May 2016 and 12 May 2016. The coefficients for both events are a similar range between 22% and 23%.

6.8.3.6 Surface Water Flow Monitoring (Turkwel Catchment)

The flow regulation provided by the Turkwel Dam releases means the Turkwel River at Lodwar is effectively perennial, unless flows are interrupted by shutdown of the dam's turbines for operational reasons (Tullow, 2018c). The average annual Turkwel Dam flow release plus the Malmalte River combined flow is estimated to be 21 m^3/s (TKBV, 2018c).

Limited results are available from the TKBV ADCP flow measurements. However, flow measurements completed in October 2018 from the Turkwel watercourse downstream of the Tailrace range from 26.5 m^3/s to 31.6 m^3/s.

Losses occur from the Turkwel River channel between the Turkwel Reservoir and Lake Turkana through abstraction for irrigation, surface evaporation and recharge to alluvial aquifers (TKBV, 2018c). The channel is often dry in the lower reaches where is nears Lake Turkana.

6.8.3.7 Turkwel Reservoir

The field observations, measurements and calculations made to inform the TKBV papers and technical reports on the Turkwel Reservoir include the following baseline information:

- The average reservoir water level between 1991 and 2016 was 1,119 masl;
- The highest water level recorded in the reservoir since commissioning in 1991 was 1,139 masl in late 2012, which according to Lodwar Meteorological data (Section 6.) was the wettest year since 1997;
- Reservoir water levels during the October 2017 field survey work were 1,121.5 masl (11 October) and 1,122.2 masl (17 October), which were 0.9 m to 1.4 m lower than during the 2016 survey;
- Reservoir water levels vary depending on the time of year (season and demand for power);
- For a typical water level of 1,120 masl, the surface area of the reservoir is approximately 22,000 km^2;
- Compensation flow releases to downstream of the dam are non-existent and most downstream releases result from water passing through the turbines and along the tailrace, which discharges approximately 4 km downstream of the dam (Figure 6.8-15). This means the Turkwel River between the dam and the tailrace outflow is usually dry due to the lack of flow compensation;
- The reservoir has been operating at levels that are typically between the minimum and optimum operating level since 1990 (Figure 6.8-16), but has never reached maximum levels and over-spilled;
- If operating at maximum capacity, the reservoir retained water volume is approximately 1.6 billion m^3;
- The evaporation loss from Turkwel reservoir at optimum operating level is 0.6 m^3/s, which amounts to 4% of inflow based on the reservoir operating at its minimum operational level of 1,105 masl;
- At optimum and full levels, the evaporation losses from the Turkwel Reservoir are 1.9 m^3/s (13%) and 3.7 m^3/s (24%), respectively; and
- The retention time within the reservoir is about four months at minimum operating level, and about 18 months at optimum operating level.

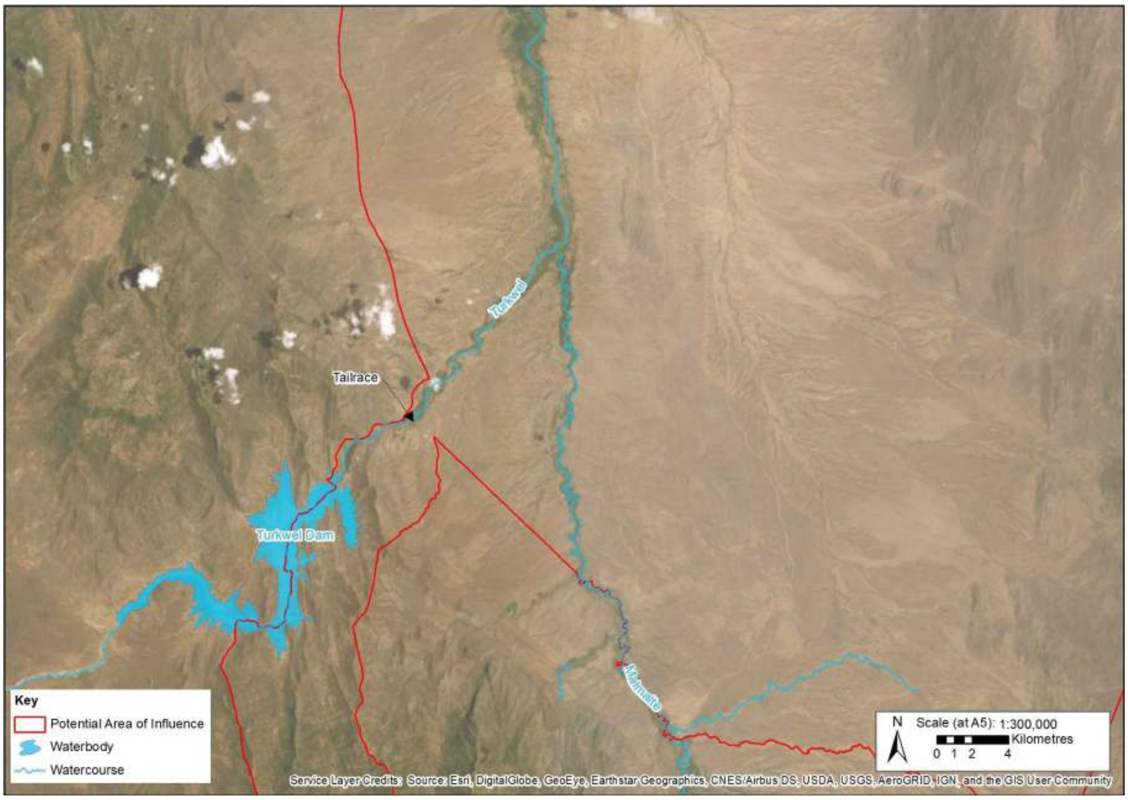

Figure 6.8-15: Turkwel Setting

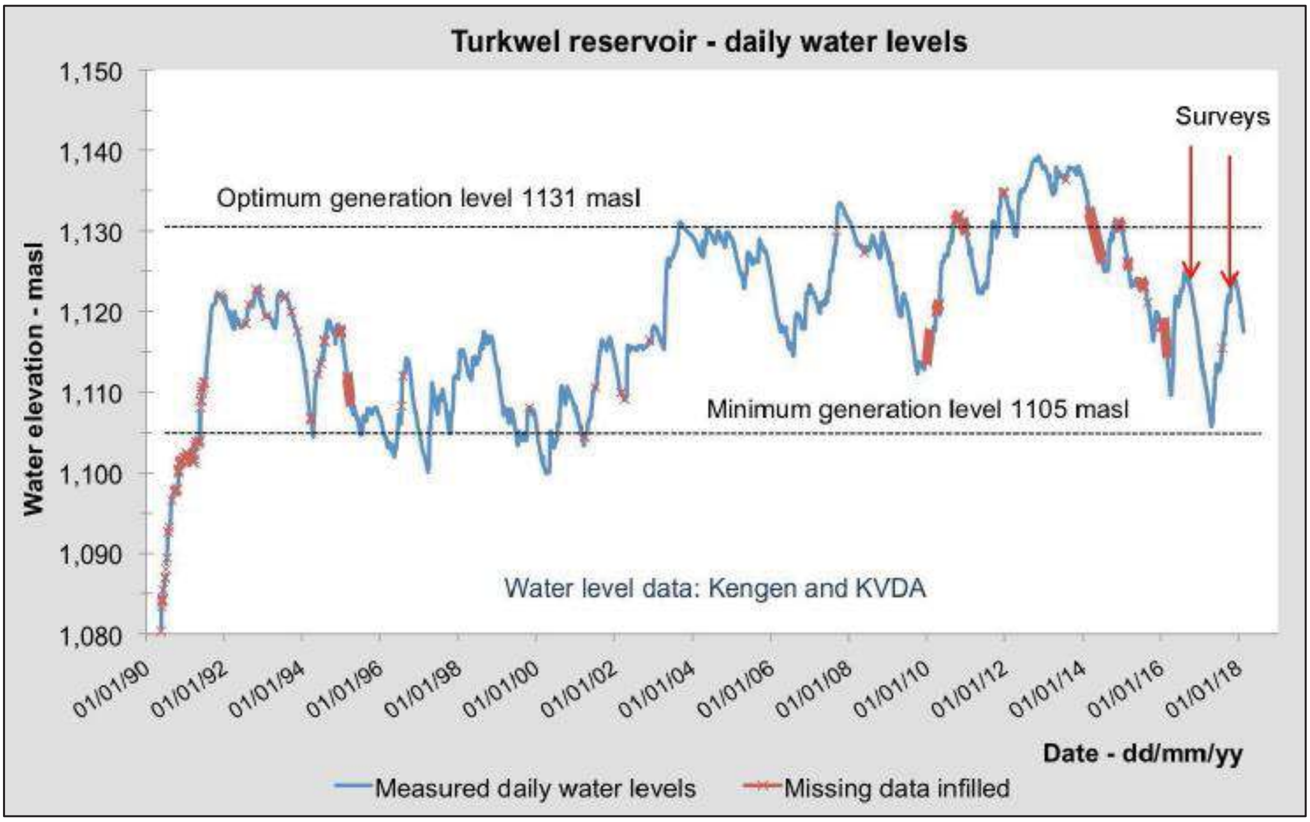

Figure 6.8-16: Turkwel Reservoir Water Level Record (TKBV, 2018a)

6.8.3.8 Water Users

Hydro-census data provided by TKBV provides information about water sources, including community water points (CWP) and source investigation locations in the local area. Figure 6.8-17 shows the locations of these. The locations and type of abstraction identified in the hydro-census are summarised in Table 6.8-9.

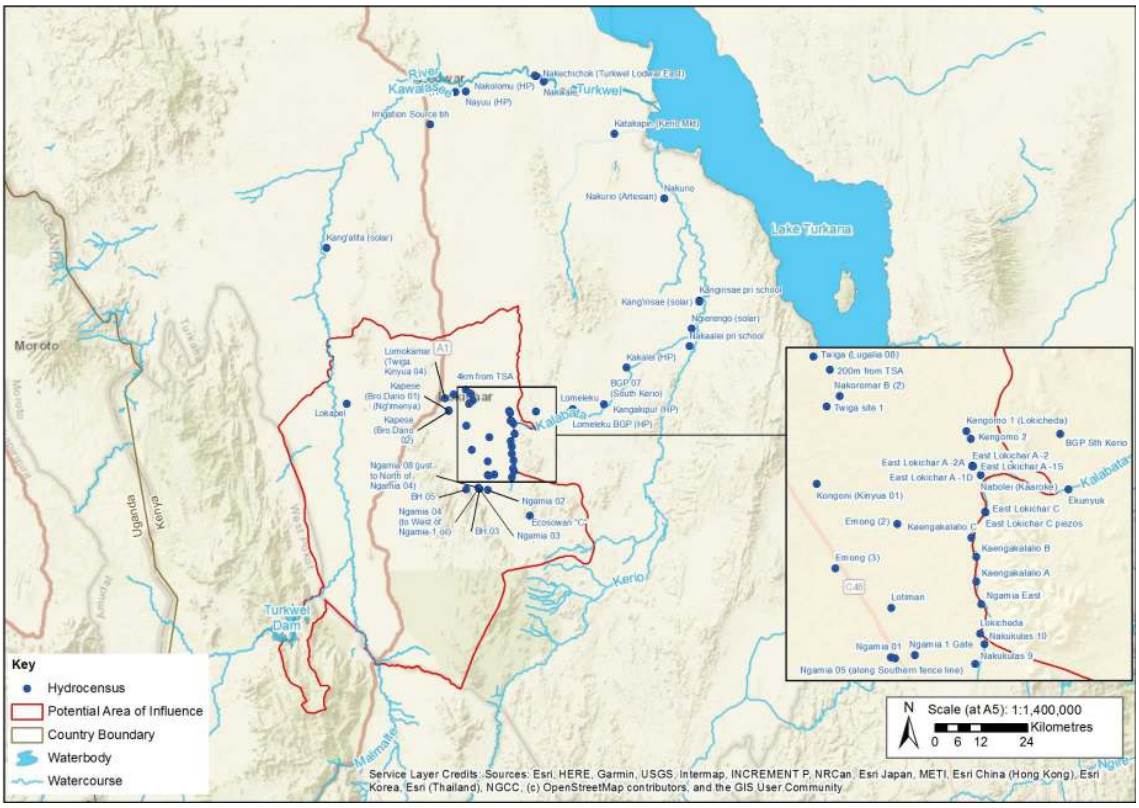

Figure 6.8-17: Water User Location Identified by TKBV Hydrocensus

Information on the sources of water in each County and when they are typically used was collated in Turkana as part of the Health Baseline for the LLCOP ESIA baseline (Golder, 2019b) and a summary is presented in Table 6.8-10. During the data collection it was noted that the water users were typically not able to locate the source of their water on a map; therefore, the type of water course and its general location only are presented.

Table 6.8-9: Summary of Tullow Hydro-Census Data

Location ID	Location Name	Quality Comment	Pump Type	Supply Location	Description
1	Nakukulas 9	Potable	submersible	pipeline to Ngamia 1 & to Amosing-A	Water supplied direct to several CWPs in Nakukulas/Lokicheda area
2	Nakukulas 10	Potable	submersible	pipeline to Ngamia 1	Water supplied direct to several CWPs in Nakukulas/Lokicheda area; will be source for solar-powered scheme
3	Ngamia East	No information provided	No information provided	No information provided	Bowser filling point for deliveries to CWPs
4	East Lokichar C	No information provided	No information provided	No information provided	Back-up bowser filling point for deliveries to CWPs
5	Kengomo 1 (Lokicheda)	Not potable	No information provided	propose to deliver to Twiga South-1	Water supplied direct to CWPs in Twiga area, and bowser filling point at Twiga lagoon
6	Kengomo 2	Tests Good	Submersible	Twiga (1) & Etuko	Water supplied direct to CWPs in Twiga area, and bowser filling point at Twiga lagoon
7	Nabolei (Kaaroke)	Not potable	Submersible	pipeline to Etuko-B	Former production borehole temporarily capped, available for use but saline
8	Ekunyuk	Tests Good	Submersible	Fly Camp	Former production borehole now fitted with a handpump
11	Lokicheda	No information provided	Hand pump	No information provided	Exploration borehole now fitted with a handpump
15	Nakechichok (Turkwel Lodwar East)	No information provided	No information provided	No information provided	Exploration borehole temporarily capped, about to be handed over to Turkana County Government (TCG)
18	Nakurio	No information provided	Hand pump	No information provided	Former seismic camp borehole now fitted with a handpump.
19	Lomeleku	No information provided	Hand pump	No information provided	Former seismic camp borehole (Kangïakipur) now fitted with a handpump.

Location ID	Location Name	Quality Comment	Pump Type	Supply Location	Description
21	Engomo	No information provided	No information provided	No information provided	Former production borehole fitted with solar, elevated tank & distribution system.
26	Kiptoro	No information provided	No information provided	No information provided	Disused borehole rehabilitated and fitted with solar, elevated tank and distribution system.
38	Kapese (Bro.Dario 01) (Ng'imenya)	No information provided	Hand pump for Community	No information provided	No information provided
40	BGP 07 (South Kerio)	Potable	Submersible	BGP camp	No information provided
69	Nakaalei pri school	Potable	No information provided	No information provided	No information provided
70	Ngamia 04 (to West of Ngamia 1 oil)	Tastes good	Hand Pump	No information provided	No information provided
74	Kangirisae pri school	Potable	No information provided	No information provided	No information provided
80	Kang'alita (solar)	No information provided	Solar	No information provided	No information provided
82	Nachukui (HP)	No information provided	Hand pump	No information provided	No information provided
83	Nayuu (HP)	No information provided	Hand pump	No information provided	No information provided
84	Nakolomu (HP)	No information provided	Hand pump	No information provided	No information provided

Location ID	Location Name	Quality Comment	Pump Type	Supply Location	Description
85	Nakwalepit (HP)	No information provided	Hand pump	No information provided	No information provided
86	Katakapin (Kerio Mkt)	No information provided	No information provided	No information provided	No information provided
87	Nakurio (Artesian)	No information provided	Artesian	No information provided	No information provided
90	Kang'irisae (solar)	No information provided	Solar	No information provided	No information provided
91	Ngierengo (solar)	No information provided	Solar	No information provided	No information provided
92	Kakalel (HP)	No information provided	Hand pump	No information provided	No information provided
93	Kangakipur (HP)	No information provided	Hand pump	No information provided	No information provided
94	Lomeleku BGP (HP)	No information provided	Hand pump	No information provided	No information provided
104	Irrigation Source BH	No information provided	No information provided	No information provided	Drilled by National Water Conservation and Pipeline Company, supplies water intermittently via a 2.5 km pipeline to communities located to the east of Lokichar toLodwar road, highly saline.
1	Nakukulas 9	Potable	Submersible	Pipeline to Ngamia 1 & to Amosing-A	Water supplied direct to several CWPs in Nakukulas/Lokicheda area.

HP = hand pump

CWP = community water pump

Table 6.8-10: Community and Livestock Water Supply in the Project-Area Communities

County	Community	Water Sources	Season
Turkana	Lokichar	■ Water points at Kalapata, Lokichada, Kamanu-Kwee, Kaimegur, and Elelea-Nabolei.	Dry
		■ Traditional wells for livestock Kaakali, Kamarese (until it rains); and ■ Natural water pans, *Ngataparin,* (Lokulubech, Apa-lolemu and Askim) can hold water for about six months.	Rainy
		■ Water points Karipun, Kanging'olemogin, Riami-riame, Lokuno.	n/a
	Lokori	■ Kerio River; ■ Water points at Lohurerei and Lokwamosing; and ■ Oases at Kaachola, Napeitom, Naskeny, Kanapot, Kangiesei, Kalomesek Sil, and Agolet.	Rainy and dry for oases
	Kalapata	■ Kareko, Elelea, Nabolei are the major wells.	Mid-rainy
		■ Borehole (Nakiling'a at Loperot) shared by school, community and pastoralists.	Dry
		■ Water points at Loturerei, Lokwamosing, Nabolei water well, Kaimegur, and Kaidima; and ■ Kerio River.	n/a
		■ Wells at Lokichada are a central source of water for pastoralists in the different regions of Loperot, Nakukulas, Lokiroe-liwo, Kaching'angar, and Ikalale Akeraan.	n/a
	Katilia	■ Wells, springs, boreholes; ■ Water catchment (*ngiburin)* and oasis (*ngichwae)*; and ■ Water (*Eriong'a)* is used on the farms.	n/a

n/a = data not available

6.8.4 Climate Change Considerations

Details about current climate trends and future climate change predictions are presented in the Meteorology Baseline (Section 6.4). This section presents a summary of existing climate trend and future climate change predictions relevant to temperature, rainfall, river flows and groundwater recharge, which are all of importance when considering water quantity.

Climate change predictions with respect to rainfall, evaporation and flooding can be highly variable. In general, climate change in Kenya is expected to increase rainfall in the long-term, but with increased extremes including intense rainfall events, drought and continuing high evapotranspiration characteristics.

Uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Niño events. The latter strongly influence the seasonal rainfall in East Africa (McSweeney et al. 2010a). Projections presented in the UNPD Climate Change Country Profile for Kenya consistently indicate an increase in total annual rainfall both over Kenya and the AoI. In addition, the proportion of rain falling in heavy rainfall events is predicted to increase (McSweeney et al. 2010a). However other studies predict a potential decrease in future rainfall in Kenya. Funk et al. (2010) for example predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean.

Rainfall change forecasts vary depending on which climate model is used. In East Africa there is high confidence in a projected increase in heavy precipitation and there is predicted to be a likely increase in mean annual precipitation over areas of central and eastern Africa (Niang et al., 2014). Values given for predicted precipitation changes east Africa in the period 2080 to 2099 (from a baseline period of 1989–1999) range between -3% and +25% precipitation (mean +7%) (World Bank, 2011). Generally, a wetter climate is predicted with more intense wet seasons, and increase in the number of extreme wet days, and less severe droughts during October to December and March to May.

In summary, temperature change predictions due to climate change across different analyses are considered consistent, but changes to rainfall patterns and total rainfall are more complex to predict. The design criteria of the Project should consider an increase in temperature over the lifetime of the Project in the order of 2.5˚C, and design should consider the worst-case scenario presented during extreme events, in the order of 33% increase in maximum daily rainfall events.

There is uncertainty over predicted changes to river flows as a result of climate change. Some climate change models predict a 20% increase in Kenya’s river flows by 2030 resulting from extreme runoff during intense rainfall events (Avery, 2013). Increases in runoff rates would lead to more erosion and flooding. Different groundwater systems are likely to react in different ways to climate change. Shallow aquifers recharged by rainfall and with short residence times will react more quickly to changes in recharge and are likely to be those most affected. Changes in rainfall and run-off patterns could reduce recharge to such aquifer and lead to reduced resource availability.

6.8.5 Discussion

Based on the available secondary and primary data sources presented above, the following statements can be made about the baseline surface water and groundwater system:

- The AoI is located in an arid environment with drainage provided by an extensive dendritic network of wide shallow streams (luggas);
- Rain falls during the long rains season (March to June) and the short rains season (November to December);
- The main watercourses that flow through the AoI are the Kalabata River, which is located in a valley to the east of AoI, the Turkwel River, which is located downstream of the Turkwel Reservoir and Dam, and the Malmalte River, which is located to the east of the Turkwel Reservoir.
- The Kalabata River is an ephemeral watercourse that is fed by direct precipitation, run-off and ephemeral flow from luggas that provide a drainage network from the south-west;
- The Turkwel River receives input from the Malmalte River and discharges from the tailrace of the dam after power production. Discharges from the tailrace mean that flows in the upper reaches of the Turkwel River are typically perennial, but flows can dry up nearer to Lake Turkana;
- Flow in the luggas is ephemeral and driven by short duration, intense seasonal rainfall, as is shown by the data collected at SW3. Given the lack of vegetation, this likely leads to extensive erosion, high suspended solids content and rapid channel migration;
- Using the elevation of observed flood debris and HECRAS modelling, the flood flow on the Kalabata (at SW1 and SW3) is estimated to be between 150 m^3/s and 330 m^3/s with velocities exceeding 1.5 m/s;
- Much of the rainfall will run-off the more compacted, less permeable, higher ground and provides the ephemeral flow in the luggas. The run-off coefficient for the Kalabata catchment, in which the AoI is located, has been estimated as 22% to 23%;
- Infiltration rates to the ground from tests have been calculated to be between 0.063 cm/min and 0.663 cm/min. The saturated vertical hydraulic conductivity is calculated to range from 8.3×10^{-6} m/s to 2.6×10^{-5} m/s;
- When rainfall exceeds evapotranspiration aquifer recharge will to occur and, during storms, surface water flow can occur;
- Rainfall is reportedly spatially variable on a very small scale, so when surface flows do occur there is potential for a lugga to flow at one location and the same lugga to be completely dry elsewhere;
- Recharge is most likely to occur during the longer periods of rainfall or during heavy rainstorms when large volumes of water fall onto the ground over short periods of time. Aquifer recharge in arid areas such as this is likely to be less than 10% of long-term average rainfall. Estimates of local infiltration rates range between 1 mm/yr and <20 mm/yr;
- The primary data indicates that groundwater is typically encountered at depth of 5 mbgl to 20 mbgl in the wells located in the east of the basin in which the AoI is located;

- The depth to groundwater is greatest where the topographic elevation is highest (~30 mbgl at Kapese) and in the area just to the north of the AoI (35 to 40 mbgl in Nabolei and Kengomo 1);
- The groundwater flow direction indicated by both secondary and primary data sources is towards the east or north-east;
- Measurements made in wells in the Miocene volcanic sequence indicate the transmissivity is highly variable and test results have a range from <1 m/d to >750 m/d. Transmissivity values measured in wells in the alluvial deposits range from >600 m/d to >5,000 m/d;
- Groundwater is abstracted from wells as a source of exploration water by TKBV. In November 2016 the main exploration local water supply abstraction was occurring from East Lokichar, Nakukulas 9, Nakukulas 10 and Kengomo 1[15];
- TKBV provides some of the abstracted groundwater to a series of community water points to augment the local people's supplies. Other sources of local water supplies include springs, oases, shallow wells and deep wells. Prior to TKBV's provision of water resources to local communities, community water supplies tended to come from hand dug wells in luggas and hand pumped wells installed by NGOs; and
- Recharge to aquifers from rainfall infiltration is limited and aquifer storage is limited, so unmanaged abstractions could exceed available water stored and recharged.

[15] The four boreholes will be used more intensely during the construction phase of the Project alongside six additional boreholes

6.9 Biodiversity

The baseline ecology and biodiversity in the AoI have been characterised using both primary and secondary data including:

- A desktop review of secondary data, including available literature and databases acquired from selected data holders; and
- Collection, processing and analysis of additional primary data through fieldwork.

6.9.1 Secondary Data Gathering Methods

The secondary assessment comprised a literature and database review plus analysis of existing information from the following categories;

- Landcover classification;
- Identification of expected species and ecosystems; and
- Identification of species and ecosystems of conservation concern.

6.9.1.1 Landcover Classification

In October 2016, Golder commissioned GeoTerra Image (GTI) (Pty) Ltd. to complete an 18-class landcover mapping and classification exercise for a designated area within the South Lokichar Basin based on 10 m raster cells (Golder, 2017). This landcover classification covered a key subset of the AoI using 10 m resolution Sentinel 2 satellite imagery[16], acquired on 28 March 2016.

An additional, a more detailed 27-class vegetation/land-cover dataset was generated from the same source imagery. This dataset provides more spatial and thematic detail on the vegetation communities on the plains and along the riparian zones. The Modified Soil Adjusted Vegetation Index (MSAVI) was used to extract this finer community detail. Sub-division and re-coding of riparian vegetation and plains vegetation types (supervised landcover mapping) was completed using vegetation and flora field data gathered during the vegetation field survey done in June 2016.

In January 2019, GTI were again appointed to extend the existing landcover classification exercise with a corridor between South Lokichar and the Turkwel Dam, based on a 2 km buffer around the proposed water pipeline route.

6.9.1.2 Identification of Expected Species

A review of available literature, data and other information relating to terrestrial and aquatic ecology was completed for a geographical area that includes the Turkwel, Kalabata, Kerio, Turkwel Dam Basin and Malmalte River catchments. Information reviewed included that available for vegetation and habitats, flora and fauna. Data sources included, yet were not limited to:

- Global Biodiversity Information Facility (GBIF, 2017 & 2018);
- Integrated Biodiversity Assessment Tool (IBAT, 2017 & 2018);
- International Livestock Research Institute (ILRI, 2011);
- Van Breugel *et. al.*, (2015);

[16] granule references 36NYH, 36NYJ, 36NZH and 36NZJ

- National Museum of Kenya museum and herbarium records;
- White (1983);
- International Union for Conservation of Nature (IUCN, 2016 to 2019); and
- Various published scientific studies, and historical and recent reports related to the AoI.

In addition to the collection of published and unpublished data, consultation was held with regional experts to gather their input and knowledge of the area, identify additional data sources, and to gain expert opinions and advice (Table 6.9-1).

Table 6.9-1: Stakeholder Consultation and Key Informant Interview Details

Date	Stakeholder/Key Informant	Organisation	Role
18 April 2016	Mr. Ademola Ajagbe	BirdLife International, Kenya	Team Leader, Conservation Action and Policy
18 April 2016	Mr. Per Karlsson	African Wildlife Foundation	Program Design Manager
23 June 2016	Mrs. Josephine Nzilani	Flora and Fauna International	Programme Coordinator, East Africa
22 February 2017	Mr. Peter Njiri Mwangi	KWS	Senior Scientist
3 March 2017	Mr. Fredrick Aloo	State Department of Livestock Production. Ministry of Agriculture, Livestock, Fisheries and Blue Economy, Range Resource Development Division	Senior Scientist
8 March 2017	Mr. Gordon Ojwang	Directorate of Resource Survey and Remote Sensing	Senior Assistant Director, Natural Resources and Remote Sensing
10 April 2018 24 January 2019	1) Prof. Steven G. Njuguna, 2) Prof. Mary Gikungu, 3) Dr. Alex Awiti, 4) Dr. Catherine Lukhoba, 5) Mr. Peter Njiiri Mwangi, 6) Mr. James Mwang'ombe, 7) Dr. Peter Njoroge	1) Associate Professor at Kenyatta University 2) NMK 3) Director East Africa Institute of Aga Khan University 4) Senior Lecturer University of Nairobi 5) Senior Research Scientist – KWS 6) Assistant Chief Conservator of Forests Kenya Forestry Services 7) Head of Ornithology - NMK	Biodiversity Advisory Panel convened specifically for the Project

Date	Stakeholder/Key Informant	Organisation	Role
25 February 2019	Mr. Shadrack Ngene	KWS	Assistant Director - Species Conservation and Management
21 March 2019	1) Mr. Jonathan Kirui 2) Mr. John Kagwi 3) Mr. Jackson Melly 4) Mr. Apollo Kariuki 5) Mr. Bernard Agwanda	1 to 4) KWS 5) NMK	KWS – Deputy Community Wildlife Service KWS – Assistant Community Wildlife Service KWS – Head of Land KWS – Head of Planning and Environmental Permitting NMK – Local Biodiversity Advisor
5 April 2019	Mr. Titus Peghin	Northern Rangelands Trust (NRT)	Regional Coordinator

The review of the available secondary data was used to assess the breadth and adequacy of the current body of ecological knowledge for the AoI. The findings of the review were used to focus the primary baseline data collection on priority areas for field survey (Section 6.9.1.2).

6.9.1.3 Identification of Species of Conservation Concern

Using the desktop information, a screening exercise was completed to identify biodiversity receptors (for example, species and habitats of conservation concern, protected areas), which could occur in the AoI which could interact with the Project components.

The following attributes formed the basis of the screening.

Species of Conservation Concern

- Globally threatened species: These include internationally recognised IUCN Red-Listed Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) species, as defined by the IUCN Red List guidelines.
- Nationally threatened species: These include species listed under the sixth schedule of the Kenyan Wildlife Conservation and Management Act (2013); species identified by KWS as priorities for conservation action (KWS, 2019).
- Migratory/Congregatory species: Species listed on Appendix I and II of the Convention on Migratory Species (CMS), also known as the Bonn Convention. This convention, to which Kenya is a signatory, aims to conserve terrestrial, aquatic and avian migratory species throughout their range, and species whose individuals gather in large groups or colonies.
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) species: As a signatory to the CITES convention, Kenya has obligations to protect species listed on Appendices I, II and III, from over-exploitation.

- Restricted-range or endemic species: Restricted-range species are defined as species with global ranges Extent of Occurrence (EoO) of 50,000 km^2 or less (Eken et al. 2004; Holland et al. 2012). For most terrestrial vertebrates (e.g. mammals, birds, reptiles and amphibians), and invertebrates (e.g. insects and arachnids), global ranges of 50,000 km^2 or less, are considered appropriate in global conservation practice (Eken et al. 2004). Thresholds for other invertebrates (particularly, aquatic and terrestrial molluscs) and aquatic species (e.g. fish) are typically set at 20,000 km^2 (Holland et al. 2012).

It is recognised that some species of conservation concern (SoCC) identified in the screening list would not actually occur in the AoI for various reasons, such as lack of habitat. Therefore, an assessment of the probability of the various receptors occurring in the AoI was determined based on:

- Findings of previous studies and published scientific literature;
- Species records from the NMK (2016), and those stored in the GBIF (2017 & 2018);
- Knowledge of the life histories of the species, habitat preferences and known ecological requirements, as determined through published information and information presented in the species profiles on the IUCN's Red List (IUCN, 2019); and
- Consultation with regional experts, and professional judgement and experience of the assessors.

Three levels of probability were used to describe the likelihood of occurrence: possible, probable and unlikely. These were defined as:

- Probable: the species or ecosystem is likely to occur in the AoI due to suitable habitat and resources being present and known records from the area. The AoI is within the known EoO and/or Area of Occupancy (AoO) of the species;
- Possible: the species or ecosystem may occur in the AoI or move through the area (in the case of migratory and highly mobile species) due to presence of suitable habitat and/or resources. No records are known from the area and/or it is a rare, erratic or a poorly known species or ecosystem. Nevertheless, the AoI is within the known EoO and/or AoO; and
- Unlikely: the species will not likely occur in the area due to lack of suitable habitat and resources, and/or the AoI is outside of the EoO and/or AoO.

The probability assessment was used as the starting point for the identification of sensitive biodiversity receptors that may occur in the AoI. Only those species and habitats with a possible and probable likelihood of occurrence within the AoI were carried through and considered for the baseline surveys.

6.9.1.4 Identification of Ecosystems of Conservation Concern

Ecosystems of importance to the public, government agencies, scientific community, NGOs and/or TKBV occurring within the AoI were identified. Ecosystems of conservation concern include:

- Internationally recognised sites of biodiversity importance, such as Important Bird Areas (IBA), Endemic Bird Areas (EBA), Key Biodiversity Areas (KBA), Ramsar sites and World Wildlife Fund (WWF) Ecoregions;
- Nationally designated and protected areas, and other areas that may have specific conservation and management requirements, as set out in national Kenyan wildlife legislation and policy;
- Community conservancies; and
- Important habitat types outside of protected areas, such as wetlands or landscape features with importance in maintaining key ecological processes and functions needed to support and maintain important biodiversity attributes, such as forests forming ecological corridors between protected areas.

6.9.2 Primary Data Gathering

Informed by the desk study and literature reviews, field surveys were designed to collect, process and provide analysis of primary data gathered within the AoI.

6.9.2.1 Vegetation Data Gathering

The following rapid field survey programmes (Sayre et al., 1999) were conducted:

- One 6-day survey took place during the short rains season (10 to 16 November 2015),
- Another 6-day survey at the end of the wet season (23 to 29 June 2016); and
- An additional 6-day day survey was conducted during the dry season (13 to 18 September 2018) between South Lokichar Basin and Turkwel Dam.

These periods were particularly suited for maximising the detection of plants in fruit and in flower, which, in many cases, facilitate more accurate and verifiable identifications. The data collected were also used to verify the ecosystems, vegetation communities and habitats identified in the AoI area during the review of secondary data.

The following flora and vegetation community survey methods (Larsen, 2016) and analyses were used:

- The November 2015 survey was completed according to mapped landcover units preliminarily identified using an unsupervised high-level classification[17] of LandSAT8 imagery (Ministry of Agriculture, 2015);
- For the June 2016 survey, a more refined unsupervised land cover classification of high-resolution Sentinel2 imagery (GTI, 2016 Section 1.2.3.2) was used. The map units were defined based on available information on vegetation pattern, structure and ecological variation (e.g. soil and moisture conditions, landscape position, level of disturbance);
- In September 2018 an additional vegetation field survey was conducted with emphasis on the area between South Lokicar and Turkwel. Several vegetation transects were conducted in the different vegetation communities observed;
- Description of plant communities followed Beentje (1994) and Herlocker (1979). Plotless landscape sampling frames were used to compile an inventory of plant species (i.e. trees, shrubs, forbs, and grasses), and to characterise the vegetation communities;
- Searches for the presence of Kenyan-listed and IUCN Red-listed plant species, in particular: CR, EN, and VU species; CITES listed species; other priority plant species listed by the KWS; regionally/locally endemic species, range-restricted species and species of local importance (including ethnobotanical importance); and any threatened vegetation communities;
- Identification of populations and distribution of invasive and pest plants; and
- Assessment of the ecological integrity and extent of existing vegetation communities.

6.9.2.1.1 Vegetation Community Condition Assessment

The condition of the vegetation communities was rated and assigned a subjective class after Herlocker's (1989) Kenya rangeland condition assessment criteria (Table 6.9-2). These criteria focus on soil erosion and vegetation structure indicators, with added criteria relating to livestock grazing and timber harvest land-uses.

[17] Image classification techniques can be either 'supervised' or 'unsupervised'. For unsupervised image classification, the analysis software assigns output classes without the user providing pre-set classes. Supervised image classification uses the same analysis software, but the user defines specific classes for representative pixel samples before the analysis is run.

These latter criteria were identified as the primary drivers of change in the vegetation communities in the wider AoI. Further details on the condition assessment approach are provided in Annex I.

Table 6.9-2: Condition Classes (Herlocker, 1989; IFC PS1)

Condition Class	Condition Description
Good	Largely natural with few modifications.
Fair	Slightly modified; evidence of change in ecosystem processes is discernible; a small loss of natural habitats and biota may have taken place
Fair to Poor	Moderately modified;
Poor	Largely modified; a large change in ecosystem processes and loss of natural habitat and biota has occurred
Very poor	Seriously modified; ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota

6.9.2.1.2 Vegetation Community Mapping

A detailed vegetation community map was derived based on the land cover assessment (Section 6.9.2.1) and verified by the data gathered during the vegetation and flora field surveys.

6.9.2.2 Invertebrate data gathering

A preliminary scoping survey consisting of passive observation-based surveys of transects, with no trapping was conducted between the 29 October and 04 of November 2015. A dedicated invertebrate sampling survey was conducted between the 15 and 22 June 2016, during the wet season. This season was deemed to be the most appropriate to survey invertebrates in the semi-arid environment of the AoI. Expert advice identified that most species would be actively breeding and foraging during this time, thereby allowing for increased survey effectiveness.

Surveys during the dry season and short rains n were not considered viable given the potential for the targeted invertebrate groups not to be active and breeding during those times. Despite being conducted during the long rains, the weather for the majority of the survey was very dry, with isolated showers towards the end of the survey. Those dry conditions would have influenced the diversity and richness of the taxa recorded.

Sampling methods included (Hill et al., 2005; Samways et al., 2010; Gonçalves and Oliveira, 2013):

- Passive pitfall trap lines set in place for four-trap nights at each survey site (Figure 6.9-1) (which were at the same locations as the reptile and amphibian surveys (section 6.9.2.3);
- Two passive light-traps established at each survey location and left open for one to two hours during the night at each site (Figure 6.9-1
- Active, timed habitat searches and sweep net surveys conducted during the day and night at each site, plus additional non-trapped sites; and
- Voucher specimens were retained for taxonomic purposes and deposited in the collection of the NMK.

The identifications of the species recorded, with additional information, such as distribution, relative abundance, communities and habitat associations was used to inform the baseline of selected invertebrates of conservation concern.

The taxonomy of many groups is not well known; therefore, after discussion and consultation with NMK, the following groups formed the basis and focus for this baseline: beetles (Coleoptera); flies (Diptera); ants, bees and wasps (Hymenoptera); butterflies and moths (Lepidoptera); and grasshoppers and crickets (Orthoptera).

6.9.2.3 Amphibian and reptile data gathering

A single survey was conducted between the 15 and 22 June 2016, during the long rains. The survey was conducted in tandem with the invertebrate survey since both surveys made use of passive pitfall trap lines. Like the invertebrate surveys, expert advice identified that a dry season survey would not be effective. Like many other tropical desert areas, the reptile and amphibian species of the semi-arid Turkana region are cryptic during that time to avoid extremes of heat and dryness (Heyer et al., 1994; Spawls et al., 2004; Channing and Howell 2006; McDiarmid et al., 2012). The weather for most of the survey period was very dry, with isolated showers towards the end of the survey. Such dry conditions would have influenced the diversity and richness of the taxa recorded, particularly the amphibians.

The survey was focussed within the AoI, and adjacent areas identified as being of high potential to support SoCC. Sampling methods included (Heyer et al., 1994; McDiarmid et al., 2012; Larsen, 2016):

- Passive trapping for ground-dwelling reptiles and amphibians using pitfall trap/funnel trap and drift fence arrays (in place for four-trap nights at each site) (Figure 6.9-1);
- Active, timed habitat searches during the day and night at each site, plus additional non-trapped sites;
- Voucher specimens were retained for taxonomic purposes and deposited in the NMK collection; and
- Species were also recorded opportunistically.

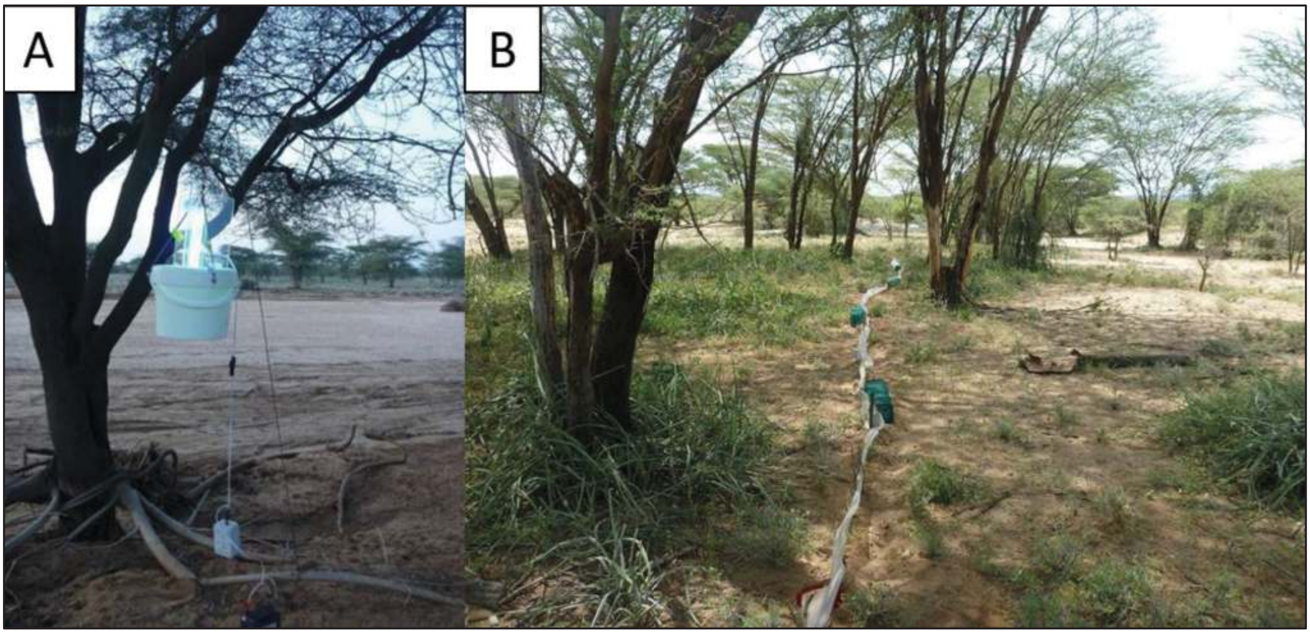

Figure 6.9-1: An Example of a Light Trap. B: Pitfall and Funnel Trap Drift Fence Array for Sampling Reptiles, Amphibians and Invertebrates

6.9.2.4 Avifaunal Data Gathering

Bird SoCC, and their respective habitat associations, were identified through five bird field surveys, conducted during the following periods:

- A short rains season survey was conducted from 11 to 18 November 2015 (corresponding to the winter migration period);

- A long rains season survey, corresponding to the summer migration period was conducted from 11 to 18 May 2016;
- A dry cool season survey was conducted from 03 to 10 August 2016;
- A survey between South Lokichar and the Turkwel Dam from 13 to 18 September 2018. Bird surveys included both transects and vantage point surveys;
- A survey of the riparian habitats along the Malmalte River and South Lokichar Basin was conducted from 27 November to 04 December 2018; and
- A survey of the habitats west of the Malmalte River associated with the proposed water pipeline was conducted from 11 to 15 June 2019.

Sampling methods focussed on each of the identified vegetation communities and habitats to identify bird communities and populations within the AoI. Methods followed Sutherland et al., 2004; Hill et al., 2005; and Larsen, 2016 and included:

- Timed species counts across fixed transect routes within each of the oil field areas and each broad habitat type/vegetation community;
- Vantage point surveys conducted at proposed wellpads and other Project proposed infrastructure, with reference to threatened vulture and raptor species, and large flocks of birds;
- Point counts were done in areas of rugged terrain, densely vegetated habitats, and habitats that were heterogeneous or highly fragmented, such as hillier areas to the west of the A1 road. Point counts were also undertaken in Lokichar town to determine whether resources in this location, such as refuse, could be drawing in species, in particular vultures; and
- Data from targeted bird surveys was supplemented with incidental observations.

6.9.2.5 Mammal Data Gathering

Surveys for mammals covered medium to large and small mammals (flying and non-flying), with different sampling techniques employed to cover the three different groups during the following field surveys:

- A short rains season survey from 03 to 18 November 2015;
- An end of dry season survey from 20 to 27 April 2016;
- A dry cool season survey from 03 to 10 August 2016;
- A beginning short rains season survey from 13 to 18 September 2018; and
- A long rains season survey from 11 to 15 June 2019.

The methods employed for each group are outlined below. Survey methods largely followed those presented in Wilson et al. (1996) and Larsen (2016).

Medium and Large Mammals

A remote camera trapping scheme was initially deployed during November 2015. Ten remote cameras (Reconyx PC900, www.reconyx.com) were installed at locations throughout the AoI, with a view for bi-monthly rotation and data download (O'Connell et al., 2011). Significant loss of remote cameras was experienced during that time. Of the ten camera traps deployed between the 8 and the 12 November 2015 six had been stolen and one severely damaged. The remaining three traps were withdrawn from the field on the 7 January 2016.

Additional camera trapping was conducted during the June 2019 Turkwel field survey. In total 207 camera trap nights were achieved over the course of the baseline assessment.

Driven transect surveys (Hill et al., 2005) were completed between the 20 and 27 April 2016, and 03 and 10 August 2016 to gain evidence of large and medium-sized mammal presence (for example, striped hyena (*Hyaena hyena*) and leopard (*Panthera pardus*)) throughout the AoI. Transects were driven during dusk (commencing approximately 30 minutes before sunset at a point furthest from Kapese Camp, and concluding upon arrival back at Kapese camp), and dawn (commencing approximately two hours before sunrise and concluding upon sun-up). The vehicle was driven at a maximum speed of 20 kph, and spotlight counts conducted with the location and species of any observed mammals recorded.

Interviews with local people were conducted throughout the AoI. Whenever the field team encountered local people during surveys, they were questioned on their knowledge of mammals observed in the area. This included gathering information on how often they had seen these animals, the most recent sighting of the animals, and any interesting observations. A pictorial field guide (Kingdon, 1997) was used to assist conversations.

Track pads (Mateus et al., 2011) were placed in areas identified as potential large mammal movement corridors and/or areas of attraction, such as water points and obvious trails.

Small Mammals

The following three trapping surveys for small mammals were completed:

- A short rains season survey from 02 to 18 November 2015;
- An end of dry season survey from 20 to 27 April 2016; and
- A cool dry season survey from 03 to 10 August 2016.

Small mammal survey methods were focussed on the deployment of Sherman trap lines across the different vegetation communities and habitat types within the AoI, to record the presence of (trappable) small mammals (Wilson et al., 1996).

Trapped mammals were photographed, identified to species level, tagged and released. A non-lethal tissue sample (ear punch) was retained from some trapped rodents for Deoxyribonucleic Acid (DNA) analysis; these individuals were also tagged to identify them in the case of recapture. Tissue sampling and tagging was conducted in accordance with standard guidelines for the use of wild mammals in research (Sikes et al., 2011).

Bats

The following bat surveys were conducted in the AoI.

- A short rains season survey from 02 to 18 November 2015;
- An end of dry season survey from 20 to 27 April 2016;
- A dry cool season survey from 03 to 10 August 2016; and
- A dry season survey conducted from 11 to 19 March 2019.

Methods included daytime searches for roosting bats within suitable habitat, trapping of flying bats at dusk using harp traps and/or mist-nets, passive, acoustic monitoring of bat echolocation calls at fixed points, and active acoustic monitoring during driven transects, with survey effort stratified by habitat type where possible (Wilson et al., 1996; Collins, 2016; Larsen 2016).

Static monitoring at several locations was conducted during the November 2015 survey, to scope the extent of bat activity and extent of species presence within the AoI. Active monitoring was carried out during the April 2016 survey only, using a SM2BAT+ bat detector (Wildlife Acoustics Inc., www.wildlifeacoustics.com). The bat detector was mounted on a vehicle, and transects were driven across the AoI, concurrent with the large mammal driven transects. Transect routes were selected based on availability and accessibility of roads and tracks, with the aim of covering the different habitats within the area.

The additional bat data collected during the March 2019 biodiversity survey comprised only of acoustic monitoring of bat echolocation calls conducted during the evenings in Kapese camp.

6.9.2.6 Fish Data Gathering

Fish surveys were conducted in the Malmalte and Turkwel Rivers in March and June 2019. Due to high flow levels in June and security concerns in March no electrofishing was conducted in the Malmalte River. As the Malmalte River is a tributary of the Turkwel River it is anticipated that the fish communities will be largely similar between the two rivers, especially in the vicinity of the confluence.

Fish sampling was conducted by means of deployment of baited minnow traps (Figure 6.9-1), seine netting and electrofishing (June 2019 survey only). Traps were deployed along the riverbanks and left for two hours after which they were removed. Electrofishing was conducted in shallow wadeable reaches of the Turkwel River by means of a portable electrofisher. Standard Length (SL) and weight in grams (g) were taken of representative samples of each species at each site. All species were photographed and a small sample representing individuals from all observed species were collected and preserved in 10% neutrally buffered formalin for confirmation of identifications at the NMK in Nairobi.

Figure 6.9-2: Baited Minnow Traps Prior to Deployments in the Turkwel River

6.9.3 Results - Secondary data

6.9.3.1 Biodiversity Context

The area considered in the secondary research comprises the following five catchments:

- Kalabata River Basin;
- Kerio River Basin;
- Malmalte River Basin;
- Turkwel Dam Basin; and
- Turkwel River Basin.

The area consists of an undulating plain, interspersed by low, steep-sided hills of volcanic origin (Amuynzu and Oba, 1991). It straddles two of the eco-climatic zones defined for East Africa (after Pratt and Gwynne, 1977) namely:

- Arid Zone (Zone V), consisting of rangeland dominated by *commiphora* and *acacia* shrubland; and
- Very Arid Zone (Zone VI), dominated by dwarf shrub grassland with *Acacia reficiens* occurring throughout.

The vegetation is characterised by Somalia-Masai *acacia/commiphora* deciduous bushland and thicket (Drawing 6.9-1), much of which is sub-classified as stunted (White, 1983; Van Breugel et al., 2015). The stunted bushland sub-class is defined by two to three-metre-high bushes and stunted trees (mostly *A. reficiens*) and occurs in areas where rainfall is less than 250 mm annually (Van Breugel et al., 2015). This results in natural vegetation distributions restricted to drainage lines and natural depressions where soils are heavier and more water-retentive (Pratt and Gwynne, 1977). During the 1970s, it was recognised that overgrazing in the Arid Zones (Zone V and VI) was an important driver in this ecosystem. The lack of land titles in communal grazing areas, and the prevailing arid conditions, are cited as facilitating excessive grazing/browsing pressure and the associated degradation of the vegetation communities in the region (Pratt and Gwynne, 1977). Human settlements and livestock populations have continued to expand since then until the present day, adding further pressure.

Historically, indigenous browsing herbivores, which would have occurred in the AoI, included Grant's gazelle (*Nanger granti*), gemsbok (*Oryx gazella*), Grevy's zebra (*Equus grevyi*), Guenther's dik-dik (*Madoqua guentheri*), gerenuk (*Litocranius walleri*), reticulated giraffe (*Giraffa camelopardalis reticulata*), black rhinoceros (*Diceros bicornis*) and African elephant *(Loxodonta africana*) (Coe, 1972; White, 1983). These would have occurred in low densities and at low frequencies (Coe, 1972; Watson, 1969), primarily due to the ephemeral nature of annual grass and browse growth in the immediate aftermath of rains (Pratt and Gwynne, 1977) and the exploitation of all grazing and browsing resources by Turkana pastoralists through maintenance of mixed livestock herds (Watson, 1969). Predatory species, including wild dog (*Lyacon pictus*), lion (*Panthera leo*), leopard (*Panthera pardus*) and cheetah (*Acinonyx jubatus*), would also have been present (Coe, 1972; White, 1983). More recent studies suggest that the presence of excessive numbers of livestock throughout the Turkana region resulted in the suppression of a broad range of wild herbivore species (Riginos et al., 2012), presumably with concomitant effects on the assemblage of predatory carnivore species, to such an extent that wildlife is now virtually absent (de Leeuw et al., 2001).

The region has a rich avian fauna however endemism is low, and most species are found elsewhere in East Africa or are European and Asian migrants (WWF, 2017b). Lake Turkana is an internationally recognised IBA, with 84 waterbird species, including 34 Palaearctic migrants, for which it serves as an important flyway and winter stop-over site for birds on passage (Evans and Fishpool, 2001). The AoI is located within the East Asia/East Africa Flyway, as identified by BirdLife International. The East Asia/East Africa Flyway is a group of well-established routes by which many species of birds migrate annually between mid-Palearctic breeding grounds in Asia and non-breeding sites in eastern and southern Africa.

6.9.3.2 Landcover Classification

The Landcover Assessment Area (LCAA) focused on a key subset of the AoI. The detailed 27-class vegetation/land-cover dataset provides spatial and thematic detail on the vegetation communities on the plains and along the riparian zones and was used as the basis for vegetation mapping within this focussed area of assessment. These more detailed categories are described in Table 6.9-3 and illustrated in Drawing 6.9-2.

Table 6.9-3: 27- Class Landcover Classification of Land Cover Assessment Area (LCAA)

Class	Class Name	Description	Area (Hectares)	Percentages (%)
1	Acacia riparian forest	Acacia dominated forest (tall trees) along major riparian zones	3271	2.3
2	Mixed acacia riparian forest	Acacia and other spp dominated forest (tall trees) along major riparian zones	160	0.11
3	Riparian woodland	Riparian woodland (not closed canopy, taller forest) along major riparian zones.	26088	18.0
4	Plain desert shrubland, tall, dense	Tall shrubland on plains, dense cover	4335	3.0
5	Plain desert shrubland, medium, dense	Medium height shrubland on plains, dense cover	10550	7.3
6	Plain desert shrubland, low, dense	Low shrubland on plains, dense cover	11294	7.8
7	Plain desert shrubland, sparse	Low or tall shrubland on plains, sparse cover	13772	9.5
8	Sand, non-vegetated	Non-vegetated bare sand areas	8322	5.8
9	Plain arid woodland / grassland, dense	Dense non-riparian woodland cover on plains	21206	14.7
10	Plain arid woodland / grassland, medium	Open / semi-dense non-riparian woodland cover on plains	14229	9.8
11	Plain arid woodland / grassland, low	Open non-riparian woodland cover on plains	9168	6.3
12	Plain arid woodland / grassland sparse	Sparse non-riparian woodland cover on plains	6380	4.4
13	Water (lake & river)	Water in lake and major river systems	282	0.2
14	Water (shallow pan), incl. dry dams	Shallow water in pan systems	3	0.0
15	Mountain sparse low shrub	Sparse low shrub and/or grass cover, with only a few bushes on mountains or rocky hills	2851	2.0
16	Mountain sense low shrub	Dense low shrub and/or grass cover, with only a few bushes, on mountains or rocky hills	6132	4.2
17	Mountain open bush 1	Open and/or scattered bush and shrub cover, on mountains or rocky hills.	531	0.4
18	Mountain open bush 2	Open and/or scattered bushes and/or shrubs, on mountains or rocky hills	120	0.1

Class	Class Name	Description	Area (Hectares)	Percentages (%)
19	Mountain dense bush 1	Dense bush and/or taller shrubs (most dense bush dominated class), on mountains or rocky hills	642	0.4
20	Mountain dense bush 2	Dense bush and/or taller shrubs (but less dense than dense bush class 1, on mountains or rocky hills	3233	2.2
21	Mountain dense bush 3	Dense bush and/or taller shrubs (but less dense than dense bush class 2, on mountains or rocky hills	581	0.4
22	Mountain dense bush 4	Dense bush and/or taller shrubs (but less dense than dense bush class 3: least dense, but more dense than open bush classes), on mountains or rocky hills	29	0.0
23	Mountain dense trees / bush	Dense tree and tall bush combination class, on mountains or rocky hills	206	0.1
24	Mountain grassland	Grass dominated areas, with only a few trees, bushes or shrubs, on mountains or rocky hills	0.2	0.0
25	Mountain sparse grassland	Sparse to open grass cover areas, typically containing scattered bushes and shrubs, on mountains or rocky hills	956	0.7
26	Cultivated lands	All cultivated lands, including both currently active and old, long term fallow / abandoned fields. In the extended western pipe transect, this includes a small area of what appears to be flood-irrigated pastures at a river confluence.	27	0.0
27	Settlements, including villages & kraals	All settlements and built-up areas. Along the make-up water pipeline route, this includes small “kraal” concentrations as well as established settlements and built-up areas.	261	0.2

Riparian woodlands (classes 1, 2 and 3) comprise 20.4% of the surface area of the LCAA. Acacia riparian forest (class 1) comprises 2.3% of the LCAA. This landcover class aligns with the riverine wooded vegetation described by the Kenya Rangeland Ecological Monitoring Unit (KREMU) (Olang, 1984) and van Breugel et al. (2015). This landcover class was present along the Turkwel and Malmalte Rivers as well as along larger luggas throughout the AoI. Riparian woodland (class 3) comprised 18.0% of the LCAA. This landcover type is associated with smaller drainage lines throughout the AoI and aligns with the riverine thicket edaphic vegetation types described by van Breugel et al. (2015).

Plain desert shrubland (classes 4, 5, 6 and 7) comprises 27.6% of the LCAA and occurs primarily in the area around Lokichar, in the area north of Lokichar and in the area between Lokichar and Kalemngorok

The plain arid woodland (classes 9, 10, 11 and 12) comprise 35.3% of the LCAA and characterises habitats outside of luggas in the area south of Lokichar and south of Kalemngorok including the area between the Malmalte River and Turkwel Dam. This vegetation community aligns with the acacia-commiphora stunted bushland described by van Breugel et al. (2015).

Mountainous landcover classes (classes 17 to 23) comprise 3.7% of the LCAA which aligns with the Somalia-Masai acacia-commiphora deciduous bushland and thicket community described by van Breugel et al. (2015), and the Bushland described by KREMU (Olang, 1984). This landcover cover type characterises the mountainous habitats to the east of the Kalabata lugga, the mountainous habitat to the west of Ngamia and Amosing, and the ridge separating Turkwel Dam from the Malmalte River.

Settlements comprise 0.2% and cultivated lands 0.02% of the surface area of the LCAA. The largest settlement within the LCAA is Lokichar, with smaller settlements at Kalemngorok and some near to Turkwel Dam.

Non-vegetated bare sand areas comprised 5.8% of the surface area of the LCAA and was most densely concentrated around Lokichar, in the area north of Lokichar and in the area between Lokichar and Kalemngorok.

6.9.3.3 Identification of Species of Conservation Concern

Based on available information, 77 SoCC could occur within the region (Annex I). These include:

- Five plant species;
- Three invertebrate species;
- Two fish species;
- Two amphibian species;
- Four reptile species;
- Forty-three bird species; and
- Eighteen mammal species.

Plants

Five plant SoCC have the potential to occur (that is, a possible or probable likelihood) within the AoI. One species namely *Blepharis turkanae* is listed as VU in the IUCN Red List of Threatened Species (IUCN, 2019). This densely branched dwarf-shrub is only known from 4 locations in the Lake Turkana region of Kenya (IUCN, 2019). The remainder of the expected plant SoCC are all range restricted species, but none are listed by either the IUCN, the Kenyan Wildlife and Conservation Management Act (KWCMA) (Act No. 47 of 2013) or KWS Endangered and Threatened Plant species (KWS, 2019).

Invertebrates

The KWCMA does not list any invertebrate SoCC (KWCMA, 2013). Two of the three expected invertebrate species are listed by the IUCN Red List (IUCN, 2019).

The mud snail (*Gabbiella rosea)* is a mollusc that is listed as Near Threatened (NT) by the IUCN however, its distribution is limited to the western shore of Lake Turkana outside of the AoI. Rift Valley woolly legs *(Lachnocnema riftensis)* is a butterfly that is listed as Data Deficient (DD) by the IUCN (2019). It is only known from two records in open savannah habitat in the Rift Valley in the vicinity of Naivasha (IUCN, 2019). The bee, *Samba turkana* is a recently described bee species first collected in the Turkana Basin in May 2012 (Packer and Martins, 2015).

Fish

Neither of the two fish SoCC expected to occur within the AoI are listed by either the IUCN, KWCMA or KWS. These species are listed due to be being little known or range restricted.

Amphibians

Two amphibian SoCC are expected to occur in the AoI. Of these, the Turkana toad (*Sclerophrys turkanae)* is listed as DD in the IUCN Red List and is only known from Loiengalani on the south-eastern shore of Lake Turkana and from the Ewaso Ng'iro River in the Samburu Game Reserve (IUCN, 2019). The snoring puddle frog (*Phrynobatrachus natalensis)* has a larger distributional range across Sub-Saharan Africa and is listed as Least Concern (LC) by the IUCN (2019). It is believed to represent a species complex, one of which is endemic to the Lake Turkana freshwater ecoregion (IUCN SSC Amphibian Specialist Group, 2013). Further research is needed in order to confirm the status of this endemic species.

Reptiles

Five reptile SoCC are regarded as having a high likelihood of occurrence in the AoI. Of these species, three are listed as being of conservation importance in the KWCMA (KWCMA, 2013):

- Kenya sand boa (*Eryx colubrinus*) is listed as Protected in the KWCMA and is also listed as a priority species by KWS (KWS, 2019);
- Lake Turkana hinged terrapin (*Pelusios broadleyi)* is listed as Threatened in the KWCMA, as a priority species by KWS and VU by the IUCN; and
- Rock python (*Python sebae)* is listed as EN in the KWCMA and is listed as a priority species by KWS (KWS, 2019).

The remaining two reptile species are both listed as DD by the IUCN (IUCN, 2019). Barnier's gecko *(Hemidactylus barbierii*) is only known from two locations of the eastern shore of Lake Turkana. More research is needed to establish this species' full range. The southern shield-backed lizard (*Philochortus rudolfensis)* has been recorded in acacia-commiphora dry bushland or semi-desert shrub at five localities in northern Kenya. The NMK have a record of this little-known species from Lake Turkana and within the AoI (NMK, 2017).

Birds

Forty-three bird species of conservation concern are likely to occur in the AoI. Of these 43 species, 23 are listed as being SoCC nationally in Kenya (KWCMA, 2013) (Table 6.9-4). The remaining 20 species not listed in Kenyan legislation include migratory species listed by the Convention on Migratory Species (CMS), CITES and endemic or range restricted species.

Ten species are listed as NT in Kenya including two species that are listed as CR by the IUCN namely white-backed vulture (*Gyps africanus)* and Rüppell's vulture (*Gyps rueppelli)* (Table 6.9-4).

The white-backed vulture is the most widespread and common vulture in Africa with a range that includes most of Sub-Saharan Africa except for the Congo Basin (IUCN, 2019). White-headed vulture (*Trigonoceps occipitalis*) is listed as VU in Kenya but is listed CR by the IUCN (Table 6.9-4). Although no records exist in GBIF (2019) of this species within the region, the presence of records and the continued presence of wild ungulates in places such as Nasolot National Reserve (NR) and South Turkana NR suggests a high likelihood of occurrence.

Rüppell's vulture occurs throughout the Sahel region of Africa from Senegal, Gambia and Mali in the west to Sudan, South Sudan and Ethiopia in the east (IUCN, 2019). It also occurs in the savanna region of East Africa including Kenya, Tanzania and Mozambique (IUCN, 2019). This species has experienced a rapid decline in population due to similar threats faced by other African vultures, loss of habitat, loss of wild ungulates leading to a reduced availability of carrion, hunting for trade, persecution and poisoning (IUCN, 2019). Although it has been recorded both to the east and west of the AoI suggesting that it does have a presence in the region.

Five of the expected bird species are listed as VU in Kenyan legislation (KWCMA, 2013) (Table 6.9-4). All five are also listed as priority species by KWS (KWS, 2019) (Table 6.9-4). Lappet-faced vulture *(Torgos tracheliotos)* is listed as VU in Kenya and EN by the IUCN (Table 6.9-4). GBIF records show the presence of lappet-faced vulture to the east of Lake Turkana and in Uganda to the west and the presence of wild ungulate populations in Nasolot NR and South Turkana NR may attract it to the AoI.

Four of the expected bird species are listed as EN both in Kenyan legislation and by the IUCN (Table 6.9-4). All four are listed as conservation priority species by KWS (Table 6.9-4). None of these species have previously been recorded in the region but their distributional ranges and habitat preferences suggest they may occur in the region.

Four of the 43 expected bird species of conservation concern are listed as protected by Kenyan legislation (Table 6.9-4). Of these species one is listed as EN by the IUCN and two as VU (Table 6.9-4).

Table 6.9-4: Conservation Status of Expected Bird Species Based on the KWMCA (KWCMA, 2013), KWS (KWS, 2019) and IUCN (2019)

Common name	Species	KWCMA (2013)	KWS (2019)	IUCN (2019)
Basra reed-warbler	*Acrocephalus griseldis*	EN	Y	EN
Madagascar pond-heron	*Ardeola idae*	EN	Y	EN
Saker falcon	*Falco cherrug*	EN	Y	EN
Egyptian vulture	*Neophron percnopterus*	EN	Y	EN
Eastern imperial eagle	*Aquila heliaca*	VU	Y	VU
Greater spotted eagle	*Clanga clanga*	VU	Y	VU
Lesser kestrel	*Falco naumanni*	VU	Y	LC
Lappet-faced vulture	*Torgos tracheliotos*	VU	Y	EN
White-headed vulture	*Trigonoceps occipitalis*	VU	Y	CR
Pallid harrier	*Circus macrourus*	NT	-	NT
European roller	*Coracias garrulus*	NT	-	NT
Sooty falcon	*Falco concolor*	NT	-	NT
Red-footed falcon	*Falco vespertinus*	NT	-	NT
Great snipe	*Gallinago media*	NT	-	NT
White-backed vulture	*Gyps africanus*	NT	-	CR
Rüppell’s vulture	*Gyps rueppelli*	NT	-	CR
Denham's bustard	*Neotis denhami*	NT	-	NT
Maccoa duck	*Oxyura maccoa*	NT	-	NT
African skimmer	*Rynchops flavirostris*	NT	-	NT

Common name	Species	KWCMA (2013)	KWS (2019)	IUCN (2019)
Grey crowned-crane	*Balearica regulorum*	Protected	-	EN
Saddle-billed stork	*Ephippiorhynchus senegalensis*	Protected	-	LC
Martial eagle	*Polemaetus bellicosus*	Protected	-	VU
Secretary bird	*Sagittarius serpentarius*	Protected	-	VU

Mammals

Four of the expected mammal species of conservation are listed as VU in Kenyan legislation (Table 6.9-5). This includes hippopotamus (*Hippopotamus amphibious)* which is listed as VU by the IUCN and lesser kudu (*Tragelaphus imberbis)* which is listed as NT by the IUCN (Table 6.9-5). Both species are known to occur in Nasolot NR.

Six of the expected mammal species are listed as EN in Kenya (Table 6.9-5). Of these species African wild dog (*Lycaon pictus)* is also listed as EN by the IUCN (Table 6.9-5). Three of these species are listed as VU by the IUCN and two as NT (Table 6.9-5). African elephant (*Loxodonta africana)*, lion (*Panthera leo)* and leopard (*Panthera pardus)* are three nationally EN species that are listed as present in the Nasolot NR and South Turkana NR.

Table 6.9-5: Mammal Species of Conservation Concern Expected to Occur in the AoI

Species	Common name	KWCMA (2013)	KWS (2019)	IUCN (2019)
Acinonyx jubatus	Cheetah	EN	Y	VU
Hyaena hyaena	Striped hyaena	EN	Y	NT
Loxodonta africana	African elephant	EN	Y	VU
Lycaon pictus	African wild dog	EN	Y	EN
Panthera leo	African lion	EN	Y	VU
Panthera pardus	Leopard	EN	Y	NT
Crocuta crocuta	Spotted hyena	VU	-	LC
Hippopotamus amphibius	Hippopotamus	VU	-	VU
Taphozous hamiltoni	Hamilton's tomb bat	VU	-	DD
Tragelaphus imberbis	Lesser kudu	VU	-	NT

6.9.3.4 Identification of Ecosystems of Conservation Concern

6.9.3.4.1 Internationally Recognised Sites of Biodiversity Importance

WWF Ecoregions

The AoI lies within the northern acacia-commiphora bushlands and thickets ecoregion (Drawing 6.9-3). The Masai xeric grasslands and shrublands and East African montane forest ecoregions represent the second and third ecoregions present in the AoI.

The northern acacia-commiphora bushlands and thickets ecoregion is a transition zone between the drier Masai xeric grasslands and shrublands and Somali acacia-commiphora bushland and thicket ecoregions to the north, and the wetter southern acacia-commiphora bushland and thicket ecoregion to the south (WWF, 2017b). This ecoregion covers much of lowland Kenya and is currently listed as VU (WWF, 2019). Mammalian species diversity in the ecoregion is high, and reasonably well-protected across protected areas including Nasolot NR and South Turkana NR.

Masai xeric grasslands and shrublands covers most of north-central Kenya and extend into south-western Ethiopia. Much of this ecoregion has been considerably degraded by heavy grazing from excessive numbers of domesticated livestock and, based on that, it is listed as VU (WWF, 2017a). Exceptions include protected areas such as Sibiloi National Park on the north-eastern edge of Lake Turkana, where good-quality habitat remains (WWF, 2017a).

WWF Global 200 Ecoregions

The WWF's Global 200 project analysed global patterns of biodiversity to identify a set of ecoregions that harbour exceptional levels of biodiversity (Olsen & Dinerstein, 2002). The AoI overlaps with the East African acacia savanna ecoregion which historically boasted some of the richest large mammal faunal assemblages in Africa and is rated as Vulnerable (Olsen & Dinerstein, 2002).

Key Biodiversity Areas

Several KBAs are situated to the north, south, east and west however none overlap with the AoI (Drawing 6.9-4). The nearest KBA is Cherangani Hills which is situated approximately 30 km south of the AoI (Drawing 6.9-4). Cherangani Hills is an IBA which contains the last known breeding population of Bearded vulture (*Gypaetus barbatus)* in Kenya (Birdlife International, 2017).

Other KBAs in the vicinity of the AoI include Lake Turkana and Mount Moroto Forest Reserve to the north-west and west of the AoI respectively and both listed as IBAs. The Lake Turkana IBA (Drawing 6.9-4) is designated on the basis of its support of approximately 84 waterbird species, including 34 Palearctic migrants, some of which overwinter at the lake in very large numbers; for example, little stint (*Calidris minuta*), which typically number in excess of 100,000 individuals. The lake is also a key stop-over site for birds on passage (BirdLife International, 2017).

Ramsar Sites

Kenya became a signatory of the Ramsar convention on 05 October 1990 (Ramsar, 2019). It has six sites designated as Wetlands of International Importance (Ramsar Sites) (Ramsar, 2019). None of the Kenyan Ramsar sites are situated within or near to the AoI. A map showing the location of the Kenyan Ramsar sites in relation to the AoI is provided in Drawing 6.9-5. The nearest Ramsar site is Lake Baringo, which is situated approximately 120 km south-east of the AoI (Drawing 6.9-5).

6.9.3.4.2 Nationally Designated and Protected Areas

The AoI overlaps with two National Reserves namely South Turkana NR and Nasolot NR (Drawing 6.9-6).

South Turkana National Reserve

South Turkana NR is located partly within the AoI (Drawing 6.9-6) and is characterised by a savanna rangeland ecosystem supporting wildlife including elephant (*Loxodonta africana*), buffalo (*Syncerus caffer*), Beisa oryx (*Oryx beisa beisa*), olive baboon (*Papio anubis*), lesser kudu (*Tragelaphus imberbis*), Thompson's gazelle (*Gazella thomsonii*) Grant's gazelle (*Nanger grantii*), warthog (*Phacochoerus africanus*), and dik-dik (*Madoqua sp.*) (Edebe et al., 2010).

Nasolot National Reserve

Nasolot NR is located partly within the AoI. It is a rugged and remote reserve supporting elephant, lesser kudu, bushbuck, duiker, lion, leopard, Kirk's dik-dik, spotted hyena, buffalo and hippopotamus (KWS, 2019).

Surrounding Reserves

Other Kenyan reserves are situated near to, but beyond the boundary of the AoI and are considered to be beyond the Project's influence. These include:

- South Island National Park is situated on an island within the southern portion of Lake Turkana;
- Central Island National Park also situated on an island in the central portion of Lake Turkana; and
- Sibiloi National Park situated on the north-eastern shore of Lake Turkana.

Community Conservancies

The Pellow Community Conservancy and Masol Community Conservancy are situated in West Pokot County. Both conservancies are administered by the NRT in cooperation with local communities and government (NRT, 2017).

The Pellow Community Conservancy (Drawing 6.9-6) adjoins the Nasolot NR and Turkwel Dam. The Pellow Community Conservancy is 52,922 ha with a population of approximately 12,000 primarily pastoralist people (NRT, 2017).

The Masol Community Conservancy adjoins to the south-eastern boundary of the Pellow Community Conservancy and is 151,899 ha. On its eastern boundary the Masol Community Conservancy adjoins the South Turkana NR thereby enabling migration of animals between South Turkana NR and Nasolot NR.

6.9.3.4.3 Important Habitats Outside of Protected Areas

The following three potentially threatened (Rodriguez et al., 2011) vegetation communities (van Breugel et al., 2015) were identified within the region (Drawing 6.9-7):

- *Acacia tortilis* wooded grassland and woodland (aligns with White's (1983) deciduous wooded annual grassland);
- Riverine wooded vegetation (aligns with White's (1983) evergreen and semi-deciduous woodland); and
- Afromontane undifferentiated forest (aligns with White's (1983) undifferentiated evergreen forest).

Of these, only riverine wooded vegetation and afromontane undifferentiated forest communities overlap with the AoI (Drawing 6.9-7).

6.9.3.4.4 Freshwater Ecoregions

The drainage lines of the Lake Turkana ecoregion include the Malmalte, Turkwel, Kerio and Kalabata Rivers. The Lake Turkana ecoregion forms part of the Nilo-Sudan freshwater bioregion (Thieme et al., 2005). The Lake Turkana freshwater ecoregion is characterised by:

- A moderate level of overall aquatic biodiversity endemism;
- An extremely high level of endemism of aquatic mollusc species; and
- A moderately high level of aquatic herpetofauna endemism (Thieme et al., 2005).

Lake Logipi is an alkaline lake that is situated to the south of Lake Turkana. It falls outside of any protected areas and the area suffers from a high degree of insecurity and overgrazing (Boere et al., 2006). Radio telemetry studies conducted on lesser flamingos (*Phoeniconaias minor*) showed that Lake Logipi is one of nine key sites for this NT species in East Africa (Boere et al., 2006).

Biological Distinctiveness

To assess all the freshwater ecoregions in Africa, Thieme et al. (2005) combined species richness and endemism rates for all the freshwater ecoregions to synthesise preliminary biological distinctiveness values. These preliminary values were then combined with non-species metric values to develop an overall index of biological distinctiveness. Non-species metrics that were assessed and scored included the presence of rare ecological or evolutionary phenomena and the presence of rare habitat types (Thieme et al., 2005). The final integrated index of biological distinctiveness of Lake Turkana ecoregion was rated as outstanding.

Conservation Status

The health of aquatic systems in Africa is under increasing pressure related to a variety of human induced impacts including construction of dams and reservoirs, overexploitation of resources, pollution particularly eutrophication and the introduction of invasive species (Thieme et al., 2005).

A snapshot of the level of threat to aquatic ecosystems was assessed based on the following categories:

- Land-based threats;
- Aquatic habitat threats; and
- Biota threats (Thieme et al., 2005).

The level of threat was then reassessed with the inclusion of a future threat assessment. Based on that nearly two-thirds of the ecoregions qualified for an elevation in conservation status based on projected threats from climate change, planned developments, and human population growth (Thieme et al., 2005). The outcome of the assessment was that the conservation status of the Lake Turkana freshwater ecoregion was rated as endangered.

6.9.4 Results - Primary data

6.9.4.1 Vegetation Data Gathering

The field surveys confirmed six broad vegetation communities with various sub-sets:

- *Acacia/commiphora* bushland and thicket:
  - *Acacia/commiphora/indigofera* stunted thickets;
  - *Acacia/commiphora/euphorbia* thicket;
  - *Acacia/commiphora* deciduous thicket;
  - *Acacia/commiphora* semi-desert shrubland;
  - Mixed *acacia/commiphora* bushland on rocky outcrops;
- *Acacia tortilis* riparian woodland:
  - Ephemeral stream woodland.
- *Acacia reficiens* low woodland/bushland on plains;
- Acacia/sansevieria bushland/thicket mosaic;
- *Acacia/boswellia* shrubland on steep rocky hillslopes; and

- Faidherbia/celtis riparian forest.

These vegetation communities broadly align with those described by White (1983), ILRI (2007), KREMU (Olang, 1984) and van Breugel et al. (2015). The characteristics of these communities, and their condition and integrity, are summarised below. Full species lists for each community are provided in Annex I.

6.9.4.1.1 Acacia/Commiphora Bushland and Thicket

This vegetation community in the South Lokichar Basin aligns with the acacia-commiphora stunted bushland described by van Breugel *et al*. (2015). Five sub-types of this community were identified, according to variations in coverage and structure due to location (for example on plains or on laval hills) and degrees of aridity; however, the species composition of the sub-types were similar.

The five sub-types identified are described in the following sections.

Acacia / Commiphora/Indigofera Stunted Bushland

This sub-type is associated with the plain desert shrubland land cover classes and aligns with the dwarf shrubland described by the KREMU (Olang, 1984). It occurs on plains within the AoI.

This community occurs in drier areas of the region and is more prevalent in the northern regions. It is dominated by a flat-topped form of the deciduous *Acacia reficiens*. Associated species include *Maerua crassifolia*, and occasional patches of dwarf *Acacia tortilis* and *Balanites rotundifolia* (Figure 6.9-3 A). Undergrowth is dominated by the dwarf shrub *Indigofera spinosa*, to approximately 20 to 30 cm height, with grasses and forbs occurring infrequently.

Acacia/Commiphora/Euphorbia Stunted Bushland/Thicket

This sub-type occurs throughout in the southern portion of the AoI and is the dominant vegetation community in the LCAA. It aligns with the acacia-commiphora stunted bushland described by van Breugel et al. (2015), and the shrub-grassland described by KREMU (Olang, 1984). It is associated with the plain arid woodland land cover classes.

This community shows greater species diversity than the acacia/commiphora/indigofera stunted bushland occurring in the northern, more arid region. Typical vegetation composition consists of patches of pure *Acacia reficiens*; *Acacia reficiens* mixing with dwarf *Acacia tortilis*; occasional individuals of *Acacia. paolii* and *Euphorbia cuneata*, *Acacia reficiens* and *Balanites rotundifolia*; and dwarf *Acacia. tortilis*, *Euphorbia cuneata* and *Jatropha dichtar* (Figure 6.9-3B). The understorey is dominated by *Indigofera spinosa* and *Sericocomopsis hildebrandtii*. The difference between thicket and more open bushland is a factor of density of plant growth, as opposed to any real difference in flora species composition, and may be attributed to differences in soil characteristics (particularly soil moisture) and rainfall levels (e.g., the density and tree height of *Acacia reficiens* increases with increasing rainfall (Olang, 1988)) rather than the vegetation itself.

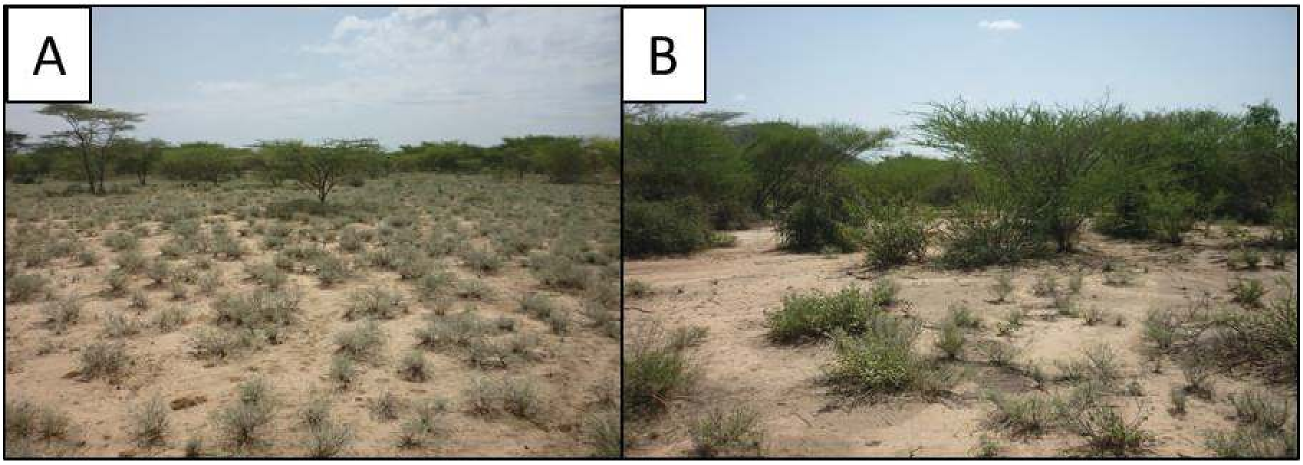

Figure 6.9-3: Acacia/Commiphora/Indigofera Stunted Bushland. B: Acacia-Commiphora-Euphorbia Stunted Bushland/Thicket

Acacia/Commiphora Deciduous Bushland and Thicket

This sub-type aligns with the Somalia-Masai acacia-commiphora deciduous bushland and thicket community described by van Breugel et al. (2015), and the 'bushland' described by KREMU (Olang, 1984). This community occurs in elevated, hill regions in the east of the region and does not occur within the AoI. It is associated with the mountain dense shrub/bush land cover classes. It is characterised by a few emergent species, dominated by *Acacia tortilis*, *Acacia reficiens*, *Acacia mellifera*, and *Salvadora persica*, with an understorey of *Indigofera spinosa*, with *Barleria acanthoides* and *Euphorbia turkanensis* also occurring. Most species have a growth habit of small bushy trees, branched near the base (Figure 6.9-4A). The species composition is very similar to that described for semi-desert shrubland. The main differentiating factor is the association of this bushland and thicket with preferential flow paths or drainage lines, and places where rainwater temporarily pools, as opposed to the rocky substrate where semi-desert shrubland occurs.

Acacia/Commiphora Semi-Desert Shrubland

This sub-type of acacia/commiphora bushland and thicket aligns with the Somalia-Masai acacia-commiphora deciduous bushland and thicket community described by van Breugel et al. (2015), and the bushland described by KREMU (Olang, 1984). This community occurs in rocky habitat in the eastern hills region and does not occur within the AoI. It is associated with the mountain sparse/open shrub/bush/grassland land cover categories. It is characterised by a sparse cover of shrub species (Figure 6.9-4B), dominated by *Acacia tortilis*, *Acacia* reficiens, and *Acacia mellifera*, with an understorey of *Indigofera spinosa*. *Barleria acanthoides* and *Euphorbia turkanensis* also occur.

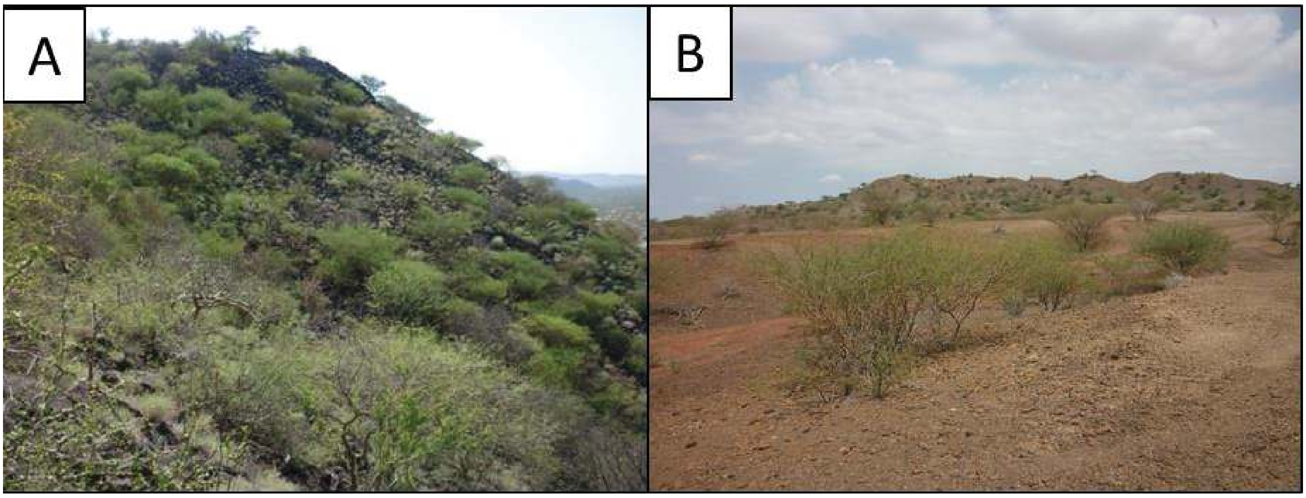

Figure 6.9-4: A: Acacia/Commiphora Deciduous Bushland, B: Acacia/Commiphora Semi-Desert Shrubland

Mixed Acacia/Commiphora Bushland on Rocky Outcrops

This vegetation community is confined to the low ridges and rocky outcrops between Lokichar and Kalemngorok and corresponds most closely to the acacia/commiphora deciduous bushland / thicket community described above. However, none of the habitat observed within the area between South Lokichar and Turkwel Dam could be classified as thicket and most of the vegetation in the AoI is deciduous, which is why the classification was revised. *Acacia reficiens* and *Acacia senegal* var. *kerensis* are co-dominant along with *Commiphora africana* and *Commiphora kataf*. Other common woody shrubs include *Euphorbia cuneata*, *Grewia fallax* and *Cadaba farinosa*. Small semi-succulent trees are a diagnostic feature of this vegetation community, particularly *Adenium obesum* and *Adenia venenatum*. Succulent dwarf shrubs and climbers include *Desmidorchis retrospiciens*, *Cynanchum viminale* and *Caralluma dicapuae*. Trees are more prominent on the higher ridges and include species more typical of the acacia – boswellia bushland community, such as *Sterculia stenocarpa*, *Boswellia neglecta* and *Diospyros scabra*.

6.9.4.1.2 *Acacia Tortilis* Riparian Woodland

This vegetation community aligns with the riverine wooded vegetation category described by van Breugel et al. (2015), and woodland described by White (1983). It correlates with the riparian forest landcover category.

Acacia tortilis-dominated riparian forest is most commonly found associated with the large luggas in all areas of the AoI, and consists largely of mature *Acacia tortilis*, typically between 8 to 12 m in height, with dwarf shrubs of the same species typically forming the understorey. During field surveys, this vegetation community was recorded on sandy, alluvial soils primarily along the banks of large, seasonal luggas within the AoI (Figure 6.9-5A). These luggas typically have periodic flows following significant rainfall, and, increased moisture storage-capacity in their sandy soils. This increased water storage capacity compensates for the low rainfall and high potential evaporation experienced in the region, thus supporting large individual trees in these areas (van Breugel et al., 2015).

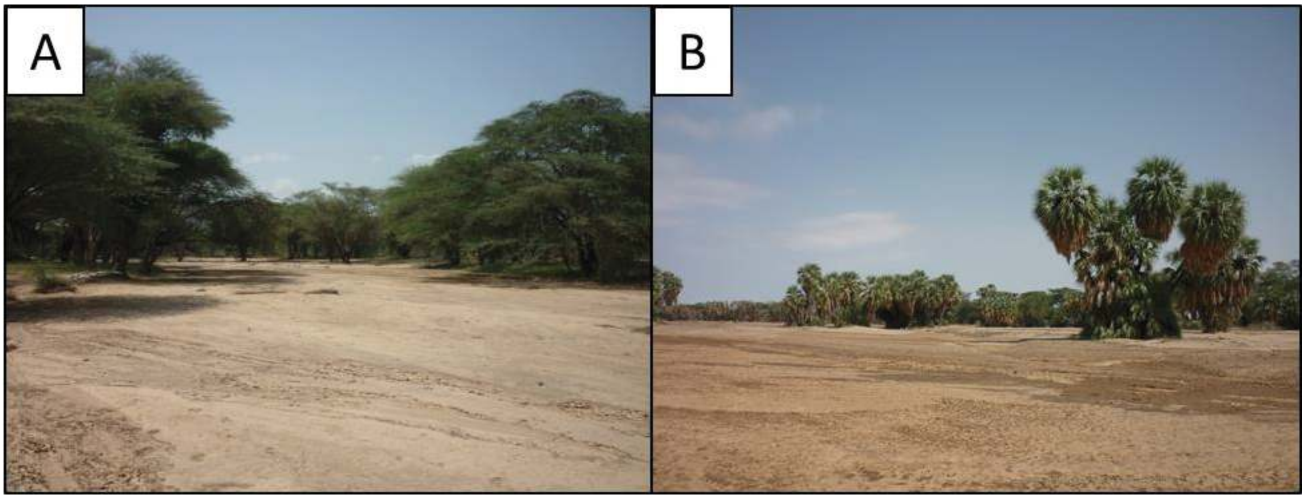

Figure 6.9-5: A: Acacia *Tortilis*-Dominated Riparian Forest, B: Hyphaene Stands in Kalabata Lugga

Some stands of hyphaene riparian forest occur in the large Kalabata lugga (Figure 6.9-5B). These palm stands are often associated with a more diverse riparian forest flora, including *Hyphaene coriacea*, *Acacia elatior*, *Acacia tortilis* and *Ziziphus mauritiana* existing as narrow forest strips along channel margins and on stable alluvial "*islands*". The understorey of these palm stands typically includes *Salvadora persica*, *Calotropis procera*, *Ziziphus mauritiana*, and young specimens of *Acacia tortilis*, and *Hyphaene compressa*. Some of the larger tributaries of the Kalabata River also support very large specimens (in excess of 15 m) of *Acacia tortilis* and *Acacia elatior*.

Ephemeral Stream Woodland

A subset of *Acacia tortilis* riparian woodland is the ephemeral stream woodland, a community which aligns with the riverine woodland and riverine thicket edaphic vegetation types described by van Breugel et al. (2015). It occurs on the banks of smaller luggas, and across the braided channels of the wider ephemeral streams (Figure 6.9-6) throughout the region and is the second most prevalent vegetation community in the AoI with the exception of Twiga where it was the third most prevalent.

Species diversity is relatively high compared to the riparian forests, due to the presence of a greater diversity of small shrubs, grasses and forbs in the understorey, and the presence of some of the species more typical of terrestrial vegetation communities.

Figure 6.9-6: Ephemeral Stream Woodland

6.9.4.1.3 *Acacia Reficiens* Low Woodland/Bushland on Plains

This is the dominant vegetation community on the plains habitats throughout the AoI (Figure 6.9-7A and Figure 6.9-7B). This vegetation community comprises elements of two of the vegetation communities described above namely:

- Acacia/commiphora/indigofera stunted bushland; and
- Acacia/commiphora/euphorbia stunted bushland/thickets.

The distinction between these two communities was not clear in the area between South Lokichar and Turkwel Dam and elements of both were present. *Acacia reficiens* is the dominant small tree throughout, with other acacia species including *Acacia senegal* var. *kerensis*, *Acacia etbacia*, *Acacia paolii* and *Acacia tortilis* subsp. *spirocarpa*. *Commiphora africana* and *Commiphora kataf* are common in patches, although commiphora species are more prominent in the mixed acacia – commiphora bushland community on rocky outcrops. Other frequently encountered woody shrubs included *Maerua crassifolia*, *Cadaba farinosa* and *Balanites rotundifolia*. *Indigofera spinosa* is the dominant dwarf shrub species in many areas, particularly on sandy plains, while *Duosperma eremophilum* and *Sericocomopsis hildebrandtii* are co-dominant dwarf shrubs in some areas. Succulents include the black-flowered *Desmidorchis retrospiciens*, as well as several Euphorbia species.

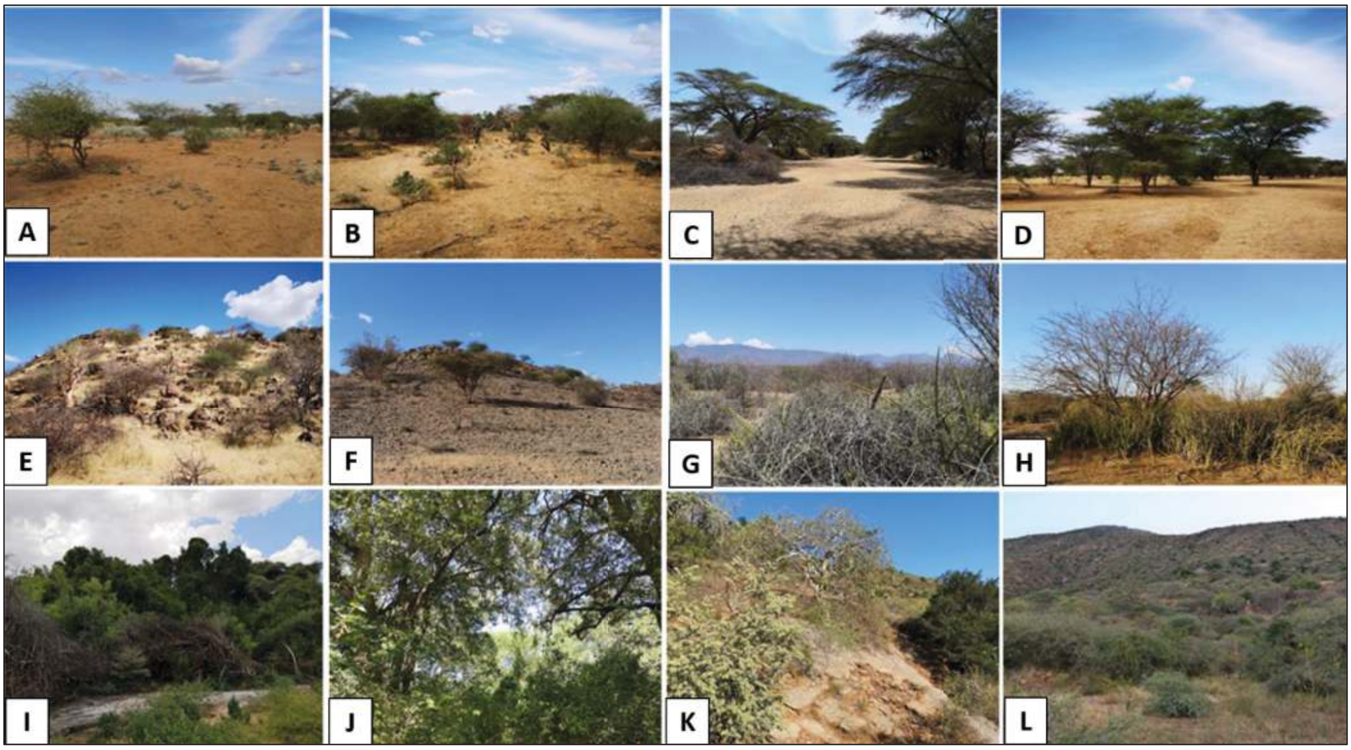

Figure 6.9-7: A & B: *Acacia Reficiens* Low Woodland/Bushland, C & D: *Acacia Tortilis* Riparian Woodland, E & F: Acacia – Commiphora Bushland on Ridges, G & H: Acacia – Sansevieria Bushland/Thicket, I & J: Faidherbia – Celtis Riparian Forest, K & L: Acacia – Boswellia

6.9.4.1.1 Acacia – Sansevieria Bushland/Thicket Mosaic

The acacia – sansevieria bushland/thicket mosaic replaces *Acacia reficiens* low woodland/bushland as the dominant vegetation community on the plains west of the Malmalte River (Figure 6.9-7G & Figure 6.9-7H). Low woodland/bushland is dominated by *Acacia reficiens* and is similar in species composition to *Acacia reficiens* low woodland/bushland. The numerous dense, deciduous thickets that define this community are characterised by *Sansevieria ehrenbergii*, which is present in most of the thickets. Other thicket species include *Acacia mellifera*, *Ximenia americana*, an unidentified maculate aloe species, *Grewia fallax* and *G. tenax*.

6.9.4.1.2 Acacia - Boswellia Shrubland on Steep Rocky Hillslopes

This is the primary vegetation community on steep rocky slopes of the high ridge between Turkwel Dam and the Malmate River (Figure 6.9-7K and Figure 6.9-7L). *Acacia senegal* var. *kerensis*, *Acacia mellifera* and *Acacia tortilis* are dominant on the lower slopes where rocks are less prominent. The rocky midslopes and upper slopes have a diverse woody community that is characterised by trees such as *Boswellia neglecta*, *Sterculia stenocarpa*, *Diospyros scabra* and *Commiphora edulis* subsp. *boiviniana*.

6.9.4.1.3 Faidherbia - Celtis Riparian Forest Along the Malmalte River

This was the only true forest community observed between South Lokichar and the Turkwel Dam and was restricted to the riparian habitat along the perennial Malmalte River. No riparian forests were observed along any of the dry luggas that were surveyed in the AoI. This community showed some similarity to the Riparian Forest community described above however, whereas *Acacia tortilis* was the dominant species in those riparian forests *Faidherbia albida* and *Celtis africana* were the most frequently encountered canopy trees at all three transects in this vegetation community. Other less common canopy trees were *Ficus sycomorus, Ziziphus mauritiana, Acacia tortilis*, *Tamarindus indica* and *Trichilia emetica*. The understorey is far more diverse than the *Acacia tortilis* riparian woodland that occurs along non-perennial luggas and is characterised by several species that are confined to this vegetation community. *Acalypha fruticosa* is the dominant herbaceous species throughout, forming dense stands in some places, while the woody mid-stratum is dominated by large shrubs such as *Cordia sinensis, Gymnosporia senegalensis* and *Allophylus rubifolius*.

6.9.4.1.4 Prevalence of Vegetation Communities

The prevalence of the different vegetation communities within the TAN areas was calculated and is presented in Table 6.9-6. The vegetation communities within the Amosing and Ngamia areas were found to be largely similar and dominated by acacia/commiphora/euphorbia stunted bushland/thickets with wooded ephemeral streams contributing between 20 to 25% of the total landcover (Table 6.9-6). At both Ngamia and Amosing, acacia/commiphora/indigofera stunted bushland was the third most common vegetation community and contributed between 7.1 and 3.6% of the total landcover respectively (Table 6.9-6).

The vegetation community at Twiga differed from that of Amosing and Ngamia and was dominated by acacia/commiphora/indigofera stunted bushland which contributed to 75% of the total landcover (Table 6.9-6). Acacia/commiphora/euphorbia stunted bushland/thicket was the second most common vegetation type at Twiga and contributed 19.2% of the total landcover (Table 6.9-6). Unlike Amosing and Ngamia where wooded ephemeral streams contributed a sizeable portion of the landcover, at Twiga it only contributed 5.4% (Table 6.9-6).

Table 6.9-6: Prevalence of Different Vegetation Communities Within the TAN Areas in Hectares and % Contributions.

Vegetation Community	Amosing		Ngamia		Twiga	
	ha	% contribution[(a)]	ha	% contribution[(a)]	ha	% contribution[(a)]
Acacia/commiphora/euphorbia stunted bushland/thicket	753.9	72.1	1202.7	66.7	335.6	19.2
Wooded ephemeral streams	231.8	22.2	458.7	25.4	94.5	5.4
Acacia/commiphora/indigofera stunted bushland	37.4	3.6	128.3	7.1	1313.3	75.0
Acacia tortilis riparian forest	20.9	2.0	12.6	0.7	8.3	0.5
Acacia/commiphora deciduous bushland and thicket	1.0	0.1	0.3	0.0	0.3	0.0
Mixed acacia/hyphaene riparian forest						
Semi-desert shrubland			0.2	0.0	0.2	0.0
Settlements						

a) *The dominant communities are highlighted in green, the second most dominant in yellow and the third most dominant in orange*

6.9.4.1.5 Plant Species of Conservation Concern

In total, 155 plant species were recorded during field surveys (Annex I). Of these, four are listed as being SoCC (Table 6.9-7). All of these species were recorded in the Katamanak hill region in the east of the AoI. *Euphorbia turkanensis* is a range-restricted plant species only known from the general vicinity of Lokichar town, with the type locality situated between South Lokichar and the Malmalte River about 1.5 km south-west of Lokichar town (Carter & Smith, 1998). Plants of this species were observed at the type locality and then searched for between South Lokichar and the Malmalte River. Several small colonies of *Euphorbia turkanensis* were found at 11 sites between Lokichar and just south of Kaputir (Drawing 6.9-8). Photos of this species are displayed in Figure 6.9-8.

A breakdown of plant SoCC per vegetation community is provided in Table 6.9-8. All four plant SoCC were recorded in the acacia/commiphora bushland and thicket vegetation community which comprises approximately 90% of the surface area of the AoI (Table 6.9-8). The only exception was *E. turkanensis* which was also recorded in the *Acacia reficiens* low woodland community (Table 6.9-8)

Alien invasive plant species were predominantly recorded in the *Acacia tortilis* riparian woodland and *Faidherbia – celtis* riparian forest vegetation communities (Table 6.9-8).

Table 6.9-7: Plant Species of Conservation Concern Identified During Baseline Surveys

Scientific Name	Occurrence	Conservation Status				Other
		KWCMA (2013)	KWS (2019)	IUCN (2019)	CITES (2019)	
Blepharis turkanae	Only known from Turkana county (Vollesen, 2008)	-	-	VU	-	Restricted range
Euphorbia turkanensis	Type locality is 1.5 km south-west of Lokichar, and the species is known from a limited distribution at a small area of north-west Kenya (Carter and Smith 1988)	-	-	-	II	Restricted range
Neuracanthus kenyensis	Only known from northern Kenya (Marsabit, Isiolo and Turkana), at Kora National Reserve and in the Gemu Gofa region of Ethiopia-Kenya border (Darbyshire *et al.* 2010)	-	-	-	-	Restricted range
Xerophyta schnizleinia	Known from Northern Frontier in Kenya, Karamoja in Uganda, Ethiopia, Somali republic and Nigeria (Smith and Ayensu 1975).	-	-	-	-	Restricted range

Table 6.9-8: Total Number of Plant Species, Number of Alien Invasive Plant Species and Plant Socc Recorded in Different Vegetation Communities

	ACB	ESW	ARW	ALW	FCR	ASB	ABS
Total number of plant species	130	69	71	36	31	31	23
Alien invasive plant species	0	0	6	3	6	2	1
Plant species of conservation concern	4	0	0	1	0	0	0

ACB - Acacia/commiphora bushland and thicket
ESW - Ephemeral stream woodland
ARW - *Acacia tortilis* riparian woodland
ALW- *Acacia reficiens* low woodland
FCR - *Faidherbia – celtis* riparian forest
ASB - *Acacia – sanseviera* bushland
ABS - *Acacia boswellia* shrubland

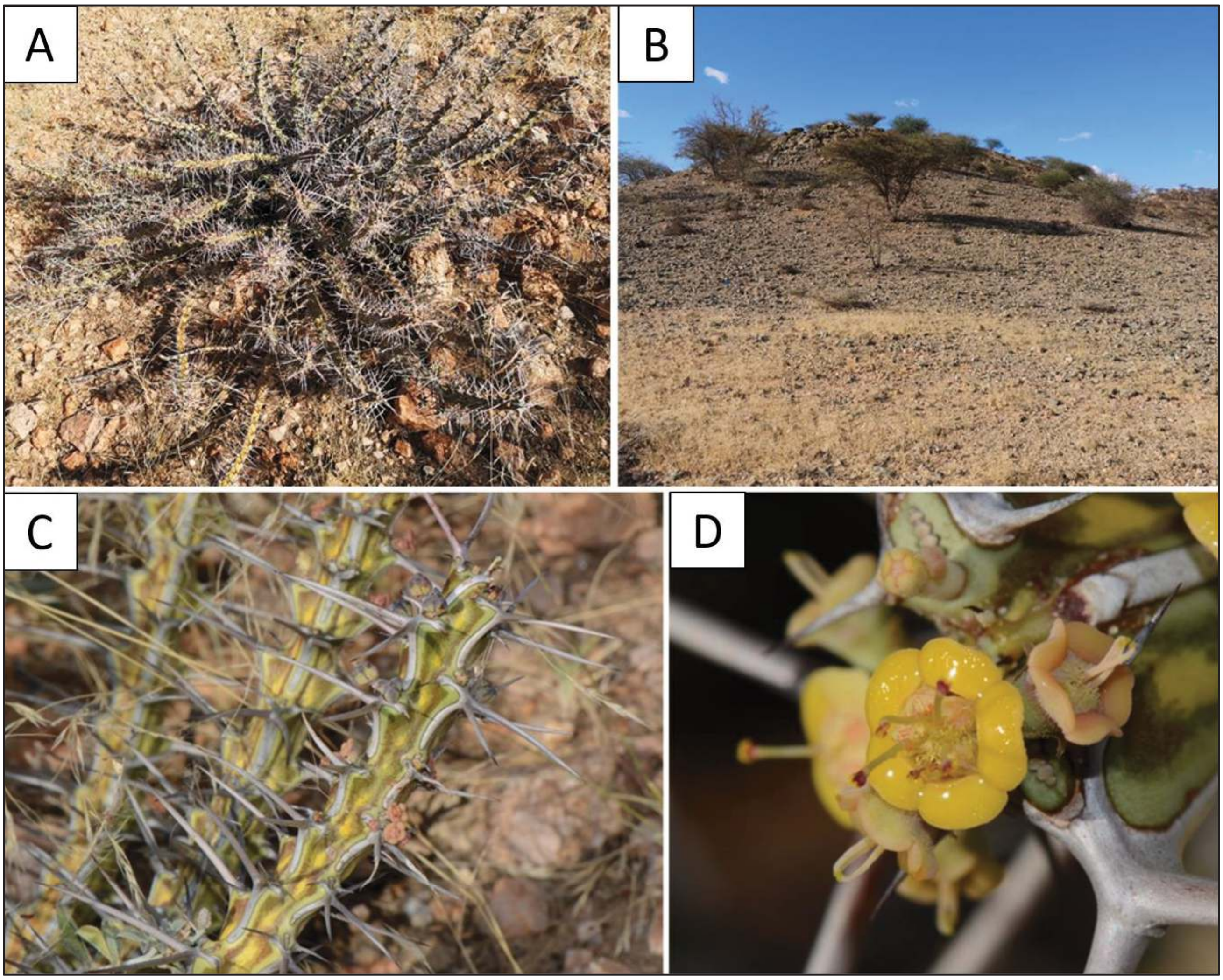

Figure 6.9-8: *Euphorbia turkanensis* A: Growth Form, B: Habitat at Type Locality, C: Branch and Spine Detail, D: Flower

6.9.4.2 Invertebrate data gathering

A summary of the baseline invertebrate species data collected is presented below. Detailed baseline results are provided in Annex I.

A total of 6,513 invertebrate specimens were collected. These included spiders (Class: Arachnida, Order: Aranae), centipedes (Class: Chilopoda), millipedes (Class: Diplopoda), woodlice (Class: Isopoda), camel spiders (Class: Arachnida, Order: Solifugae), scorpions (Class: Arachnida, Order: Scorpionae), and insects (Class: Insecta). By far the most abundant and diverse invertebrates in the region were the insects, with 12 orders comprised of 61 families and 466 genera recorded.

As discussed with NMK this assessment focussed on beetles (Coleoptera); flies (Diptera); ants, bees and wasps (Hymenoptera); butterflies and moths (Lepidoptera); and grasshoppers and crickets (Orthoptera) and the results are presented below.

Coleoptera (Beetles)

Two hundred and fifty four species of beetle were recorded, representing 20 families and 66 genera. Darkling beetles (Tenebrionidae) were the most species rich and abundant, with 14 genera, 19 species and 1,928 individuals recorded. This represents 29% of all invertebrate specimens collected. Scarab beetles

(Scarabeidae) were the next most abundant, with ten genera, 12 species and 1,502 individuals recorded. This represents 23% of all invertebrate specimens collected. Ground beetles (Carabidae) were the third most diverse group, with nine genera and ten species recorded.

Diptera (Flies)

Twenty three species were recorded, representing seven families and six genera. House flies (Muscidae) were the most species rich, and abundant, with three genera, and 115 individuals. Although this only represents 3% of all invertebrate specimens collected, the specimens from this family represent nearly 70% of all flies collected (115 individuals of 166). All the other flies recorded were not species rich or very diverse, with families typically being represented by one or two genera and/or species. Fruit flies (Drosophilidae), although not species rich or diverse, were abundant, with 30 specimens collected representing 18% of all flies collected.

Hymenoptera (Sawflies, Wasps, Bees, Ants)

Thirty species of Hymenopteran were recorded, representing 12 families and 15 genera. Ants (Formicidae) were the most species rich and abundant Hymenopteran group, with six genera and 866 individuals recorded. This represents 13% of all invertebrate specimens recorded, and 78% of all Hymenopteran individuals recorded. Chalcid wasps (Chalcidae) were the second-most abundant group, with 205 specimens collected, representing almost 19% of all Hymenopterans sampled, followed by bees (Apidae), with 127 specimens sampled (11%). Other families showed lower levels of richness, diversity and abundance (with one to three genera represented).

Lepidoptera (Butterflies)

Twenty four butterfly species were identified, representing four families and 13 genera. Whites (Pieridae) was the most species-rich and abundant family, with 15 species positively identified. This family accounted for 78% of sampled butterfly specimens. All other species were sampled in low numbers (one to five individuals) during the baseline survey.

The migratory brown-veined White Butterfly (*Belenois aurota*) was frequently encountered (24 occasions) during the November 2015 preliminary survey, with just three observations during the June 2016 survey. Given that it breeds throughout Sub-Saharan Africa, the potential breeding habitat within the region is of relatively low importance in the context of the vast area throughout which this species breeds and migrates, and it is not included as a species of concern for this assessment.

Orthoptera (Grasshoppers, Crickets, Katydids, Locusts)

Twelve species of cricket and grasshopper were recorded, from four families and eight genera. Species abundance was split almost evenly between crickets (Gryllidae) and grasshoppers (Acrididae). The grasshoppers showed greater species richness, with seven species recorded, followed by Gryllidae with three species recorded.

6.9.4.2.1 Invertebrate Species of Conservation Concern

An invertebrate SoCC was recorded. A single specimen of a ground beetle in the genus Omophron (Family: Carabidae, Sub-family: Omophrininae) (Figure 6.9-9) was collected near Loperot in the east of the AoI. Omophron (Latreille 1802) is a genus of ground beetle, and the only extant genus in the subfamily Omophrininae. It is mostly distributed in the northern hemisphere, with the southern border of its African distribution running through South Africa and Madagascar (Valainis, 2010). This genus has never been recorded in Kenya and may represent a new species. The specimen was confirmed by NMK to be a new species. Additional surveys were undertaken in December 2019 to look for additional specimens, but none were recorded.

Figure 6.9-9: Unidentified Omophron *sp*. Collected at Loperot During the June 2016 Survey

6.9.4.3 Amphibian and Reptile Data Gathering

A summary of the primary baseline data of the reptile and amphibian species is presented based on the findings of the field investigations. The detailed baseline survey results are presented in Annex I.

Due to the dry weather conditions experienced during the survey, reptiles and amphibian diversity was lower than expected. Some rainfall occurred towards the end of the survey, mostly as isolated showers. Active searches were conducted in those areas where rainfall occurred. Only one species of amphibian, the Turkana toad (*Amietophrynus turkanae*), was recorded.

Thirteen reptile species have been recorded in the project area. In addition, the TKBV snake catching team has recorded seven snake species which were not recorded during the formal surveys. With the addition of these records, the total count of reptile and amphibian species is 21, 18 of which were recorded in the AoI.

Additional observations of reptiles were sought during March and June 2019 baseline surveys, however no new species were observed. Photographs of reptile species observed during the March 2019 survey are provided in Figure 6.9-10. An additional survey was conducted in December 2019 with the specific objective of confirming the presence of the Turkana toad in the project area and describing its habitat preference. No specimens of this species were recorded during the survey however 3 other amphibian species were recorded.

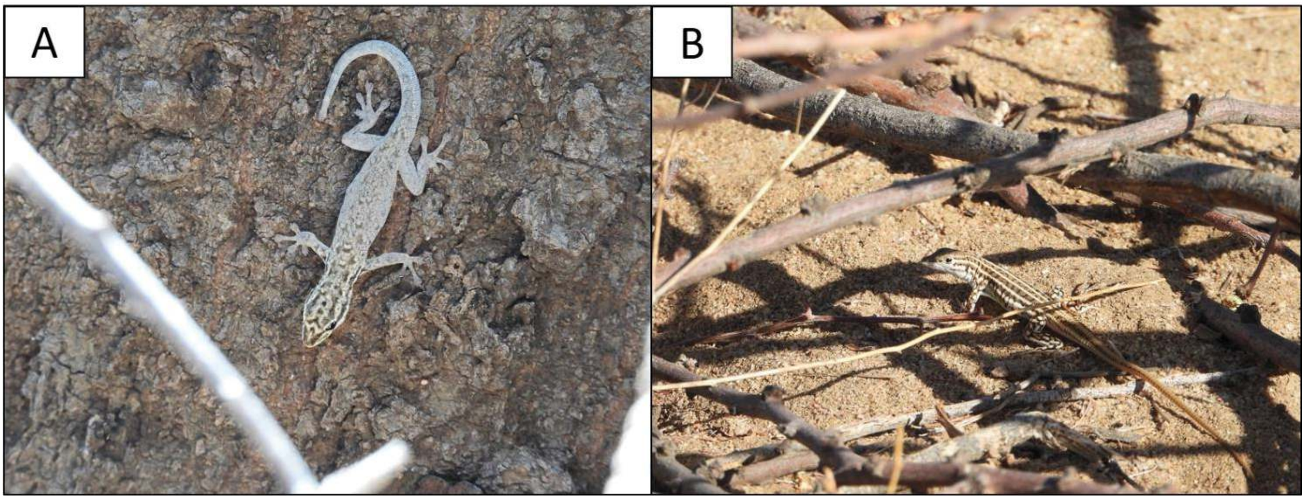

Figure 6.9-10: A: Kenyan Dwarf Gecko (*Lygodactylus keniensis*) and B: Speke's Sand Lizard (*Heliobolus spekii*) Observed in the AoI During the March 2019 Field Survey

Habitats

Most species were recorded in riparian forest and wooded ephemeral streams, with just four species recorded from other, more open habitats such as acacia/commiphora bushland and thicket, and semi-desert shrubland. No habitat data was provided for reptile species caught by the TKBV snake catchers, because call-outs are typically for snakes that entered work areas, that is, modified habitats; however, the dominant vegetation communities surrounding the fields in these areas are wooded ephemeral streams and acacia/commiphora/ euphorbia bushland/thicket.

6.9.4.3.1 Herpetofaunal Species of Conservation Concern

Two herpetofaunal species of conservation concern were recorded during the baseline surveys.

The rock monitor (*Varanus albigularis*), is a species of monitor lizard in the family Varanidae. Despite having a distributional range that covers central, eastern and southern Africa it is listed as Protected by Kenyan legislation (KWCMA, 2013) and is listed by KWS as a priority species (KWS, 2019).

The Turkana toad is a range restricted amphibian species previously only known from two localities, Loiengalani on the south-eastern shores of Lake Turkana and the Ewaso Ng'iro River in the Samburu Game Reserve (IUCN, 2019). Its presence in the Project area represents a range extension. It is listed as DD by the IUCN and listed as Protected by Kenyan legislation (KWCMA, 2013).

Of the seven snake species collected by the TKBV Snake Catchers two are listed as protected in Kenya namely:

- Kenya sand boa (*Eryx colubrinus*); and
- Puff adder (*Bitis arietans*) (KWCMA, 2013).

Both species are also listed as priority species for conservation by KWS (2019).

6.9.4.4 Avifaunal Data Gathering

Two hundred and seventy seven bird species were recorded during the combined baseline surveys. Most of the recorded species are relatively common and typical of the region. Species community composition generally comprised resident woodland and grassland species. The full list of bird species recorded is presented in Annex I. Photographs of selected bird species are provided in Figure 6.9-11.

Figure 6.9-11: Bird Species Observed During the June 2019 Biodiversity Baseline Survey, A: African Pygmy Kingfisher, B: Jackson's Hornbill, C: Parrot Billed Sparrow, D: White-Headed Buffalo Weaver, E: White-Throated Bee-Eater, F: Grey-Hooded Kingfisher, G: Golden-Backed Weaver, H: Chestnut Weaver, I: Beautiful Sunbird, J: D'Arnaud's Barbet, K: Ruppell's Sunbird and L: Olive Bee-Eater

No major differences in community composition were observed between seasons; however, several Palearctic and Afro-tropical migrant species were observed during the May and August 2016 surveys, which coincided with the end of the long rains season, and the dry cool season, respectively.

A relatively high diversity of raptor species (19 species) was recorded over the course of the baseline surveys. Several of the observed raptor species are Palearctic migrants, including black kite (*Milvus migrans*), Eurasian hobby (*Falco subbuteo*), lesser kestrel (*F. naumanni*), pallid harrier (*Circus macrourus*), steppe buzzard (*Buteo rufofuscus*) and steppe eagle (*Aquila nipalensis*).

The highest avifaunal diversity was recorded in the *acacia/commiphora/euphorbia* bushland/thicket vegetation community (116 species). However, the majority of these (103 species) were also recorded in the ephemeral stream woodland community. The richness, diversity and abundance of birds recorded within the riparian forest community was lower, with only 36 species recorded. In general, the birds recorded within specific vegetation types were subsets of the wider bird community recorded across the region, with no species being particular to a specific vegetation community the only exception being the *Faidherbia - celtis* riparian forest along Malmalte River.

In November 2018 an additional bird survey was conducted with the objective of assessing bird communities between South Lokichar and Turkwel Dam with specific emphasis on the riparian habitats along the Malmalte River. One hundred and nine species were recorded over the course of the survey. Seventeen of these species (61% of newly recorded species) were only recorded at sites along the Malmalte River highlighting the difference between the Malmalte River bird community and that of the remainder of the AoI.

6.9.4.4.1 Avifaunal Species of Conservation Concern

Forty two species that are endemic to the Somali-Masai biome were observed during fieldwork. This comprises 15% of the total number of observed bird species. The Somali-Masai biome has 129 species that are described as “*biome-restricted endemics*”, 94 of which occur in Kenya (Fishpool & Evans, 2001). Even though these species are referred to as “*endemics*”, they are confined to large regions and none fulfil the requirements for being classified as “*range-restricted species*”, i.e. they each have an extent of occurrence of greater than 50, 000 km^2.

Sixteen bird SoCC concern were recorded (Table 6.9-9). This included two species listed as VU and two as NT by Kenya legislation. Rüppell's and white-backed vultures are both listed as CR by the IUCN. The lappet-faced vulture and steppe eagle are both listed as EN by the IUCN. The observed bird community also showed a large number of migratory species with five species listed as Annex I – Endangered migratory species by CMS. A further seven species are listed as Annex I - Migratory species conserved through Agreements by the CMS (Table 6.9-9).

Table 6.9-9: Bird SoCC Recorded in the AoI

Common name	Scientific Name	KWCMA (2013)	IUCN (2019)	CMS (2019)	KWS (2019)	Confirmed in AoI
Lappet-faced vulture	*Torgos tracheliotos*	VU	EN	I	✓	✓
Lesser kestrel	*Falco naumanni*	VU	LC	I	✓	✓
African white-backed vulture	*Gyps africanus*	NT	CR	I		✓
Rüppell's vulture	*Gyps rueppelli*	NT	CR	I		✓
Pallid harrier	*Circus macrourus*	NT	NT	II		✓
Steppe eagle	*Aquila nipalensis*		EN	I		✓
Tawny eagle	*Aquila rapax*		VU	II		✓
Bateleur	*Terathopius ecaudatus*		NT			✓
Kori bustard	*Ardeotis kori*		NT			✓
Eurasian hobby	*Falco subbuteo*		LC	II		✓
Spur-winged plover	*Vanellus spinosus*		LC	II		✓

Common name	Scientific Name	KWCMA (2013)	IUCN (2019)	CMS (2019)	KWS (2019)	Confirmed in AoI
Abdim's stork	*Ciconia abdimii*		LC			✓
Cattle egret	*Bubulcus ibis*		LC			✓
Common quail	*Coturnix coturnix*		LC	II		✓
Black kite	*Milvus migrans*		LC	II		✓
Steppe buzzard	*Buteo buteo*		LC	II		✓

Photographs of selected bird species observed during the June 2019 survey are provided in Figure 6.9-11.

6.9.4.5 Mammal Data Gathering

Thirty six mammal species were either directly observed or deduced to be present based on secondary evidence such as track-pads or anecdotal records gathered from local people (Table 6.9-10).

During the September 2018 biodiversity survey between South Lokichar and the Turkwel Dam, signs of African elephant (*Loxodonta africana*) activity were noted in the Faidherbia - celtis riparian forest along the Malmalte River. This led to engagement with KWS to obtain an understanding of the movements of these elephants and particularly to understand whether there was a seasonal element to their movements. In 2014 and 2015, Elephants Without Borders (EWB) together with KWS and with support from The Great Elephant Census conducted aerial surveys throughout Kenya to obtain updated information on the status of elephant populations in various ecosystems throughout Kenya (Chase et al., 2016). Based on that assessment around 600 elephants were found in the Kerio Valley with the majority occurring in Nasolot NR and South Turkana NR (Chase et al., 2016). Research conducted by KWS and Save the Elephants from 2017 onwards confirmed extensive movements of elephants between Nasolot NR and South Turkana NR with the animals also spending considerable time along the Malmalte River between the two reserves (Ihwagi et al., 2018), although the collared elephants did not venture northwards past the confluence of the Malmalte and Turkwel Rivers towards Kaputir. Honey producers that were interviewed at Kaputir during the March 2019 biodiversity survey also confirmed the occasional presence of elephants along the Turkwel River. The seasonal presence of elephants along the Malmalte and Turkwel Rivers was confirmed during the June 2019 survey.

Table 6.9-10: Mammal Species Concluded to be Present in the AoI Either Based on Direct Observations, Identification of Tracks/Scat and Anecdotal Information Obtained from Local Inhabitants

Common Name	*Scientific Name*	KWCMA (2013)	IUCN (2019)	KWS (2019)	CITES (2019)	Observed in AoI during baseline
Elephant	*Loxodonta africana*	EN	VU	✓	I	✓
Striped hyena	*Hyaena hyaena*	EN	NT	✓	III	✓
Leopard	*Panthera pardus*	EN	NT	✓	I	
Lesser kudu	*Tragelaphus imberbis*	VU	NT			✓
Percival's spiny mouse	*Acomys percivali*		LC			✓
Wilson's spiny mouse	*Acomys wilsoni*		LC			
African grass rat	*Arvicanthis niloticus*		LC			
Four-toed hedgehog	*Atelerix albiventris*		LC			
Somali hedgehog	*Atelerix sclateri*		LC			
Golden jackal	*Canis aureus*		LC		III	
Black-backed jackal	*Canis mesomelas*		LC			✓
African civet	*Civettictis civetta*		LC		III	✓
Spotted hyena	*Crocuta crocuta*		LC			✓
Rufous sengi	*Elephantalus rufescens*		LC			
Senegal galago	*Galago senegalensis*		LC			✓
Small-spotted genet	*Genetta genetta*		LC			
Large-spotted genet	*Genetta maculata*		LC			✓
Black-tailed gerbil	*Gerbilliscus nigricaudus*		LC			
Cape/Crested porcupine	*Hystrix africaeaustralis/ H. cristata*		LC			
Striped polecat	*Ictonyx striatus*		LC			
Yellow-winged bat	*Lavia frons*		LC			
Serval	*Leptailurus servalis*		LC		II	✓
Cape hare	*Lepus capensis*		LC			✓
Guenther's dik-dik	*Madoqua guentheri*		LC			
Honey badger	*Mellivora capensis*		LC		III	

Common Name	*Scientific Name*	KWCMA (2013)	IUCN (2019)	KWS (2019)	CITES (2019)	Observed in AoI during baseline
Schlieffen's twilight bat	*Nycticeinops schlieffeni*		LC			
Aardvark	*Orycteropus afer*		LC			✓
Bat-eared fox	*Otocyon megalotis*		LC			✓
Olive baboon	*Papio anubis*		LC			
Emin's tateril	*Taterillus emeni*		LC			
Unstriped ground squirrel	*Xerus rutilans*		LC			✓
Vervet monkey	*Chlorocebus pygerythrus*		LC			✓
Yellow-spotted rock hyrax	*Heterohyrax brucei*		LC			✓
Warthog	*Phacochoerus africanus/P. aethiopicus*		LC / LC			✓
White-tailed mongoose	*Ichneumia albicauda*		LC			✓
Striped ground squirrel	*Xerus erythropus*		LC			✓

Medium and Large Mammals

Twenty five medium and large mammal species[22] were recorded over the course of the four seasonal mammal surveys (Table 6.9-10). Medium and large mammal fauna assemblage consists primarily of medium-sized carnivorous/omnivorous mammals, such as African civet, large-spotted genet, serval, jackals, bat-eared fox, spotted and striped hyena, with the remainder made up of smaller-sized species such as hedgehogs, hares and ground squirrels. African elephant was confirmed to be present along the Malmalte – Turkwel corridor based on visible signs and anecdotal information obtained from honey producers.

The most frequently recorded species were unstriped ground squirrel (*Xerus rutilans*) and Cape hare (*Lepus capensis*) which were present throughout the AoI. Photographs of selected mammal species or the visual signs that indicate their presence are provided in Figure 6.9-12.

[22] Medium and large mammal species include all species except rodents and bats.

Small Mammals (rodents)

Nine small mammal species were recorded across the baseline surveys (Table 6.9-10). The abundance and species richness of captured species was low compared to a potential 22 small mammal species that have been recorded in Turkana region to date (Coe, 1972; Webala *et al*., 2010). The overall trap success rate for the survey was also relatively low, varying between 3% and 8% across the survey events (Annex I). Similar results were achieved in a relatively recent small mammal study conducted on the eastern side of Lake Turkana (Webala et al., 2010) in which low species diversity (11 in total, and 6 in similar habitat) and low capture success (5.46% average success rate) was also noted; the baseline survey results may thus reflect generally low levels of species richness associated with arid plain habitats.

Small Mammals (bats)

Two bat species were confirmed via trapping during baseline surveys (Table 6.9-10). The yellow-winged bat (*Lavia frons*) and Schlieffen's twilight bat (*Nycticeinops schlieffeni*) are both listed as LC by the IUCN (2019).

Active transect surveys were conducted during 12 dusk and dawn periods in April 2016 and covered approximately 153 km. Two hundred and one bat echolocation call files were generated during the driven transect survey. Of these, 61 were indistinguishable. Most of the remaining calls were identified as from the families Molossidae and Vespertilionidae, suggesting up to six additional species including *Myotis tricolor*, *Pipistrellus kuhli*, *Neoromicia nanus*, *Charaephon pumila*, *Mops condylurus* and *Mops cf demonstrator* (Webala et al., 2009) may occur. The mean encounter rate per kilometre was 0.91 calls, indicating a low overall level of bat activity during that survey period.

Suitable roosting habitat for tree/crevice-roosting species is present AoI; Schlieffen's twilight bat was recorded from a tree roost. Cave-roosting species may be present along the ridge separating Turkwel Dam from the Malmalte River and fruit bats may be present along the Malmalte River but due to security concerns nocturnal surveys could not be conducted in these areas.

Figure 6.9-12: Mammal Species Recorded During the Baseline Surveys: A) Vervet Monkey, B) Yellow-Spotted Rock Hyrax, C) Warthog Dung, D) Elephant Dung, E) Günther's Dik-Dik Droppings, F) African Civet Midden, G) Mongoose Tracks, H) Lesser Kudu Tracks, I) Aardvark Track, J) Porcupine Dung

6.9.4.5.1 Mammal Species of Conservation Concern

Four mammal SoCC were confirmed within the AoI during the baseline surveys (Table 6.9-11).

Three species are listed as EN in KWCMA (2013) and identified as priority species for conservation by KWS (2019). The African Elephant is listed as VU by the IUCN whilst Striped Hyena and Leopard are both listed as NT (Table 6.9-11). The lesser kudu is currently listed as NT by the IUCN (2019) (Table 6.9-11). Within the study area it was recorded along the Malmalte River. The lesser kudu is closely associated with acacia-commiphora thorn bush in semi-arid areas of north-eastern Africa (IUCN, 2019). Although resilient to some degree of hunting pressure, it is susceptible to outbreaks of rinderpest, an infectious disease of ruminants, especially cattle.

Table 6.9-11: Mammal SoCC Recorded as Likely to Occur or Confirmed in the AoI

Common Name	*Scientific Name*	KWCMA (2013)	IUCN (2019)	KWS (2019)	Recorded in AoI during baseline
African elephant	*Loxodonta africana*	EN	VU	✓	✓
Striped hyena	*Hyaena hyaena*	EN	NT	✓	✓
Leopard	*Panthera pardus*	EN	NT	✓	
Lesser kudu	*Tragelaphus imberbis*	VU	NT		✓

6.9.4.6 Fish data gathering

During the March 2019 survey the Turkwel River was surveyed for fish downstream of the confluence with the Malmalte River in the vicinity of Kaputir village. The Turkwel River at this point is approximately 150 m wide and shallow with a sandy substrate and well vegetated margins (Figure 6.9-13).

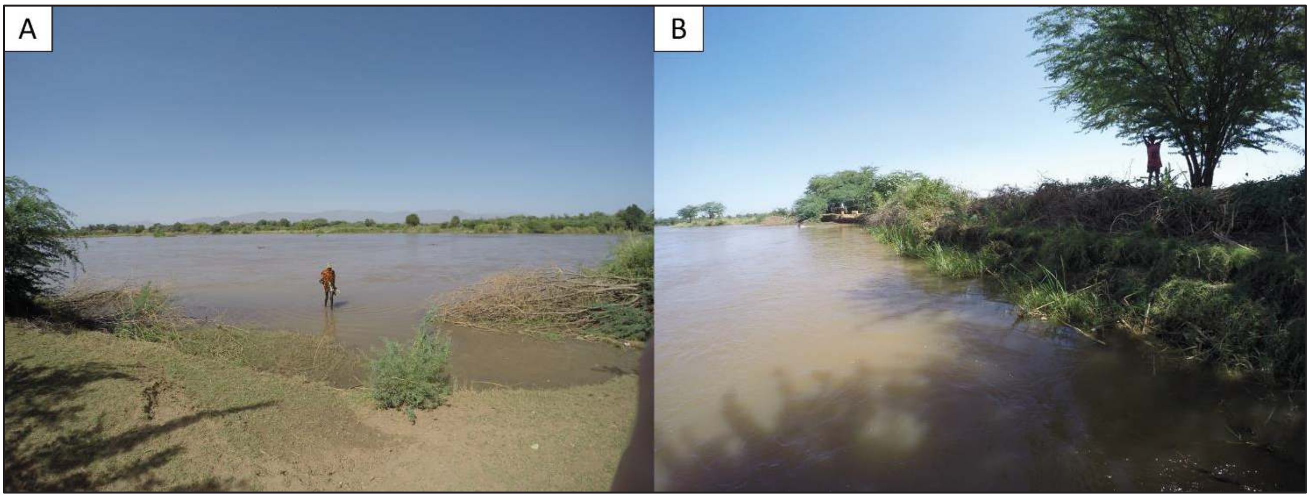

Figure 6.9-13: Turkwel River in the Vicinity of Kaputir Village Showing A: Width and B: Vegetated Margin

Eleven fish species in two families were recorded on the Turkwel River during the March and June 2019 surveys (Table 6.9-12).

The Senegal minnow (*Raiamas senegalensis*) was the most abundant species recorded, while the Cyprinidae was the most diverse family, with seven species recorded (Table 6.9-12). Four cichlid species were recorded including Nile tilapia (*Oreochromis niloticus*) (Table 6.9-12). The Nile tilapia has reportedly been stocked in the Turkwel Dam in order to promote fisheries in that impoundment. Two Haplochromis species were recorded in the Turkwel River, both species are known from Lake Turkana. The records from the Turkwel River therefore represent a range extension for both species. Photographs of selected fish species are provided in Figure 6.9-14.

It is believed that the observed fish community represents only a fraction of the full fish species diversity of the Malmalte and Turkwel Rivers. This is based on the short duration of the surveys and the limited access particularly to the Malmalte River. Very limited baseline information exists on the fish communities of the Malmalte and Turkwel Rivers and those sources that do exist point to the presence of little-known species or species potentially new to science.

Table 6.9-12: Fish Species Recorded in the Turkwel River During the March and June 2019 Biodiversity Baseline Surveys

Family	Species	IUCN (2019)	March 2019	June 2019
Cyprinidae	*Enteromius aff. stigmatopygus*		7	47
	Enteromius aff. jacksoni		3	1
	Labeo cylindricus	LC	4	29
	Labeo horie	Unlisted		1
	Labeo aff. coubie		1	
	Labeobarbus intermedius	LC	3	23
	Raiamas senegalensis	LC	103	24
Cichlidae	*Haplochromis turkanae*	LC		30
	Haplochromis macconneli	LC		2
	Oreochromis niloticus	LC	1	46
	Coptodon zillii	LC		5
No of species			**7**	**10**

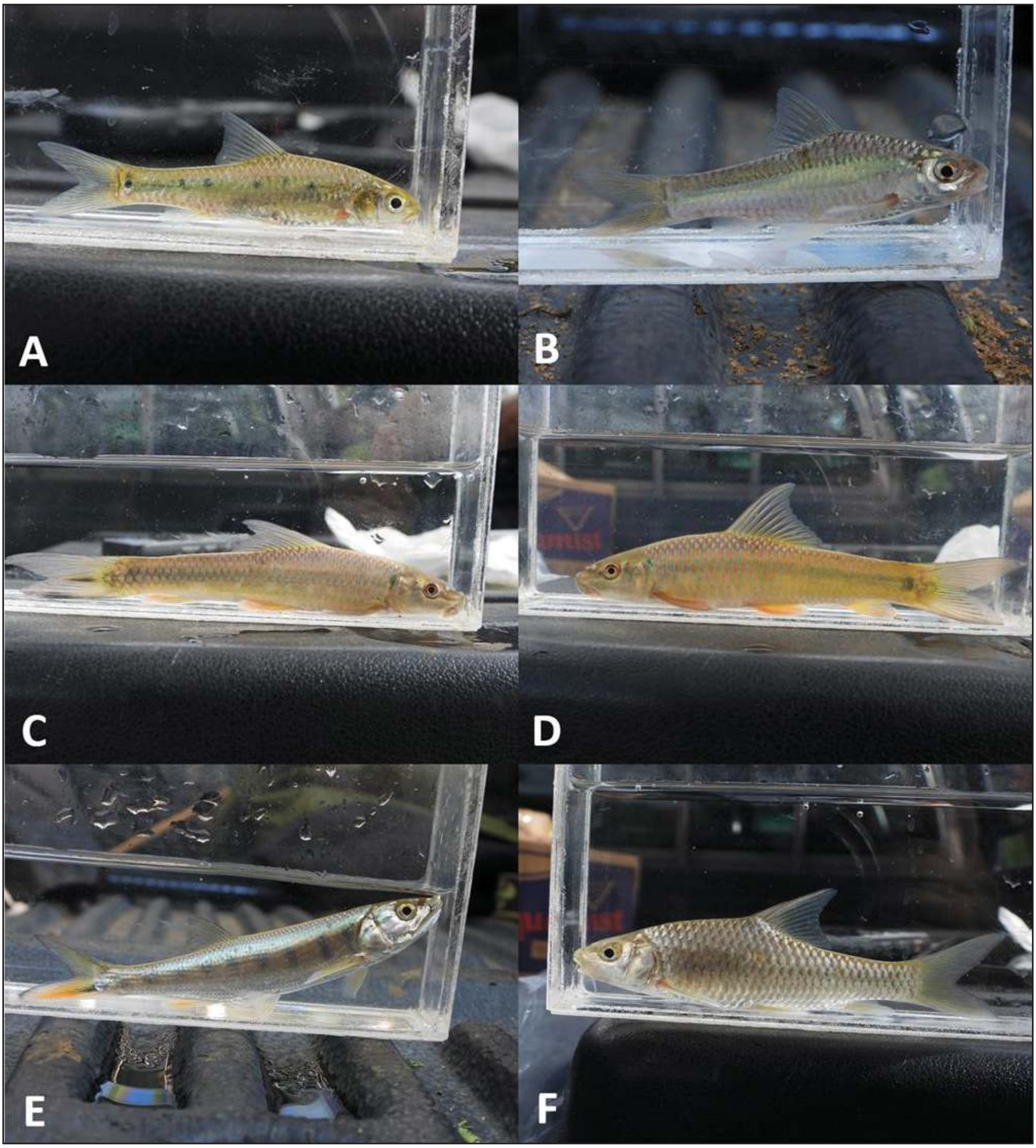

Figure 6.9-14: Fish Species Recorded in the Turkwel River During the March and June 2019 Biodiversity Baseline Surveys. A: *Enteromius Aff. Stigmatopygus*, B) *Enteromius Sp. Jacksoni*, C) *Labeo Horie*, D) *Labeo Cylindricus*, E) *Raiamas Senegalensis*, F) *Labeobarbus Intermedius*

6.9.4.6.1 Fish Species of Conservation Concern

Two fish SoCC were recorded during the baseline survey. Both *Haplochromis turkanae* and *H. macconneli* were considered to be Lake Turkana endemics. Their presence in the Turkwel River represents a range extension for both species. Despite the extension of their range, the geographic span of both species remains below the 500 km Criterion 2 threshold and both species are therefore regarded as range restricted.

The likelihood that additional species of conservation concern occur in the Malmalte and Turkwel Rivers, including little-known and previously undescribed species, is regarded as high.

6.9.5 Discussion

The AoI overlaps with portions of South Turkana NR and the northern-most portion of Nasolot NR as well as the Pellow Community Conservancy. These areas provide refuge for wild ungulates and large mammals species such as elephants and lions that have largely been extirpated from the remainder of Turkana County. The presence of wild ungulates and large mammals attracts bird species such as the white-backed vulture (CR), which was observed in the AoI, Rüppell’s vulture (CR) and lappet-faced vulture (EN). The Malmalte River is situated between these reserves and although not officially protected it has received some de facto protection due to the security issues in the region and was shown by the KWS and Save the Elephant study to represent key habitat for the elephants in the region. These reserves and their adjoining areas should therefore be regarded as highly sensitive biodiversity areas and impacts on these areas should be avoided.

Several plant and animal SoCC were confirmed as present in the AoI during the baseline surveys. These included four endemic plant species all of which were recorded in the Katamanak hill region in the east of the AoI. *Euphorbia turkanensis,* a range-restricted plant species only known from the general vicinity of Lokichar town, was found at 11 sites between Lokichar and the area just south of Kaputir.

A single specimen of a ground beetle in the genus *Omophron* (Family: Carabidae, Sub-family: Omophrininae) was collected near Loperot in the east of the AoI. The specimen was confirmed by NMK to be a new species.

Due to the dry weather conditions reptile and amphibian diversity was lower than expected however four protected herpetofaunal species were recorded (three reptiles and one amphibian). The Turkana toad (*Amietophrynus turkanae*) is a range restricted amphibian species previously only known from two localities, Loiyangalanii on the south-eastern shores of Lake Turkana and the Ewaso Ng’iro River in the Samburu Game Reserve. Its presence in the AoI therefore represents a range extension. The Turkana toad is listed as DD by the IUCN and listed as Protected by Kenyan legislation.

Sixteen bird SoCC including species listed as CR and EN by the IUCN were recorded. Rüppell's and white-backed vultures are both listed as CR by the IUCN. Two bird species listed as EN by the IUCN were recorded in the AoI namely lappet-faced vulture and steppe eagle. A high diversity of raptor species was recorded over the course of the baseline surveys this included Palearctic migrants including black kite, Eurasian hobby, lesser kestrel, pallid harrier, steppe buzzard and steppe eagle.

Large mammals and free roaming wild ungulates have largely been extirpated from the AoI with the exception of those remaining within Nasolot NR and South Turkana NR. The only exception is African elephant which was confirmed to be present along the Malmalte to Turkwel corridor. Outside of the reserves the mammal community consists primarily of small species such as hedgehogs, hares and ground squirrels. Medium sized mammal species that occur outside of reserves include carnivorous/omnivorous mammals, such as African civet, large-spotted genet, serval, jackals, bat-eared fox, and spotted and striped hyena. Three mammal species of conservation concern were confirmed within the AoI during the baseline surveys. All three species are listed as EN in the KWCMA (2013) and identified as priority species for conservation by KWS. The African elephant is listed as VU by the IUCN whilst striped hyena and leopard are both listed as NT.

Two fish species of conservation concern were recorded during the baseline survey. The potential of additional species of conservation concern to occur in the Malmalte and Turkwel Rivers, including little-known and previously undescribed species, is regarded as high.

6.10 Ecosystem Services

Ecosystem services consist of all the natural products and processes that contribute to human well-being, and the personal and social enjoyment derived from nature (Landsberg, et al., 2013). For example, arid and semi-arid areas provide important services, including soil formation and conservation, which plays a role in preventing desertification and support of certain vegetation species (e.g. acacia), which directly provide a range of services, such as fuelwood, food, materials for construction, forage for livestock, and support of wild fauna (Safriel et al., 2005).

Ecosystem services are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems (IFC PS1). The benefits gained can either be physical or psychological, and can be obtained actively or passively, directly, or indirectly (IFC, 2012). The benefits of ecosystems are passed on to beneficiaries at many levels. These include:

- Local scale – ecosystem services may be the basis for rural livelihoods and subsistence. For example, grasses and shrubland in an otherwise arid landscape are an important grazing resource for livestock, which provides both cash income and food for low-income families;
- Regional scale – prevention of erosion and desertification through maintenance of natural vegetation conditions; and
- Global scale – ecosystems regulate climate and act as a reservoir of carbon storage and also regulate biodiversity, which underpins biological production of all types, including agriculture.

Ideally, a project should maintain the value and functionality of priority ecosystem services[23] to those beneficiaries directly dependent upon them. This should be achieved through the direct management and control measures that the project can impose. Ecosystem services whose beneficiaries are at the global scale and, to a lesser extent, the regional scale, and are therefore outside the influence of the direct management and control measures that the Project can impose, are not covered by this assessment.

Kenyan legislation and policies pertaining to biodiversity conservation and wildlife management do not specifically define what constitutes an ecosystem service. However, they are mentioned in the national Wildlife Policy in the context of sustainable economic development (Ministry of Forestry and Wildlife, 2012), and as features of protected areas that should be conserved (KWCMA, 2013). The NBSAP (Ministry of Environment and Natural Resources, 2000) provides for the conservation and sustainable use of natural resources that provide the basic source of livelihood for an estimated 80% of the country's population, including food, firewood, construction materials and medicines. All of these are ecosystem services.

For the purposes of this assessment, the definitions of different types of ecosystem services are based on those developed by the Millennium Ecosystem Assessment (MA, 2005) (Table 6.10-1).

[23] Priority ecosystem services are those services on which project impacts may affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries, and those services that could prevent the project from achieving planned operational performance (Landsberg et al., 2011).

Table 6.10-1: Ecosystem Services Categories (MA, 2005)

Broad categories	Definition
Provisioning services	Supporting human needs (e.g., traditional hunting grounds, medicinal plants and minerals, water sources, wild foods, firewood, and construction materials).
Cultural services	Aesthetic, spiritual, recreational and other cultural values (e.g., sacred sites, traditional meeting areas, traditional knowledge, and sense of place).
Regulating services	Control of the natural environment (e.g., maintenance of key ecological processes, groundwater recharge, erosion control, and water quality).
Supporting services	Natural processes essential to the resilience and functioning of ecosystems (e.g., primary production, soil formation and conservation, and nutrient cycling).

Using the definitions of ecosystem services provided above, this baseline describes the ecosystem services, and the benefits that local people derive from them, in the AoI, as presented in the biodiversity baseline (Section 6.9). This baseline also identifies the services on which the Project will depend for its operational performance.

The ecosystem services AoI is defined at two scales, the area within which impacts on ecosystems supplying ecosystem services could occur (the Biophysical AoI) and the area within which demand for ecosystem services by beneficiaries was characterised (the Social AoI) (see Section 6.12).

6.10.1 Approach

The approach follows the guidance and tools developed by the World Resources Institute (Landsberg et al., 2011). The process includes:

1) Identifying the suite of ecosystem services within the AoI;
2) Identifying priority ecosystem services; and
3) Establishing the baseline for those priority services in the AoI. This is done by:
    - Identifying the ecosystems that supply them, and the capacity of those systems to supply priority services; and
    - Identifying the beneficiaries who use those services, and the current demand for them.

6.10.1.1 Identifying Ecosystem Services

Ecosystem services provided in the AoI were identified using the following data sources:

- Literature review – online search for literature on ecosystem service provision in Turkana County. Sources consulted include:
    - *The Prevalence of Wild Food Knowledge Among Nomadic Turkana of Northern Kenya* (Watkins, 2010);
    - *Usufruct Rights to Trees: The Role of Ekwar in Dryland Central Turkana, Kenya* (Barrow, 1990);
    - *Trees - Ecosystem services: provisioning services and cultural services provided by trees in Turkana* (Booth et al., 2016); and
    - *Impacts of pastoralists on woodlands in South Turkana, Kenya: Livestock-mediated tree recruitment* (Reid & Ellis, 1995);

- Field notes – during the various biodiversity primary data gathering surveys by the Golder team, notes were taken on ecosystem services, including aspects such as:
  - Movements and activities of pastoralists and make-up of livestock herds;
  - Harvesting and collection of firewood by local inhabitants;
  - Sources of water especially the presence of hand-dug wells;
  - Presence or absence of agricultural activities; and
  - Presence of beehives in luggas.
- Focus group meetings – questionnaires on ecosystem service use were provided to the social team for use in focus group meetings with local stakeholders.

6.10.1.2 Prioritising of Ecosystem Services

The ecosystem service prioritisation exercise was carried out systematically, using current guidance regarding conducting an ecosystem services Review(Landsberg et al, 2013) . The focus of the prioritisation exercise is to identify the priority ecosystem services that could be affected by the Project. These priority ecosystem services include:

1) Type I, comprising those services on which the Project impacts could affect beneficiaries' livelihoods, health, safety, or culture; and
2) Type II, comprising those services that could prevent the Project from achieving operational status (IFC, 2012, Landsberg et al., 2013).

Type I ecosystem services were prioritised according to the Project impact by answering three key questions (Landsberg et al., 2013);

1) Could the Project affect the ability of others to benefit from this ecosystem service?
2) Is the ecosystem service important to beneficiaries' livelihoods, health, safety or culture?
3) Do beneficiaries have viable alternatives to this ecosystem service?

Type II ES were prioritised according to operational risks to Project performance by answering the following two key questions (Landsberg et al., 2013);

1) Could this ecosystem service change in ways that could affect operational performance?
2) Does the Project have viable alternatives to this ecosystem service?

The outcomes of the prioritisation exercise are detailed in Annex I.

6.10.2 Results

This section presents a summary of the services supplied by the ecosystems identified in the AoI.

6.10.2.1 Beneficiaries of Ecosystem Services

Turkana County is characterised by clustered settlements, of which Lokichar is one of the main urban centres. In West Pokot County, the main urban centre is Kapenguria in West Pokot Sub-County, which also acts a trading centre.

Rural areas are settled by nomadic pastoral communities that move frequently in search of water and pasture for their livestock (Turkana County Government, 2013; as referenced in the social baseline, Section 6.12).

The pastoralist Turkana and Pokot communities of northern Kenya migrate as part of their livelihood, moving their homes and animals to find natural resources in the arid natural environment. Rural settlements are often dispersed along luggas, with the community taking their name from the lugga closest to the location (social baseline, Section 6.12).

It would however be inaccurate to consider the movements of the Pokot or Turkana pastoralists as truly nomadic in the sense of random movements governed by rainfall and forage availability. The reality is that both the Pokot and Turkana pastoralists have well defined grazing strategies and patterns combined with intricate concepts of ownership that are more well defined in drier areas (Barrow, 1988). The Turkana and Pokot pastoralists have evolved well-managed ecological strategies that enable them to use the vegetation on a sustainable basis through exploiting different economic niches (grazers, including cattle, sheep, and donkeys, and browsers, including camels and goats), as well as diversified food procurement strategies (Brainard, 1981 in Barrow, 1990). As described by Ellis et al. (1987, in Barrow 1990), these strategies include:

- Use of large diverse ranges;
- Access to productive dry season ranges, including trees;
- High mobility and low to moderate stocking rates;
- High to moderate stock units per person;
- Use of wild fruits and tree foods; and
- Low labour input, rain-fed or flood sorghum gardening.

Trees and other woody species are recognised by the people as being especially important because they can survive and produce even through the long dry seasons. Ethnobotanical knowledge reflects the extent of the dependence of local people on woody vegetation, which is used for dry timber for wood fuel and charcoal; building timber for houses, fencing, and thatching; food for livestock, particularly in the dry season; wild fruits and foods for people; veterinary medicines for a variety of livestock diseases; human medicines for a variety of diseases; making of household utensils; amenity for shade to act as a meeting place and a variety of cultural activities; water purification; and ceremonies (Barrow, 1990).

For the purposes of defining different groups of beneficiaries using ecosystem services affected by the Project, the following categories were set:

- Beneficiaries residing in Locations in West Pokot County adjacent to the Turkwel Dam, particularly fishers;
- Beneficiaries residing in Locations in West Pokot and Turkana County adjacent to the water pipeline, particularly sorghum farmers;
- Mobile pastoralists using the AoI on a transient basis; and
- Residents in Kochodin and Lokichar Locations that will host Project infrastructure.

6.10.2.2 Supply and Prioritisation of Services

The following sections provide some narrative around provisioning, regulating, cultural and supporting ecosystem services supplied in the AoI. As *Supporting* ecosystem services have no specific/direct beneficiaries, and impacts to these are captured within the *Provisioning, Regulating* and *Cultural* categories for the Project, they are not included in the prioritisation exercise.

The results of the prioritisation exercise for Type I and Type II ecosystem services are detailed in Annex I. Type I and Type II ecosystem services, and reasoning behind their classification as priority/non-priority ecosystem services are discussed in the following sections.

6.10.2.2.1 Provisioning Services

The AoI provides numerous priority provisioning ecosystem services for beneficiaries; in particular, grazing/browsing resources for livestock, wild foods, medicinal plants, firewood and charcoal, freshwater supply and construction materials for homes and livestock.

Food – Cultivated Foods

The Turkana have a strong tradition of sorghum gardens (*amana*, pl. *ngamanat*), which are planted during the rains and, if harvested, help supplement the pastoral diet (Barrow, 1988). In the AoI, sorghum is cultivated at various locations along the Turkwel River. The gardens close to the river are typically of two types, those at the high flood level where the soils are better, but there is a higher risk that a crop will not grow, and those lower down where the crop could be washed away by flood waters (Barrow, 1988). In traditional Turkana sorghum plots, a form of agroforestry is employed, whereby trees are not cut down and only the undergrowth is removed. The gardens are irrigated with water drawn from the Turkwel River.

Honey-producing beekeeping enterprises exist at sites along the Turkwel River (Kasitei sub-location). There, beekeeping is practised by approximately 3% of respondents, and is a form of livelihood for those beneficiaries (mostly men).

The cultivated crops and honey are a dietary and livelihood supplement and as such are important to beneficiaries' livelihoods and/or health. Beneficiaries are unlikely to have viable alternatives to this ES, being generally unable to source or purchase the same foods elsewhere; therefore, the ES is considered a Type I priority ES (Annex I).

Food – Grazing/Browsing Resources for Livestock

The Turkana practise transhumance, a type of pastoralism or nomadism in which livestock are moved seasonally between fixed summer and winter pastures (Barrow, 1988). Generally, the hilly western areas of Turkana County are much wetter than the rest of the county. Broadly, livestock (particularly cattle) are grazed in the lowlands after the rains to make use of the annual flush of grass. This may only last for a few months and then the stock will gradually move to the west and to the hills to make use of the dry season grazing and browsing areas. In the dry season, valuable dry season fodder in the form of pods and leaves from various trees, such as *Acacia tortilis* (English: umbrella thorn acacia; Turkana: *ewoi*) will be sought.

The ecosystem service forms an important dietary and livelihood supplement and as, such, is important to beneficiaries' livelihoods and/or health. Beneficiaries are unlikely to have viable alternatives to this ecosystem service, being generally unable to source or purchase the same foods elsewhere; therefore, the ecosystem service is considered Type I priority (see Annex I).

Food – Capture Fisheries

Communities surrounding the Turkwel Dam (Chepokachim Sub-Location) engage in fishing. Focus group responses indicated that they acquired these fishing skills from the Luo community who moved to the area at the time of the dam construction. Fishing is done for domestic consumption and if there are many fish, the excess is sold. This Ecosystem Service is not considered a priority for impact assessment.

Food – Wild Foods

A large variety of plant foods are collected from the vegetation communities throughout the AoI. Morgan (1981) identified 53 species of wild plants that are included in the Turkana diet. Parties of women harvest wild fruits from tree species, such as *Cordia sinensis* (English: grey-leaved saucer berry, Turkana: *edome*) and *Salvadora. persica* (English: mustard tree; Turkana: *esekon*). The most important wild food plants are *elim* (*Diospyros scabra*), *ekalale* (*Ziziphus mauritiana*), *ewoi* (*Acacia tortilis*), *eipa* (*Maerua oblongifolia*), and *eregai* (*Acacia reficiens*). *Eregai* is seen as particularly important because when this plant is plentiful, the livestock have enough to eat and, therefore, the people also have enough food and living conditions improve. In terms of priority, *ewoi* and *ekalale* are the most important trees for the Turkana, producing leaves and flowers for livestock and fruits for people during the dry season.

The importance of wild food products is evidenced by the effort that is taken to render some of them edible. For example, the fruits of *Balanites orbicularis*, *Boscia coriacea* (Turkana: *edung*) and *D. glabra* (Turkana: *edapal*) need to be boiled several times before they can be eaten (Morgan, 1981). The pods of the ubiquitous *Acacia tortilis* (English: umbrella thorn acacia; Turkana: *ewoi*) are collected and ground into flour known as '*apoonet*'.

Pollination is recognised as a priority *Regulating* ecosystem service because of the Turkana people's reliance on wild fruits and seed pods as a source of food for themselves and livestock (see Section 6.10.2.2.2 for discussion of Regulating services). Honey from wild bees is opportunistically collected in the rest of the AoI.

The use of wild animals for food is seen to be less important within the AoI. People interviewed in Nakukulas indicated that children may sometimes hunt and eat birds (such as *ekolsalalat* and *ekuri*), hares (*sungura*) and squirrels; however, adults do not eat these foods and instead largely eat goat meat. Nevertheless, dik-dik are taken opportunistically for food.

Wild foods are considered a priority ecosystem service, as availability will be affected as a result of reduced supply areas. They are an important component of beneficiaries' diets, and beneficiaries are unlikely to have viable alternatives to this ecosystem service, being generally unable to source or purchase the same foods elsewhere (see Annex I).

Medicinal Plants

As doctors, clinics and hospitals are mostly absent from the remote areas through which the Turkana move, medicinal plants are considered to be very important, both to the people and the livestock. The EOPS Phase II ecosystem services baseline (Golder, 2018d) listed 22 species as medicinal, whilst Morgan (1981) mentions 67 species used by the Turkana. Dependence on medicinal plants has not been quantified in this or the social baseline, but is believed to be high, with most stakeholders interviewed making mention of the use of an array of species for various purposes (Cultural Heritage baseline - Section 6.13).

Important species include *emus*, *echuchulka*, *amuroekile*, *elim* (*Diospyros scabra*), *locham* and *ekamongo* (*Leptadenia hastata*), which are variously used for treating stomach complaints, coughs and eye ailments, or as antiseptics and animal medicines. Some species, such as *esokon* (*Salvadora persica*) and *eipa* (*Maerua oblongifolia*) are used as toothbrushes and are harvested and sold by women in places such as Lokichar as a source of income. Medicinal plants appear to occur across all the vegetation communities identified in the AoI. No areas were identified as being of particular importance for the supply of medicinal plants during focus group meetings conducted as part of the ecosystem service prioritisation process.

Medicinal plants are considered a priority ecosystem service according to the Project impact, as their availability will be affected as a result of reduced supply areas, they are an important component of beneficiaries' health and safety, and beneficiaries are unlikely to have viable alternatives to this ecosystem service, being generally unable to source or purchase alternative traditional medicines or western medicines elsewhere (see Annex I).

Biomass Fuel (Firewood and Charcoal)

Household cooking is fuelled by firewood, usually collected by women, from already dead trees. As mentioned, the cutting down of trees for firewood or charcoal manufacture is generally not permitted; nevertheless, the use of timber for charcoal manufacture is likely putting pressure on trees. Research in the Turkana region has shown that, typically, once all of the dead firewood within walking/carrying distance of permanent settlements has been collected, people tend to revert to harvesting live trees within walking/carrying distance of their homesteads, resulting in a radius of deforestation extending around permanent settlements (Amyunzu, 1991;

Olang, 1982; Reid & Ellis, 1995). Information received during the 2016 cultural heritage baseline data-gathering programme suggested that there are penalties for anyone that cuts down a tree, particularly if the tree is *ewoi* (*Acacia tortilis*), *edung* (*Boscia coricea*), *esanyanait* (*Acacia elatior*), *ekalale* (*Ziziphus mauritiana*) or *esokon* (*Salvadora. persica*).

Biomass fuel is considered a priority ecosystem service according to the Project impact, as it's availability will be affected as a result of reduced supply areas, it is an important component of beneficiaries' livelihoods as well as their health, and beneficiaries are unlikely to have viable alternatives to this ecosystem service, being generally unable to purchase fuel elsewhere, In addition, the increased use of alternative sources of this ecosystem service could compete with existing users and exacerbate indirect effects on vegetation communities supplying this ecosystem service (i.e. habitat degradation) (see Annex I).

Biological Raw Materials (Construction Materials, Utensils, Ceremonial Articles, Animal Skins)

Many plants are used for construction of houses and shelter (Annex I). The most important are *eregai* (*Acacia reficiens*), *epetet* (*Acacia nubica*), *edung* (*Boscia coriacea*), and *ebucharatet*. Branches from *Salvadora persica* are used for construction of shelters, and *Hyphaene sp*. trunks are used as poles (Booth et al., 2016).

Wood from *edome* (*Cordia sinensis)* is used for making traditional carved sticks with curved heads, and *ekicholong* (*Commiphora* spp.) (Turkana seat/head rest). Wood from *Commiphora spp*. is used for making local cups and bowls for drinking, and *ekicholong* (Booth et al., 2015). *Hyphaene sp*. leaves are used for weaving baskets and mats, and making rope (Booth et al., 2015). *Ekalale* (*Ziziphus mauritiana*) branches are used for making bows and stools, as well as for, fencing. (Booth et al., 2015). All Turkana wooden utensils are constructed from the *ekurichanait* tree (*Delonix elata*), including plates (*atuba*), cups (*elepit*) and jugs (*aguarum*) (Booth et al., 2015). Animal skins are used in the fabrication of traditional Turkana clothing and their sale also forms a source of livelihood for pastoralists.

Biological raw materials are considered a priority ecosystem service according to the Project impact, as their availability will be affected as a result of reduced supply areas, they are an important component of beneficiaries' livelihoods (utensils, skins), health and safety (home construction) and culture (utensils, ceremonial articles). Beneficiaries are considered unlikely to have viable alternatives to this ecosystem service, largely due to uncertainty as to whether the use of an alternative source would compete with existing users, and whether the supply of the alternative resource could meet the needs of the affected beneficiaries (see Annex I).

Freshwater

As nomadic pastoralists, the Turkana obtain all freshwater from the environment via rainfall, wells and from rivers such as the Turkwel and Malmalte. Away from rivers, beneficiaries are traditionally reliant on using hand-dug wells in luggas as sources of drinking water; many hand-dug wells and installed wells are still in use. During the biodiversity baseline survey, migrating pastoralists were observed digging shallow wells in lugga sands shortly after a passing rainstorm.

Alternative water sources are provided for pastoralists by TKBV at points throughout the AoI via community water supply points.

Current water supply for oil production and consumption at Kapese Camp is provided from shallow wells drilled in nearby luggas.

This ecosystem service is considered a priority for Pastoralists and AoI community members, since the availability of freshwater for drinking may be affected by groundwater abstraction. There is a reliance of many beneficiaries in the AoI on TKBV supplied community water points, with no alternative sources of fresh water in similar quantity or quality available to those beneficiaries.

However, freshwater supply is not considered a priority ecosystem service for Turkwel Dam communities, since the Project is not expected to affect the ability of others to avail of this ecosystem service, as the abstraction of water from the Turkwel Dam is expected to have a negligible effect on the dam water levels and hence the availability of fresh water resources to those beneficiaries (see Annex I).

Table 6.10-2: Summary of Supply of Provisioning Ecosystem Services Within the AoI

Ecosystem Service	Supplying Ecosystem	Definition of Service
Provisioning		
Cultivated foods	■ *Acacia-Commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ The Turkana cultivate sorghum gardens (*amana* pl. *ngamanat*) on the floodplain of the Turkwel River. These gardens are irrigated with water obtained from the Turkwel River. ■ Beekeeping is practised by a small proportion of men along the Turkwel River (Kasitei sub-location) ■ The smoke from burning *Cordia sinensis* (English: grey-leaved saucer berry, Turkana: *edome*) wood is used as a preservative for milk (Tullow, 2016; Stave et al., 2007).
Food – Grazing/ browsing resources for Livestock	■ *Acacia-Commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Cattle, sheep, goats, camels, and donkeys graze and browse throughout the AoI based on seasonal patterns. ■ Riparian vegetation (leaves and seed pod litter) in the luggas provide a vital food source for livestock. ■ The riparian forests along the Turkwel and Malmalte Rivers are considered to be some of the most important dry season grazing areas for the Turkana people (Barrow, 1988). ■ Riparian vegetation in luggas provide shade for young goats and cattle. The luggas also are used as migration corridors by herders when moving between grazing areas and when moving to water.
Food – capture fisheries	■ Turkwel Dam	■ Fishing is done for domestic consumption and if there are many fish, the excess is sold (Focus group discussion, Chepokachim Sub-Location)
Food – wild foods	■ *Acacia-Commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Beneficiaries use various fruits and seeds (e.g. doum palm fruit), berries and wild honey as supplements to their staple diet (Watkins, 2010). ■ During the biodiversity baseline assessment (Section 6.9), children were observed catching fish along the vegetated margin of the Turkwel River. ■ Honey production takes place at various locations along the Turkwel River, including Kaputir village. Honey production is reliant on a readily available source of water and the flowers of trees and shrubs found in the riparian forests. ■ Opportunistic hunting of dik-dik, hares, ground squirrel, small birds for meat, mostly by children

Ecosystem Service	Supplying Ecosystem	Definition of Service
Medicinal plants	■ *Acacia-Commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Numerous medicinal plant species are used by the Turkana (Annex I). ■ Species include *Salvadora persica* (English: mustard tree; Turkana: *esekon*), which is used as a toothbrush (Figure 6.10-1); *Euphorbia turkanensis*, which is used as a treatment for cuts and burns; and *Euphorbia tirucalli* (English: pencil cactus), which is a poisonous species that can be used to induce abortion (TKBV driver, *pers. comm.* during biodiversity surveys). ■ *Vahlia viscosa* is used in the treatment of jaundice (Morgan, 1981). ■ Roots of *Salvadora persica* are used to treat malaria. The roots are soaked in water and then juice is drunk to prompt vomiting (Booth *et al.,* 2015).
Biomass Fuel	■ *Acacia-Commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Firewood is the primary energy source for cooking both traditional foods and purchased grain-based foods (e.g., maize meal, millet). ■ Charcoal production occurs throughout the AoI. The charcoal is mostly sold to generate income. Generally, however, the Turkana do not cut down trees because they are a valued resource with strong cultural ties. Therefore, charcoal tends to be produced from already dead trees or occurs in areas close to larger settlements.
Wood and fibre	■ *Acacia-Commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Thorny branches from various species, typically *Acacias*, are used in construction of temporary bomas for protecting livestock. ■ Wood from *Cordia sinensis* (Turkana: *edome*) is used for making traditional carved sticks with curved heads, and *ekicholong* (Turkana seat/head rest). ■ Wood from *Commiphora* sp. is used for making local cups and bowls for drinking, and e*kicholong* (Booth *et al.,* 2015). ■ Branches from *Salvadora persica* are used for construction of human shelters (Booth *et al.,* 2015). ■ *Hyphaene* sp. leaves are used for weaving baskets and mats and making rope; and trunks are used as poles for construction (Booth *et al.,* 2015). ■ *Ziziphus mauritiana* (English: Chinese date; Turkana: *ekalale*) branches used for making bows for arrows, and fencing (Booth et al., 2015). ■ *Delonix elata* (English: Creamy Peacock Flower, Turkana: *ekurichanait*) is used to make all Turkana wooden utensils, including plates (*atuba*), cups (*elepit*) and jugs (*aguarum*) (Booth et al., 2015).
Freshwater	■ Luggas	■ Away from rivers, drinking water is largely sourced from shallow groundwater supplies in luggas via hand-dug wells. During baseline biodiversity field surveys,

Ecosystem Service	Supplying Ecosystem	Definition of Service
	■ Turkwel and Malmalte Rivers ■ Groundwater	migrating pastoralists were observed digging shallow wells in lugga sands shortly after a passing rainstorm. ■ TKBV provides water to pastoralists at locations, including Ngamia 1. This water is derived from shallow wells in nearby luggas. ■ Villages that are situated close to rivers, such as Kaputir and Kainuk, obtain drinking water directly from the rivers. ■ Wells for the supply of drinking water (for stock and settlements) are available throughout the AoI.
Freshwater	■ Luggas ■ Turkwel and Malmalte Rivers ■ Groundwater	■ Freshwater for camp supply and current oil production is obtained from wells in nearby luggas, and will be pumped from the Turkwel dam to the Project via a buried pipeline

Figure 6.10-1: *Salvadora Persica* (English: Mustard Tree; Turkana: *Esekon*). The Fruit from this Tree is Eaten by the Turkana People Whilst the Roots are Used as Medicine and the Branches are Used as Toothbrushes.

6.10.2.2.2 Regulating Services

Regulating ecosystem services are not necessarily priority based in terms of the Project impact. However, many of the regulating services are important to the operation of the Project. The baseline regulation of water flow and timing, erosion control, filtering water and flow regulation are crucial to the Project efficacy over the short, medium and long term.

Regulation of Air Quality

Riparian forest, ephemeral stream woodland and *Acacia-commiphora* bushland/thicket vegetation may contribute to extraction of atmospheric chemicals (e.g., near roadways).

The Project is unlikely to push the regulation of air quality across a sustainability or regulatory threshold, and emissions are expected to be within the standards required by the IFC. This ecosystem service is not considered to be in short supply relative to demand in the AoI, given the baseline of very little industrial or commercial enterprises in the area. Regulation of air quality is therefore not considered to be a Type I priority ecosystem service in terms of Project impact for this assessment.

However, stakeholders might perceive that the Project could affect air quality, in which case the Project would be reliant on this ecosystem service to continue to be maintained throughout its lifetime to maintain its social license to operate, making regulation of air quality a Type II priority.

Regulation of Water Flows and Timing

The Project footprint crosses numerous luggas and ephemeral streams. These hydrological systems regulate water run-off, influence groundwater recharge, and maintain the water storage potential of the landscape. In particular, riparian forest, ephemeral stream woodland and the sandy lugga substrate contribute to the retention of water and regulation of water quality during dry seasons when rainfall is limited.

Regulation of water flows and timing is not considered a priority ecosystem service, as the Project will not impact on the supply of this service, as effects on this service by the Project land take will be mitigated successfully by incorporated design measures as well as those measures used to mitigate effects on water quantity (see Section 7.3).

This ecosystem service is considered a Type II priority as the Project is reliant on the ongoing provision of this service to continue to be able to abstract its water requirement from groundwater, as well as year round from the Turkwel Dam and has no viable alternative to this ecosystem service.

Regulation of Disease

The arid, desert environment limits the availability of suitable conditions for malaria vectors. Although this is an important ecosystem service, it is not considered priority in terms of the Project impact, as the Project is unlikely to push the regulation of disease across a sustainability or regulatory threshold, and the extent of loss of the chief supplying ecosystem (Acacia-commiphora bushland/thicket) is negligible in the context of the available resource in the AoI.

Soil Stability and Erosion Control

Vegetation clearance for the Project may increase the vulnerability of the surrounding soils to the erosive forces of wind and floods. However, erosion-related mitigation measures and environment management plans are expected to be adhered to during construction and operation of the Project infrastructure; therefore, the Project is not expected to impact on this ecosystem service in such a way that the ability of others to benefit from this service would be affected. Therefore, this ecosystem service is not considered a priority for this assessment.

Pollination

All beneficiaries of food-based provisioning services are reliant on pollination of the plant species that produce wild foods eaten by people and/or provide grazing/browsing opportunities for livestock, as well as pollination of subsistence crops so that seeds can be harvested and used for the following season's planting.

The Project is unlikely to significantly impact any pollinator species (bees, birds, bats) and so this ecosystem service is not considered Type I priority based on the Project impact.

Table 6.10-3: Summary of Supply of (Regulating) Ecosystem Services Within the AoI

Ecosystem Service	Supplying Ecosystem	Definition of Service
Regulating		
■ Regulation of air quality	■ *Acacia-commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Leaves of trees, shrubs and forbs trap air pollutants, especially near permanent settlements, and along roadsides.
■ Regulation of water flows	■ *Acacia-commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ The AoI spans the Turkwel, Kalabata, Kerio, Turkwel Dam Basin and Malmalte River catchments. These hydrological systems regulate water run-off, influence groundwater recharge, and maintain the water storage potential of the landscape. ■ Riparian vegetation and sandy luggas retain water and regulate water quality during dry seasons when rainfall is limited.
■ Regulation of disease	■ *Acacia-commiphora* bushland/thicket	■ The arid, desert environment limits the availability of suitable conditions for malaria vectors.
■ Soil stability and erosion control	■ *Acacia-commiphora* bushland / thickets ■ Riparian forest ■ Ephemeral stream woodland	■ Vegetation cover within the AoI reduces soil loss and prevents erosion.
■ Pollination	■ *Acacia-commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Local people and their livestock are seasonally reliant on the pods of *Acacia* spp. for food, and the fruits produced by many other species. ■ Users of grazing resources and gatherers of edible plants are reliant on pollination services for the maintenance of vegetation communities and associated resources.

6.10.2.2.3 Cultural Services

Cultural ecosystem services can be defined as the connectedness that individuals derive from natural or cultivated ecosystems, or indeed educational and inspirational values. Cultural ecosystem services are often intangible.

Spiritual Values

Intangible value from ecosystem services is derived from the natural setting and the trees that support a traditional way of life. Each settlement has traditional elder trees that are important meeting points. Trees are vital to the Turkana way of life, and the importance of trees is strongly expressed culturally. People and places are named after trees, shady trees act as meeting places, trees provide traditional medicine. Trees also play a vital and integral role in many initiation ceremonies, such as birth, marriage and various feasts (Barrow, 1988). Trees that have important cultural associations cannot be cut down without serious consequences.

Edung (*B. coricea*) is key in Turkana community cultural life. During initiation ceremonies, the seeds are boiled for several hours and used to seal the process through being eaten by the elders presiding over the initiation as a sign of final blessing to the initiates. The same is true for marriage ceremonies and when a mother has given birth. In both cases *edung* is consumed as the final meal served to the elders and the mother when she is ready to come out of seclusion from the home.

Construction activities and the presence of the Project in the landscape will affect beneficiaries' sense of heritage and identity and disturbance of their surroundings. There is no alternative to this ecosystem service and, as such, it is considered a Type I Priority. In addition, the Project could be reliant on the availability of this ecosystem service remaining constant throughout its lifetime in order to maintain its social license to operate, so this ecosystem service is also considered a Type II Priority.

Education and Inspirational Values

The Turkana landscape inspires folklore and contributes to beneficiaries' sense of heritage and identity. The landscape lends itself to the entire Turkana way of life, including the practising of pastoralism and the passing of knowledge on seasonal grazing patterns from generation to generation.

Construction activities and the presence of the Project in the landscape will affect beneficiaries' sense of heritage and identity. There is no alternative to this ecosystem service and, as such, it is considered a Type I Priority. In addition, the Project could be reliant on the availability of this ecosystem service remaining constant throughout its lifetime in order to maintain its social license to operate, so this ecosystem service is also considered a Type II Priority.

Recreation

The Turkwel River is used by children and adults for swimming, play and bathing purposes. As no impact on the quantity of water in the Turkwel Dam or downstream due to the Project water abstraction is anticipated, this this ecosystem service is not considered Type I priority on the basis of the Project impact.

Table 6.10-4: Summary of Supply of (Cultural) Ecosystem Services Within the AoI

Ecosystem Service	Supplying Ecosystem	Definition of Service
Cultural		
■ Spiritual values (Sacred trees)	■ *Acacia-commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Trees are vital to the Turkana way of life and play a pivotal role in cultural practices. ■ Cultural sites include the trees (particularly *Maytenus* sp.) beneath which the men of the community and elders gather to discuss community issues, politics, marriages, community affairs. It is taboo for women to sit beneath these trees. Cutting of these trees is also not permitted. ■ Initiation ceremonies for boys occur at certain locations in the AoI.

Ecosystem Service	Supplying Ecosystem	Definition of Service
		■ Important trees including *Acacia tortilis* (English: umbrella thorn acacia; Turkana: *ewoi*), *Hyphaena coriacea* (English: Lala palm), *Cordia sinensis, Ziziphus mauritiana, Dobera glabra* (Turkana: *edapal*) and *Faidherbia albida* (English: Ana tree) are particularly protected by custom (Barrow, 1986; Soper, 1984).
■ Educational and inspirational	■ *Acacia-Commiphora* bushland/ thicket ■ Ephemeral stream woodland ■ Riparian forest	■ The Turkana landscape inspires folklore and contributes to beneficiaries' sense of heritage and identity. ■ People are named for the place where they were born, e.g. under the big Acacia by the lugga
■ Recreation	■ Turkwel River	■ During the field visits conducted for the biodiversity baseline (Section 6.9), children were observed swimming and playing, and men bathing in the Turkwel River near to Kaputir.

6.10.2.2.4 Supporting Services

Supporting ecosystem services provide living spaces for, and maintain the diversity of plants and animals, and thereby provide the basis of all ecosystems and their services (FAO, 2019). Supporting ecosystem services provided in the AoI include primary production, and sustainable water cycling.

Since *Supporting* ecosystem services have no specific/direct beneficiaries, and impacts to these are captured within the *Provisioning, Regulating* and *Cultural* categories for the Project, they were not included in the prioritisation exercise, and are simply summarised here for completeness.

Table 6.10-5: Summary of Supply of (Supporting) Ecosystem Services Within the AoI

Ecosystem Service	Supplying Ecosystem	Definition of Service
Supporting		
■ Nutrient cycling / primary production	■ *Acacia-commiphora* bushland/thicket ■ Riparian forest ■ Ephemeral stream woodland	■ Throughout the AoI, these ecosystems provide grazing and browsing resources for livestock and wildlife. ■ Riparian habitats support crop production along its banks through provision of water and rich alluvial soils
■ Water cycling	■ Luggas ■ Riparian forest ■ Turkwel catchment and lake Turkana ■ Ephemeral stream woodland	■ Non-perennial luggas direct surface water flow during times of high rainfall toward the various catchments. ■ Riparian habitats throughout the AoI play a part in sustainable water cycling. ■ The Turkwel and Kalabata catchments form major components of the regional hydrological cycle.

6.10.2.3 Landcover Classification and Ecosystem Services Supply

Based on the landcover classification that was conducted for biodiversity baseline (Section 6.9) and the priority ecosystem services identified above, levels of ecosystem service provision (high, moderate and low) were assigned to specific vegetation communities (as defined in Table 6.10-6). The landcover classification did not cover the entire AoI but focussed more specifically on the Project footprint. The levels of priority ecosystem service provision within the AoI are presented in Figure 6.10-2, which shows high levels of ecosystem service provision occur in the Ngamia and Amosing areas. This is due to the vegetation communities in these areas. The highest level of ecosystem service provision is found along the Turkwel and Malmalte Rivers. Ecosystem service is low in the northern portion of the AoI and in the area between Lokichar and the Turkwel River. This is due to drier conditions and the scarcity of large trees in these areas. The riparian vegetation communities in these areas are dominated by the shrubby *Acacia reficiens*, whereas the luggas in the Ngamia and Amosing areas and along the Turkwel and Malmalte Rivers are dominated by taller *Acacia tortilis* and mixed Acacia communities.

Table 6.10-6: Level of Priority Ecosystem Service Provision Within the Aoi, Based on Landcover Classification

Land cover classification	Linked ecosystems	Level of Provision of Priority Ecosystem Services
▪ Acacia and mixed acacia riparian vegetation (luggas) ▪ Cultivated lands	Riparian forest Ephemeral stream woodland Turkwel, Malmate Rivers	High
▪ Arid woodland / grassland ▪ Mountain bush	*Acacia-commiphora* bushland/ thicket	Moderate
▪ Plain desert shrubland ▪ Non-vegetated areas ▪ Mountain shrub and grassland	*Acacia-reficiens/sanseveria/ Boswellia* woodland/ bushland/ shrubland / thicket	Low

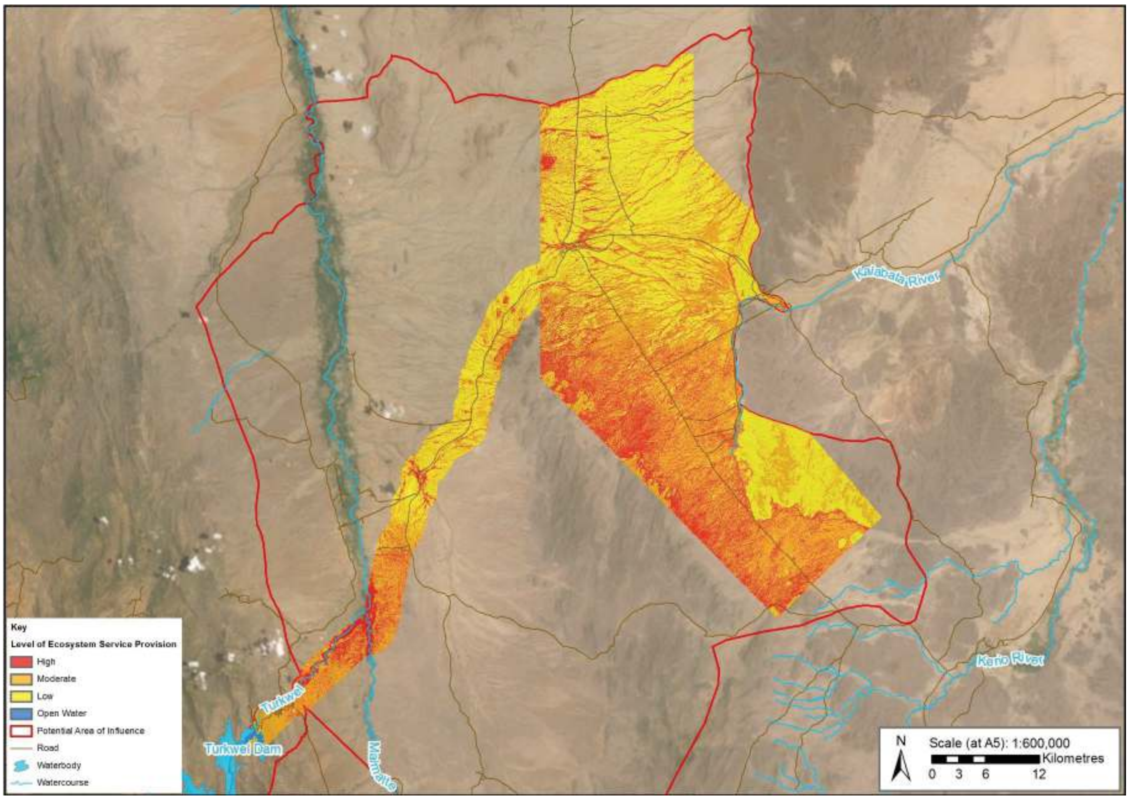

Figure 6.10-2: Level of Provision Of Priority Ecosystem Services Based on Landcover Classification

6.11 Landscape and Visual

6.11.1 Introduction

The landscape and visual baseline desk study has been undertaken to:

- Establish the key characteristics of the landscape and their relative sensitivity within the AoI; and
- Assess the visual baseline by characterising baseline visibility from key locations within the AoI.

The methodology employed for this assessment is primarily based on UK guidance (GLVIA, 2013), in the absence of Kenyan Legislation. The study has used a Landscape and Visual Assessment Area (LVAA) to ascertain the area from which infrastructure associated with the Project may be visible.

6.11.2 Secondary Data

The following resources were used for the assessment:

- The following aerial imagery used to analyse the terrain and landscape features:
  - Pleiades, 0.5 m resolution, date of capture: December 2016;
  - Pleiades, 0.5 m resolution, date of capture: February 2015: and
  - Aerial Imagery, 1.0 m resolution, date of capture: 2018;
- A virtual landscape created using numerous topographic datasets supplied by TKBV and analysed to provide the most realistic representation of the landscape[24]:
  - 1 m DTM (Digital Terrain Model) – sourced from the Pleiades Satellite. Date of capture: 1 April 2015;
  - 10 m DTM – sourced from the Prism Satellite. Date of capture: 20 March 2014; and
  - 90 m SRTM (Shuttle Radar Topography Mission) Topography – sourced from National Aeronautics and Space Administration (NASA) on 9 December 2002;
- Baseline Vegetation/land-cover of Turkana Project Area generated using Sentinal-2 satellite imagery at a 10 m resolution;
- Protected Area dataset from IBAT supplied by TKBV, November 2018;
- The following Points of Interest (PoI) sourced from Visit Turkanaland website (January 2019), County Government of West Pokot website (March 2019) and KWS (March 2019) to determine potential receptor locations of visitors, tourists and travellers to the region:
  - Rift Valley, also known as the Great Rift Valley, spans over 6,000 km. It contains a mosaic of landscapes, including lakes, volcanoes, coral rifts, mountains and wide valley plains. It is famous for humanoid remains found near Lake Turkana. Tourism in the areas includes safaris, hiking, golfing and walking;
  - Lake Turkana National Parks World Heritage Area, encompasses the Northern Island, Central Island of Lake Turkana and the adjacent Sibilioi National Park. Central supports varied wildlife including Egrets, Stocks and Cormorants;

[24] No Digital Surface Models (DSM's) were used in the Geographical Information System (GIS) analysis due to lack of landscape coverage. DSM's are topographic coverages containing all elements of the landscape, including vegetation and trees

- The South Turkana NR is characterised by a savanna rangeland ecosystem, and supports a variety of wildlife including Elephant, Buffalo, Gazelle and Warthog (Edebe et al., 2010);
- The Nasolot NR is a remote reserve situated in a rugged and mountainous location, located north of Mount Melo. The reserve supports a variety of important wildlife including Elephant, Lion, Leopard, Spotted Hyena, Buffalo and Hippo (KWS, 2019); and
- Turkwel Gorge Reservoir and Dam is located on the Turkwel River and serves several purposes to include hydroelectric power production, irrigation, tourism and fisheries.

Protected areas and PoIs are presented in Figure 6.11-1.

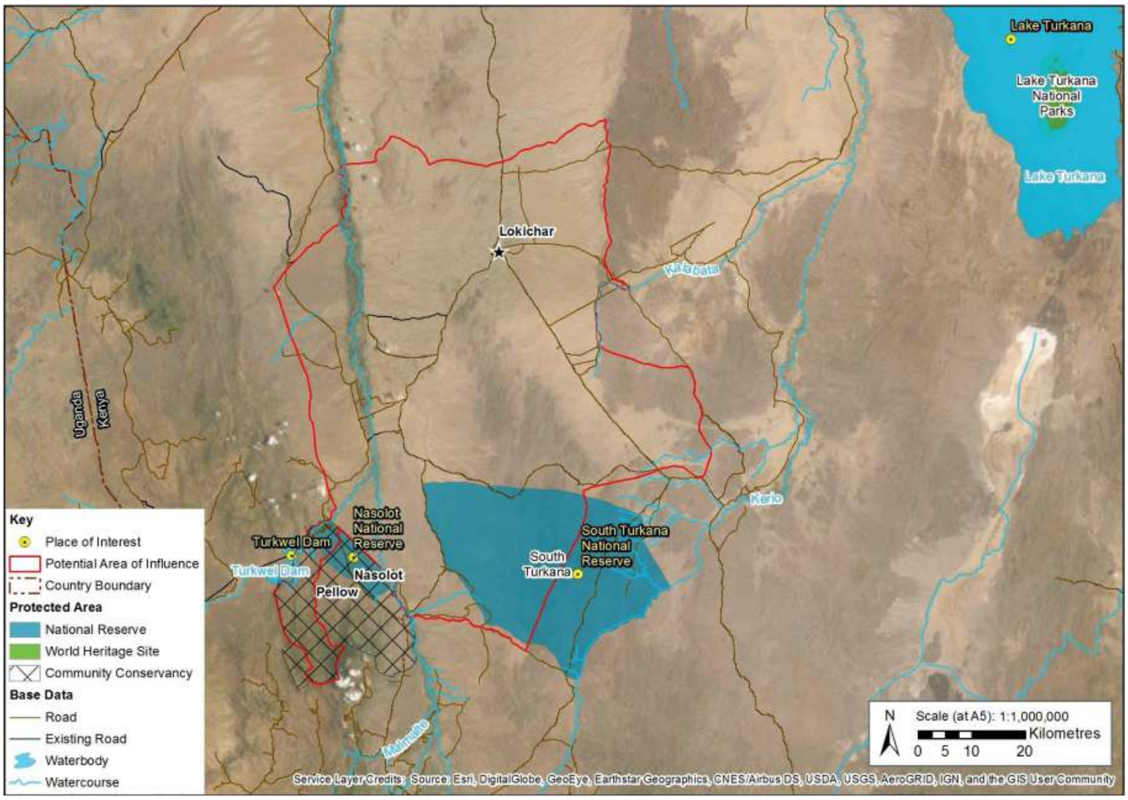

Figure 6.11-1: Points of Interest

6.11.2.1 Methods

Landscape Character

It is a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another. The landscape assessment is a process of identifying and describing variation in the character of the landscape.

Areas displaying similar characteristics are referred to as 'Landscape Character Areas' (LCAs). LCAs are made up of recognisable patterns or elements (physical and perceptual) that occur consistently in a particular area and define its character, or 'sense of place'.

The process of assessing the landscape character was based on a review of available aerial photography and topographical maps as well as previous studies, in terms of:

- Natural elements;
- Human-made elements;
- The topographical character of the site and its surroundings and potential occurrence of landform;
- Features of interest;
- The presence of water bodies;
- The general nature and level of disturbance of existing vegetation cover; and
- The nature and level of human disturbance and transformation evident.

ArcGIS 10.4.1 was used to process the data to determine the landscape character. The terrain datasets were used to create a realistic terrain within the LVAA. The DTMs were mosaicked to produce a 5 m cell resolution coverage of the LVAA. The landscape characterisation was digitised using the baseline vegetation and landcover dataset.

Visual

Secondary data was assessed for the following within the AoI during an initial desk-based review, to ascertain the baseline visual characteristics:

- Settlements and homesteads;
- Luggas and vegetation types forming riparian habitat;
- Access routes, such as roads and trackways;
- Artificial lighting; and
- Terrain characteristics.

6.11.3 Primary Data

The LVAA comprises the area from which infrastructure associated to where the proposed development may be visible.

6.11.3.1 Visual Methods

An initial visual analysis was to create a preliminary zone of theoretic visibility (ZTV) to inform the photo capture locations for baseline characterisation. Then during three field surveys between 2017 and 2019, photographs were taken from a selection of representative field viewpoints. Photographs were taken during the following field visits:

- In June and July 2017 in the Ngamia and Amosing areas;
- In April 2018 in the area between South Lokichar and the Turkwel Dam; and
- In April 2019 for the TAN areas.

6.11.4 Results

6.11.4.1 Landscape Character

The elevation of the LVAA ranges from 635 masl to 1,300 masl. The Turkana region is predominantly flat sandy desert intermingled with scattered scrub and thicket increasing to denser scrub and thicket on the alluvial rivers, plains and hills. Several settlements are located within the area, ranging in size from permanent major settlements such as Lokichar, to standalone, homesteads which are scattered across the landscape.

LCA boundaries do not necessarily indicate an abrupt change in landscape characteristics; the transition between the different areas may be gradual, especially the boundaries between the undulating scrub bushland LCA and the dense bushland scrub LCA. These categorisations are not related to whether habitats are natural or modified.

The sensitivity of the landscape was assessed in relation to its capacity to accommodate change without unacceptable adverse effects on the existing landscape character. The extent to which a landscape can accept such change is dependent on the physical characteristics of the landscape and the scale and nature of the change.

Four LCAs were identified within or adjacent to the LVAA. Figure 6.11-2 presents the LCAs:

- LCA 1 – Semi-desert:
  - Defined by a broad sandy plain with scattered stunted bushland and ephemeral streams. Vegetation is generally characterised by low shrub and stunted bushland. Occasional luggas lined by riparian vegetation. The land use of the area is generally used for rough grazing by livestock.
- LCA 2 – Dense bushland:
  - Defined by an increased density of vegetative growth in the southern and western hills, occurring on rocky, laval hillsides, consisting of low shrub cover with a few emergent bushes, the LCA occupies the southern extent of the LVAA. Acacia/Commiphora deciduous bushland and thicket contains average vegetation heights of up to 4 to 5 m.
- LCA 3 – Rocky Habitat/Stunted Bushland:
  - Defined by sparse cover of shrub species found on the eastern, southern and western hills. The area comprises rocky outcrops of up to 1,100 m, with minimal human and fauna activity.
- LCA 4 – Alluvial woodland:
  - This area is defined by the extent of the floodplain of the watercourses, namely the Turkwel River, Malmalte River and Kalabata River. The riparian forest is dominated by *Acacia tortilis* with heights reaching 4 to 5 m. Wooded ephemeral streams contain a high diversity of trees and shrubs, reaching heights of up to 8 to 12 m. As a result, the views in this LCA are characteristically limited due to the density of riparian woodland.

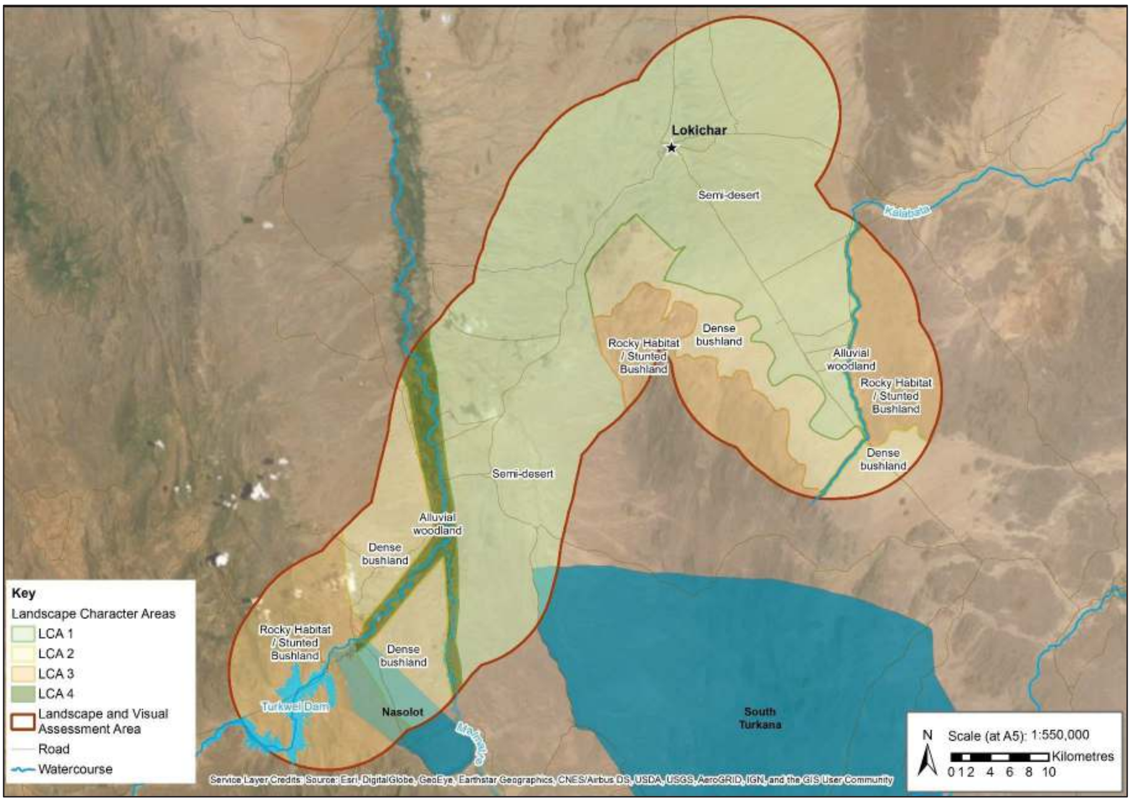

Figure 6.11-2: Landscape Character Areas Within the LVAA

6.11.4.2 Visual Baseline

Eighteen viewpoints were identified to cover the LVAA and to provide a representative sample of the landscape and typical views experienced by the local population.

Table 6.11-1 presents results from field survey work in June and July 2017, April 2018 and March 2019. Photographs and locations of photographs are presented in Drawings 6.11-1 to 6.11-4, as indicated in the table footnotes.

Table 6.11-1: Baseline Photo Representative Location

Photo Location	Location Description
T-1 [(a)]	■ The photo was taken in an easterly to southerly direction. ■ The line of sight contains scattered trees and low-lying vegetation. The topography is flat to slightly undulating.
T-2 [(a)]	■ The photo was taken in an easterly to southerly direction. ■ The line of sight contains scattered trees and low-lying vegetation, with a wide lugga corridor dissecting the line of sight. The topography is flat to slightly undulating.
N-1 [(b)]	■ The photo location occurs at 415 masl. The photo was taken in a southerly direction. ■ The photo conveys scattered to dense trees with sparse undergrowth.
N-2 [(b)]	■ N-2 displays the scattered shrub and extensive low-lying undergrowth and scattered tall trees. It has an elevation perspective at 746 masl. ■ The line of sight displays trees on the horizon line.
N-3 [(b)]	■ The photo location occurs on an elevation of 752 masl. ■ The vegetation is sparse with trees dissecting the line of sight in the foreground and in the background.
N-4 [(b)]	■ The location occurs at an elevation of 681 masl. ■ The overlying vegetation is sparse, the horizon line is dissected with scattered trees.
N-5 [(b)]	■ N-5 occurs at a distance of 525 m from NG-1. It was visible in the viewshed analyses. The photo location occurs at an elevation of 528 masl. ■ The overlying vegetation is sparse, the horizon line is dissected with scattered trees.
N-6 [(b)]	■ The location occurs at an elevation of 725 masl. ■ Trees follow a lugga corridor and form the view from the location.
N-7 [(b)]	■ The location is at an elevation of 731 masl. ■ The vegetation is scattered shrub.
N-8 [(b)]	■ The photo location occurs at an elevation of 765 masl. ■ The line of sight is heavily dissected in both the foreground and the background with trees.

Photo Location	Location Description
N-9 [b]	■ The location was taken in a westerly to north-easterly direction, at an elevation of 731 masl. ■ The foreground has sparse vegetation, a line of trees along a lugga corridor fill the horizon view.
A-1 [c]	■ The location occurs on an elevation of 705 masl. ■ The landscape is dissected by scattered trees, grading into a dense cluster in the background and horizon.
A-2 [c]	■ The location occurs on an elevation of 726 masl. ■ It displays a line of lugga trees grading across to more scattered trees and shrubs. Low-lying hills form in the partial line of sight. ■ A collection of homesteads was evident at the time of the visit.
A-3 [c]	■ The location occurs on an elevation of 730 masl. ■ The photo was captured in an easterly direction. ■ A collection of homesteads was evident at the time of field survey.
A-4 [c]	■ The photo was taken in a northerly direction, at an elevation of 723 masl. ■ A lugga dissects the view line.
A-5 [c]	■ Location occurs on an elevation of 700 masl. ■ Tall trees dissect the line of sight in the foreground with a further line of trees grading in the background to the horizon. The photo location occurred is beside the lugga.
A-6 [c]	■ The photo displays a sparse landscape, with few trees in the vicinity. Tall trees from the line of line to the horizon.
A-7 [c]	■ The location was taken from the A1 Lokichar road, facing in an easterly direction. The road comprises a bare earth track.
WPL-a to WPL-l [d]	■ Cluster of photographs displaying landscape in Turkana, with dense bushland characteristics.

(a) Location of photograph and photograph image is presented in Drawing 7.11-1
(b) Location of photograph and photograph image is presented in Drawing 7.11-2
(c) Location of photograph and photograph image is presented in Drawing 7.11-3
(d) Location of photograph and photograph image is presented in Drawing 7.11-4

6.11.5 Discussion

This baseline presents the following key landscape and visual findings in the LVAA:

- The terrain is generally flat in the LVAA, with the exception of several elevated positions across the landscape. These are particularly associated with LCA- 3 (Rocky Habitat/Stunted Bushland near Lokichar and the Turkwel Dam, offering open panoramic views of the surrounding areas, with greater exposure to potential development facilities.
- Natural barriers of existing dense vegetation and trees exist along the ephemeral luggas and the riparian forests of the Malmalte and Turkwel Rivers, which offer a natural barrier to visibility throughout the LVAA.
- Where vegetation is not present, the area is generally comprised of open sandy plains (with some scattered stunted bushland), presenting dust potential from vehicle movements and construction activities.
- Land use is largely formed of undesignated open plains, used by nomadic pastoralists and for rough grazing by livestock. However, several PoIs are located within the LVAA, namely Turkwel Dam, Nasolot NR and South Turkana NR, which are key character feature points; the latter two of which are nationally designated protected areas.
- Settlements are scattered throughout the LVAA and predominantly comprise of semi-permanent, individual residential dwellings of simple construction (homesteads), larger concentrated settlements and permanent major settlements (e.g. Lokichar).
- Roads in the LVAA are generally formed of compacted bare earth tracks, with the exception of stretches of tarmacked surfaces on the A1 road, which passes down from Lokichar towards Kainuk.
- With respect to artificial lighting, minimal light pollution occurs within the LVAA as the area does not have a built-up nature. Existing facilities at Kapese base present some night-time lighting within the camp area. Further light sources are located at Lokichar; the nearest urban centre to the Project facilities, which is located approximately 7.5 km to the south-west of the Twiga oil field.

6.12 Social

The socio-economic baseline comprises nine sub-categories:

- Administrative divisions and governance structure;
- Demographics;
- Infrastructure and services;
- Economics and livelihoods;
- Land use and ownership;
- Community health and safety;
- Education;
- Social maladies; and
- Social capital, security and conflict.

6.12.1 Methods

6.12.1.1 Secondary Data - General Socio-Economic Data

A wide range of secondary material has been gathered and consolidated between 2015 and early 2019. This includes printed resources available from the GoK and reports by NGOs, and multi-lateral organisations such as the United Nations (UN) and other development organisations. Where possible, quantitative information has been collected from organisations such as the Kenyan NDMA. During fieldwork, researchers have also sought to collect printed data directly from key informants that have been interviewed.

Golder has also reviewed and drawn on data and information collected by TKBV and other consultants as part of Exploration and Appraisal activities.

Secondary material for all social baseline topics is referenced throughout the baseline, a full list of references cited is included as part of the ESIA.

6.12.1.2 Secondary Data – Community Health

The approach used that describes the baseline health status in relation to the proposed Project was based on an approved methodology endorsed by the IFC that supports the IFC Performance Standards on environmental and social sustainability. This approach uses 12 Environmental Health Areas (EHAs) to support the systematic analysis of health. It provides a variety of biomedical and key social determinants of health (WBG, 2009). In addition, the IPIECA updated guidance on health impact assessment in the oil and gas industry was used as this provides specific guidance to the upstream industry.

The desktop review for community health focused on the national, county and (where available) local level secondary health literature in the public domain. The desktop work was used to describe the broad health status of the population in the region, based on a systematic review of the 12 EHAs.

6.12.1.3 Primary Data - General Socio-Economic Data

Field visits to West Pokot and Turkana Counties have been completed as part of the socio-economic baseline data gathering for the the Project.

A preliminary scoping visit took place in May 2015, which included brief travel to Turkana but was limited to collecting only data supplied by TKBV.

In June 2016, the field work campaign was initiated with a two-day workshop held by Golder, bringing together the different social baseline data gathering teams for the general socio-economic research, community health and safety, and security and conflict sub-categories. The objective of the workshop was to align research objectives and plan for Key Informant Interviews (KIIs) and focus group discussions. After the workshop, the socio-economic research team trialled semi-structured questionnaires during KIIs and focus groups. Eight trial interviews were conducted, which allowed for adjustments in semi-structured questionnaires and research approaches.

Following the trial interviews, primary data collection took place during five field visits between 2016 and 2019.

- The first 15-day trip took place from 22 June to 5 July 2016. Two teams conducted a total of 54 meetings with government officials, NGOs, Civil Society Organisations and residents living near TKBV operations. The meetings sought to get information primarily from the administrative units that are most likely to be affected by the Project. However, comparative information was also collected from government officials from those administrative units farther away in Turkana County, who are unlikely to be directly affected, as well as with NGOs and representatives of development organisations with a broader understanding of the entire county and neighbouring counties in Kenya. This comparative data and information are useful in understanding socio-economic trends in other parts of the County to compare with those areas closest to the AoI.
- During the first week, both teams focused on KIIs and focus groups located in the Turkana County capital, Lodwar. Researchers sought a balance of national and county government officials and ministries. Lodwar is also the main office location for many of the international NGOs and regional civil society organisations (CSOs) with a regional mandate in Turkana. During the second week, the two teams separately travelled to the Sub-county centres of Lokichar in Turkana South Sub-county and Lokori in Turkana East Sub-county.
- The second trip consisted of a specialised team focusing on security and conflict issues. The team travelled extensively in Turkana and West Pokot Counties, paying particular attention to border areas, migration corridors and areas of historical tension between the two ethnic groups. Between 27 July and 9 August 2016, 17 meetings were held and included KIIs with government officials responsible for security focus group discussions with traditional leadership and elders.
- A trip that took place from 10 to 19 May 2017 sought to fill critical gaps in baseline information from the initial fieldwork. One research team conducted 25 additional KIIs.
- Once the preferred option for the source of Project water was identified, Golder conducted a scoping level study for the proposed water supply pipeline from the Turkwel Reservoir to the proposed location of the CPF in South Lokichar, from 13 to 20 April 2018, a multi-discipline team travelled the pipeline route. Specific social objectives included holding discussions with settlement representatives to identify potential culturally sensitive sites in the pipeline corridor, to review potential PAP along the route and to identify potential concerns with pipeline construction.
- A trip was undertaken from 24 January to 5 February 2019 to update information on Turkana County and expand qualitative research to areas of West Pokot. Three research teams conducted 72 KIIs or focus group meetings.

- In April 2019 an additional trip was completed with a primary objective of mapping traditional leadership for engagement. However, KIIs and focus group meetings during this trip have contributed additional information.
- In June 2019, a final research trip was undertaken from 11 to 15 June to further investigate aspects of West Pokot. One research team conducted 12 primary research meetings.

The following limitations were encountered during primary general socio-economic data gathering:

- Secondary data for both Counties, especially data at a Sub-county level, was difficult to obtain. This was due to the relative remoteness of the areas, historical marginalisation from other parts of the country and the nature of pastoralist livelihoods that makes the collection of demographic and other data difficult;
- Administrative units have changed as a result of the new Kenyan Constitution;
- Government administrative units and traditional governance units are often inconsistent, which can compromise collection of primary data; and
- Many administrative units have the same name (e.g., Lokichar *Division*, *Location*, *Sub-location*, *Settlement* and *Ward*), and data sources do not always explicitly state which administrative unit they refer to.

6.12.1.4 Primary Data - Land

Primary baseline data relating to land use in areas affected by the Project footprint was collected between 2015 and 2019 by TKBV, Golder and AECOM, involving a combination of field survey work engagement with communities and stakeholders and desk-based analysis of aerial imagery. This work aimed to identify which areas of land are used by members of the nearby settlements, for what purposes, where people live and graze their livestock or use land for other activities, and how locations of habitation and land use change over time, including in different seasons. The baseline field surveys and analysis of aerial imagery covered the Project footprint in the gazetted[25] the TAN field areas and is listed in Table 6.12-1:

Table 6.12-1: Land Baseline Data Gathering

Area	Lands Baseline survey work
Twiga field area	■ November 2015: baseline survey of a larger area encompassing the Gazetted Twiga field area, incorporating analysis of aerial imagery; ■ November 2018: baseline survey of the Gazetted Twiga field area, incorporating analysis of aerial imagery taken February 2018; and ■ July 2019: baseline survey of the Gazetted Twiga field area.
Ngamia field area	■ November 2015: survey of “Zone C” which covered a northern part of the Ngamia field area, incorporating analysis of aerial imagery; ■ December 2015: survey of Ngamia field area, covering 90% of the Gazetted Ngamia field area, incorporating analysis of aerial imagery; ■ March 2016: survey of 3 km radius around Ngamia 8 wellpad, covering additional parts of the Ngamia field area to the Dec 2015 survey; ■ September 2016: EOPS Phase II baseline data survey of areas around Ngamia 1, Ngamia 3 and Ngamia 8 wellpads, covering 20% of the Gazetted Ngamia field area; ■ May 2017: EOPS Phase II baseline data survey of areas around Ngamia 1, Ngamia 3 and Ngamia 8 wellpads, covering 20% of the Gazetted Ngamia field area;

[25] Gazettement of the TAN field areas took place on February 2019.

Area	Lands Baseline survey work
	■ November 2018: baseline survey of whole of the Gazetted Ngamia field area, incorporating analysis of aerial imagery taken February 2018; and ■ July 2019: baseline survey of whole of the Gazetted Ngamia field area.
Amosing field area	■ November 2015: covered larger area including the Gazetted Amosing field area, incorporating analysis of aerial imagery; ■ September 2016: EOPS Phase II baseline survey which covered 16% of the Amosing field around the Amosing 1 wellpad; ■ May 2017: EOPS Phase II baseline survey which covered 16% of the Amosing field around the Amosing 1 wellpad; ■ November 2018: baseline survey of whole Amosing field area, incorporating analysis of aerial imagery taken Feb 2018; and ■ July 2019: baseline survey of the Gazetted Amosing field area.
Interconnecting flowline routes between fields	■ July 2019 baseline survey of interconnecting flowlines; and ■ Analysis of aerial imagery (early 2018 and July 2019) of interconnecting routes.
Water pipeline route	■ Analysis of aerial imagery (early 2018 and July 2019) of water pipeline route. Water pipeline scoping study field visit along the pipeline route. In April 2018 which included high level review of potential PAP.

The methodology for the baseline field surveys involved the following:

- Field areas were divided into 500 m x 500 m grid squares;
- Satellite/ Light Detection and Ranging (LiDAR) images were examined to identify signs of recent animal shelters and homesteads;
- GPX[26] files on field areas were loaded onto handheld Global Positioning System (GPS) devices for use in the field;
- TKBV Social Performance Team (SPT) representatives contacted Location or Sub-location Chiefs in advance to advise them of the fieldwork;
- Fieldwork was undertaken by TKBV lands team and Turkana-speaking members of the TKBV SPT along with Golder or AECOM representatives;
- Each grid square was systematically surveyed, on foot or in vehicles, depending on the terrain;
- Features such as homesteads, animal shelters, graves and community assets were recorded as GPS coordinates, photographed and details recorded. A similar classification of homesteads was used in all the baseline surveys from 2015 to 2019.
- When land users or households occupying homesteads were met in the field, discussions were held to obtain information on land use and land users. In addition, discussions were held with local elders in the vicinity of the field areas to check and confirm the understanding of current and recent land use patterns and trends;

[26] GPS data saved in exchange format

- Where *Adakar*[27] or *Arumum*[28] (see Section 6.12.2.2.4 for more information on traditional social units) were identified in the field, coordinates of the overall adakar and arumrum perimeters were taken and estimates made of the number of households currently present. Discussions were also held with local elders to obtain more information about the adakar and arumrum such as the number of households present, when they were established, where the people were from, where they live at other times and the factors influencing establishment and locational decisions; and
- Findings from the field work were recorded as GPS data and in Lands Baseline Fieldwork reports, covering topics such as:
  - Land tenure, administration and ownership;
  - Land use and land based livelihoods;
  - Community linkages to land;
  - Homestead locations and recent trends;
  - Use of natural resources such as cultural and economic trees, significant luggas;
  - Services and infrastructure facilities; and
  - Cultural assets and sites (discussed in section 6.13).

6.12.1.5 Primary Data - Community Health

A preliminary scoping visit took place in April 2016. The objectives of the field activity were to gain a high-level impression of the health status in the South Lokichar Basin and define what health services were available; understand the availability and quality of health data; identify key informants; and obtain a broad understanding of the potential health areas of concern.

A field visit was conducted from the 21 to 30 November 2018 with the objective of gaining a more detailed understanding of the baseline health status and define what health services were available. The trip also sought to further our understanding of the availability and quality of health data. Field activities were initiated with a participatory key informant meeting with the County Health Management Team (CHMT). Secondary data, which is routinely collected through the District Health Information System (DHIS) from all public health facilities, was obtained and reviewed for both Turkana and West Pokot Counties. This data provides an evidence base for longitudinal monitoring of key health indicators and the performance of the health system in general. Available public health services were evaluated to gain an understanding of the health infrastructure and health issues in the AoI. This was facilitated using an assessment tool adapted from the WHO Service Availability and Readiness Assessment index, including an evaluation of the following variables:

- Quantity and skills of healthcare personnel;
- Availability and range of general health services;
- Availability of services;
- Referral networks and the quality and cost of access to the health system, and
- The most common diseases or burden of disease at the facility.

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[27] An *Adakar* is a clustering of *awi* or homesteads. Sometimes referred to as *"cattle camps*" even if the herd does not specifically contain cattle. Golder's research indicates that *adakar* is often used interchangeably with the term *kraal*, a term more commonly used in South Africa.

[28] An *Arumrum* is a larger convergence of families than an Adakar, with households living together for an extended period of time for reasons of security and collaboration.

The fieldwork included an additional 18 KIIs and focus group meetings. Focus group meetings were evenly split by gender.

The following limitations were encountered during primary community health data gathering:

- The health baseline was developed primarily using information from key informant health professionals, however, it was more difficult to secure interviews with other health actors, such as NGOs and private/independent entities;
- There is limited data at the Sub-county level. While the current data may be adequate to support the ESIA process, further data will be required to support monitoring and to support design for community-based health management plans and the evaluation of the effectiveness of these interventions; and
- Security challenges and key informant availability led to cancellations.

6.12.2 Discussion of Baseline Data

6.12.2.1 National Overview

Administrative Divisions

Kenya has undergone a change in political structure and now operates with a devolved governance system, which means administrative governance has been decentralised into 47 counties. The national government began a devolution process in the wake of interethnic violence after the 2007 elections. The 2010 Constitution substantially remodelled the Kenyan state by creating two layers of government, the National Government and County governments. Elected governors replaced provincial administration executives that had previously been appointed by the President (Crisis Group, 2017).

While most parts of Kenya view devolution as a positive step, with 77% of the population throughout the country supporting the new model, the context of the Northern Rift Counties is susceptible to past abuses in competitive politics along ethnic lines. The process of devolution is still unfolding. The risk related to devolution are more pronounced in north, where counties divided along ethnic and sub-ethnic lines are susceptible to winner-take-all contests that have been seen at the national level (Crisis Group, 2017).

Kenya is divided into 47 Counties that are administered by elected governors. Counties are divided into Constituencies or Sub-counties that are further subdivided into Divisions, Locations and Sub-locations. Constituencies are often synonymous with Sub-counties, but not always, as some Counties include more than one Constituency. Each Constituency is a political unit represented by one Member of Parliament who sits in the National Assembly (Parliament of Kenya, 2018). Sub-counties are also divided into electoral wards, with each Ward represented by a Member of County Assembly (MCA), who sit in the County Assembly.

Economics and Livelihoods

From the early 2000s, the GoK has achieved sustained economic growth. Notable initiatives, such as free primary education, improved health services and infrastructure developments, were implemented (World Bank 2016).

In the 2018 UN Human Development Report, Kenya ranked 142 out of 189 countries worldwide. The report ranks countries by the Human Development Index (HDI), a composite value that can range between 0 and 1, with 1 being the highest possible development[29]. Kenya ranks above the average for all 46 Sub-Saharan African countries. However, it ranks well below the average of all medium human development countries (0.645). Table

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[29] HDI classifications are based on HDI fixed cut off points, which are derived from the quartiles of distributions of the component indicators. All of Kenya's neighbouring countries are less than 0.550 or "low human development". Kenya is considered "medium, between 0.550–0.699. High is from 0.700–0.799 and a ranking of 0.800 or greater is considered "very high" human development.

6.12-2 compares Kenya's key development indicators with neighbouring countries, as well as the average rankings for the region and the medium human development category.

Table 6.12-2: United Nations Development Programme (UNDP) Human Development Rankings, 2017

Ranking	Country	HDI Ranking	Life Expectancy at Birth (years)	Expected Years Schooling / Mean Years Schooling	Gross National Income (GNI) per capita PPP[30] 2011
-	*Medium Human Development*	*0.645*	*69.1*	*12.0 / 6.7*	*6,849*
142	**Kenya**	**0.590**	**67.3**	**12.1 / 6.5**	**2,961**
154	Tanzania	0.538	66.3	8.9 / 5.8	2,655
-	*Sub-Saharan Africa*	*0.537*	*60.7*	*10.1 / 5.6*	*3,399*
162	Uganda	0.516	60.2	11.6 / 6.1	1,658
173	Ethiopia	0.463	65.9	8.5 / 2.7	1,719
187	South Sudan	0.388	57.3	4.9 / 4.8	963

Source: UNDP, 2018a

The rise in Kenya's HDI between 1990 and 2017 has been driven by increases in life expectancy at birth (by 9.8 years), mean years of schooling (by 2.8 years), expected years of schooling (by 3.0 years) and GNI per capita (28.9%) (UNDP 2018b). Table 6.12-3 indicates changes in human development indicators in Kenya since 1990.

Table 6.12-3: UNDP HDI Trends, 1990-2017

	1990	1995	2000	2005	2010	2015	2016	2017
HDI Score	0.468	0.456	0.451	0.490	0.543	0.578	0.585	0.590
Life expectancy at birth	57.5	53.9	51.8	55.8	62.9	66.7	67.0	67.3
Expected years of schooling	9.1	8.7	8.4	9.4	10.7	11.7	11.9	12.1
Mean years of schooling	3.7	4.5	5.3	5.8	6.1	6.3	6.4	6.5
GNI per capita (2011 PPP$)	2,297	2,130	2,112	2,223	2,467	2,806	2,898	2,961

Source: UNDP, 2018b

Kenya is predominantly rural but is urbanising rapidly. In 2017, 26.6% of Kenyans lived in cities, with an annual urban population growth of around 4.4% in the last decade (World Bank DataBank, 2018). Kenya is a diverse nation with over 40 ethnic groups that are distinguished by two major language groups, Bantu and Nilotic.

It is a prominent member of the East African Community (EAC) and is generally considered the economic, commercial, financial and logistics hub of East Africa (ITA, 2017). Kenya is East Africa's second largest economy and is the eighth-largest economy in Africa, overall. Since 2014, the country has accounted for an average of 18% of regional output growth (Africa Development Bank (AFDB), 2018). Kenya has had long-standing macroeconomic stability, although it faces potential challenges with continued subdued credit growth

[30] Purchasing Power Parity (PPP) is a method of economic analysis that equates the price of a basket of identically traded goods and services in two countries, allowing for a comparison between countries with different currencies.

to the private sector and negative spillovers from the global economy caused by tighter financial market conditions and global trade tensions (WBG, 2018).

Kenya's Real Gross Domestic Product (GDP)[31] has been high, with annual growth averaging 5.4% in the last five years (WBG, 2018). In 2017, however, Kenya's economy slowed to a real GDP growth of 4.9% due to multiple factors that weighed down economic activities. These included drought conditions, which negatively impacted agricultural output, credit growth slowdown, and election-induced uncertainty. Real GDP growth is expected to recover in the medium term, i.e. by 2020, to 6.1%, due to the impact of improved rains on agricultural output and the dissipation of political uncertainty (WBG, 2018).

As shown in Table 6.12-4, Kenya has a market-based economy that is dominated by the agriculture, forestry, and fishing sector, which is the largest individual sector and contributes a third of the GDP. The largest industry contributors to the GDP between 2011 and 2017, however, were the tertiary industries, which contributed approximately 50% of the GDP, followed by primary and secondary industries.

Table 6.12-4: GDP by Sector (Percentage of GDP at Current Prices)

Sector	2011	2016	2017	% Change from 2011 to 2017
Primary Industry				
Agriculture, forestry and fishing	29.3	35.6	31.5	7.5%
Mining and quarrying	1.0	0.9	0.8	-20.0%
Primary industries subtotal	***30.3***	***36.5***	***32.3***	***6.6%***
Secondary Industry				
Manufacturing	13.1	10.0	8.4	-35.9%
Electricity, gas and water	2.1	2.6	2.5	19.0%
Construction	4.9	5.5	5.8	18.4%
Secondary industries subtotal	***20.1***	***18.1***	***16.7***	***-16.9%***
Tertiary Industry				
Wholesale and retail trade, repair of vehicles, household goods; restaurants and hotels	10.5	8.7	8.4	-20.0%
Transport, storage and communication	9.8	9.6	9.1	-7.1%
Finance, real estate and business services	15.2	14.7	14.9	-2.0%
Public administration and defence, security	4.7	4.4	4.3	-8.5%
Other services[32]	9.4	7.9	14.3	52.1%
Tertiary industries subtotal	***49.6***	***45.3***	***51.0***	***2.8%***

Source: AFDB, 2018

[31] Inflation adjusted measure that reflects the value of all goods and services provided by an economy in a given year, expressed in base-year prices and is often referred to as "*constant-price*" GDP.

[32] Other services include education, health and social work and other services.

Tourism is part of the tertiary industry and is a growing sector that has become the second-largest foreign exchange earner in the country (Oxford Business Group, 2017). By 2028, direct contributions from tourism is projected to be $4.9 billion United States dollars (USD) and total contributions are estimated to be $12.9 billion (World Travel and Tourism Council 2017, 2018). The country's numerous parks and reserves, cultural and historic attractions, and 500 km of coastline offer broad appeal for tourists and play an important role in employment and earnings (Oxford Business Group, 2018).

Oil and gas is an emerging industry in Kenya. Exploration efforts in the coastal Lamu Basin began in the 1950s, but commercially viable oil reserves in northern Turkana County were only discovered in 2012 (KCSPOG 2014). Oversight over exploration, development and production of oil and gas in Kenya will be under the review of the newly proposed Kenya Petroleum Regulatory Authority (National Assembly Bills, 2017). Kenya is in the process of setting up the regulator, which will assume the regulatory powers currently under the purview of the National Oil Corporation of Kenya (Standard Media, 2018). In June 2018, parliament passed the Petroleum Bill, which will provide a framework for regulating petroleum contracting, exploration and development (Kenya Civil Society Platform on Oil and Gas, 2018).

In terms of business development for small and medium businesses, Kenya has been improving and is well ahead in comparison with neighbours. The World Bank's annual assessment of the "*ease of doing business*" ranks Kenya 61 out of 190 countries globally (World Bank – Doing Business, 2019). This compares with:

- Uganda – 127 out of 190;
- Tanzania – 144 out of 190;
- Ethiopia – 159 out of 190;
- South Sudan – 185 out of 190; and
- Somalia – 190 out of 190.

In its most recent report, *Doing Business 2019: Training for Reform*, Kenya was listed as one of the top ten improved countries in 2017/18. The report notes improved working conditions in:

- Registering property, due to the introduction of an online system to clear land rent rates;
- Getting credit, following the introduction of a new law on secured transactions that created a unified secured transactions legal framework and establishing a new unified and notice-based collateral registry;
- Protecting minority investors, as a result of increased disclosure requirements, regulating the approval of transactions with interested parties and increasing available remedies if said transactions are prejudicial, increasing shareholders' rights and role in major corporate decisions, and requiring greater corporate transparency;
- Paying taxes, with the merging of all permits into a single unified business permit and by simplifying the value added tax schedule on its iTax platform; and
- Resolving insolvency, by facilitating the continuation of the debtor's business during insolvency proceedings, providing for equal treatment of creditors in reorganisation proceedings and granting creditors greater participation in the insolvency proceedings.

The assessment does not necessarily refer to international business, but rather is based upon the ease with which a local limited liability company operating in the largest business city can develop. The purpose is to highlight the extent of obstacles to growing business and to highlight issues for policy makers. The full scores for Kenya are listed in Table 6.12-5.

Table 6.12-5: Kenya Ranking in "*Ease of Doing Business*" Change from 2018 - 2019

Category in Doing Business	Rank 2018 (of 190)	Rank 2019 (of 190)
Ease of Doing Business (Overall Ranking)	80	61
Starting a Business	117	126
Dealing with Construction Permits	124	128
Getting Electricity	71	75
Registering Property	125	122
Getting Credit	29	8
Protecting Investors	62	11
Paying Taxes	92	91
Trading Across Borders	106	112
Enforcing Contracts	90	88
Resolving Insolvency	95	57

Source: World Bank – Doing Business, 2018 and 2019

Employment in Kenya has been strong, with a growing labour force and decreasing unemployment. In 2015/16, an estimated 25.0 million people in Kenya were between the ages of 15 and 64, an increase of 25.6% from a decade earlier (KNBS, 2018a). The number of employed individuals has also risen by 40.9%, while the number unemployed has fallen by 26.3%, during the same period, from 1.9 million to 1.4 million Table 6.12-6. The majority of workers were engaged in full-time employment, making up almost two-thirds (63.2%) of employment.

Table 6.12-6: Historical Employment Indicators for the Population Aged 15-64 (in millions)

Indicator	2005/06	2009	2015/16	Percentage Change from 2005/2006 (%)
Base Population	19.9	20.5	25.0	26
Total Labour Force	14.6	15.8	19.3	32
▪ Employed	12.7	14.2	17.9	41
▪ Unemployed	1.9	1.5	1.4	-26
▪ Economically Inactive	5.3	4.7	5.6	6

Source: KNBS, 2018b

Employment in Kenya roughly corresponds with the size of each economic sector. The service sector is the country's largest employer, followed by agriculture and industry. The service sector employs nearly half of the population (48%) with agriculture employing approximately 40% (FAO, 2018). The industry sector employs the smallest proportion, around 15% of the population.

Employment in Kenya can also be categorised by work in the formal or informal sectors. Informal sectors are characterised by small-scale activities, with easy entry and exit due to fewer regulations, skills from vocational institutions, less capital investment, limited job security and self-employment.

Table 6.12-7 presents that in 2017, Kenya's informal sector employed 14.1 million people, over five times the size of its formal sector, which employed approximately 2.7 million people (KNBS, 2018c). Employment in the informal sector is also more common in rural areas. An estimated 9 million people are employed in the informal sector in rural area. This is close to double the number found in urban areas. Both formal and informal sectors experienced growth between 2013 and 2017, with the number employed in the formal sector rising by 16% and the number employed in the informal sector rising by 26.4% (KNBS, 2018c). The informal sector has expanded over the years to also include manufacturing activities and information, communication and technology activities (KNBS, 2018c).

Table 6.12-7: Wage Employment by Sector ('000)

Sector	2013	2014	2015	2016	2017	Percentage Change (%)
Formal Sector						
Private	1,600	1,669	1,760	1,817	1,866	17
Public	683	700.8	718.4	736.3	790.2	16
Formal Sector Employment Total	*2,283*	*2,370*	*2,478*	*2,554*	*2,657*	*16*
Informal Sector						
Urban	3,974	4,208	4,458	4,710	5,000	26
Rural	7,176	7,638	8,104	8,600	9,098	27
Informal Sector Employment Total	*11,150*	*11,846*	*12,562*	*13,310*	*14,098*	*26*

Source: KNBS, 2018c

The total population of Kenya in 2018 is 49.7 million people, an increase of 30.4% from a decade earlier (38.1 million) (World Bank DataBank, 2018). Half of the total population is below 18 years of age and almost 79% of the population is under the age of 35 (KNBS 2009; ITA 2017).

Data on the extent of the population involved in pastoral systems in Kenya is scant as there is no common standard of measurement (IUAES Commission on Nomadic Peoples, 2014). Data from the decennial Kenya Bureau of Statistics does not disaggregate information on pastoral producers and did not include data from northern Kenya (where most pastoralist districts are located) until 2003. Without accurate data, an understanding of the number of pastoralists and magnitude of pastoral systems in Kenya is extremely difficult to ascertain. Livestock holdings are substantially under-represented and pastoral mobility is poorly captured, especially in relation to livestock production (IUAES Commission on Nomadic Peoples, 2014). An estimate of four data sets, ranging from 2006 to 2013, estimated conservatively that the minimum pastoral population of Kenya may be approximately 10% of the national population of 40 million, or 13% of a rural population of 28 million (IUAES Commission on Nomadic Peoples, 2014).

The total population of poor individuals declined in the last decade, from 16.6 million to 16.4 million, during which time the total national population increased by approximately 10 million. Poverty in Kenya is below the average in sub-Saharan Africa and is amongst the lowest in the East African Community (EAC) (WBG, 2018).

Poverty in Kenya is more prevalent in rural areas than urban areas (Table 6.12-8). About 40% of individuals in rural areas live in poverty, which is about 10% higher than individuals living in peri-urban and core-urban areas (KNBS, 2018d).

Inequality remains a major issue in Kenya, with exclusion and disadvantages based on class, ethnicity, gender, and geographic region (WBG, 2016). Kenya's GINI index[33], which measures economic inequality, dropped from 57.5 in 1992 to a low of 40.5 in 2015 (WBG, 2016). The average measured by UNDP between 2010 and 2017 is 48.5 (UNDP, 2018a). While poverty rates have moderately declined in Kenya from 2005 to 2015, almost two-thirds of the population are below USD $3.20 in 2011 PPP and one-third are below the international poverty line of $1.90 USD in 2011 PPP (Table 6.12-9).

Table 6.12-8: Poverty Measures (2015/2016)

Indicator	Headcount Poverty Measures	Poor Individuals 2015		Poor Households 2016	
		% of Population	Number of people ('000)	% of Population	Number of people ('000)
National	Food Poverty	32.0	14,539	23.8	2,718
	Overall Poverty	36.1	16,401	27.4	3,126
	Hardcore Poverty	8.6	3,908	6.0	682
Rural	Food Poverty	35.8	10,419	28.1	1,808
	Overall Poverty	40.1	11,687	32.6	2,097
	Hardcore Poverty	11.2	3,273	8.7	560
Peri-Urban	Food Poverty	28.9	965	21.5	173
	Overall Poverty	27.5	920	21.1	166
	Hardcore Poverty	6.0	199	4.6	37
Core-Urban	Food Poverty	24.4	3,155	17.7	736
	Overall Poverty	29.4	3,795	20.6	880
	Hardcore Poverty	3.4	436	2.0	85

Source: KNBS, 2018c

Table 6.12-9: Poverty Indicators (2005 and 2015)

Indicator	Poverty Headcount (%)		Poverty Gap (%)	
	2005	2015	2005	2015
US$ 1.25 - 2011 PPP poverty line	22.7	14.9	7.5	4.0
US$ 1.90 - 2011 PPP poverty line	43.6	35.6	16.1	11.3
US$ 3.20 - 2011 PPP poverty line	68.7	63.7	33.0	27.5

Source: World Bank, 2015

[33] **GINI index** measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution.

Poverty in Kenya, like other African countries, is concentrated in rural areas. Inequality in Kenya can be attributed to historical factors, such as natural resource endowments, political patronage, and policy choices biased towards urban areas (WBG, 2015). As a result, various ethnic groups and regions in Kenya have lagged behind in terms of political participation and access to resources for socio-economic development. The World Bank identified the key drivers of economic decline in rural Kenya as: 1) corruption and/or collapse of formal institutions, resulting in compromised service delivery; 2) physical security and poor education issues; 3) unequal land distribution system; and, 4) impact of HIV/AIDS, which places extreme burden and high dependency ratios on rural households to care for the sick (WBG, 2015).

Community Health and Safety

Kenya is implementing a devolved system of governance through which the health service has been fully decentralised to 47 Counties. At the national level, health leadership is provided by the Ministry of Health (MoH). The country's health care is organised in a four-tiered system as summarised in Table 6.12-10, which has replaced the previous six levels defined under the Kenya Essential Package for Health (KEPH) (Ministry of Health, 2014a; Ministry of Health, 2014b). Counties manage and supervise community health units, primary care units and County hospitals. The national referral facilities are semi-autonomous units managed by a board under the supervision of the MoH. Other semi-autonomous national health actors include the Kenya Medical Supplies Agency which procures and provides drugs, and other medical and non-medical supplies to all public health facilities, the National Hospital Insurance Fund which finances or subsidises medical bills for members and their dependants, the Kenya Medical Research Institute (KEMRI), the National AIDS Control Council, and public medical training colleges (Ministry of Health, 2014a; Ministry of Health, 2014b).

Table 6.12-10: Tiers of the Health Care System in Kenya

Tier	Description (Current classification)	KEPH Level (Old classification)	Catchment
I	**Community health units:** Serve as the first level of care and virtually comprises all community-based demand creation activities, that is, the identification of cases that need to be managed at higher levels of care	I Community	5,000
II	**Primary care units:** This level is made of all dispensaries, health centres and maternity homes for both public and private providers and is essentially the first level of contact with a health facility	II Dispensaries	10,000
		III Health Centres	30,000
III	**County referral services:** These are County referral hospitals operating in, and managed by a given County and comprise the former level 4 and level 5 district hospitals	IV District Hospitals	100,000
		V Provincial Hospitals	1,000,000
IV	**National referral services:** These consist of facilities that provide highly specialised services and include all tertiary referral facilities.	VI National Hospitals	Entire Country

Source: Kenya Health Sector Human Resources Strategy 2014-2018

Kenya currently has four national hospitals - Moi Teaching and Referral Hospital (MTRH) in Eldoret and the Kenyatta National Hospital, Mathare Psychiatric Hospital and National Spinal Injury Hospital all located in Nairobi.

Kenya has a routine Health Management Information System (HMIS) to record, generate and manage health information to guide evidence-based decision making in the provision of health and related services at the national, County and local levels. However, a weak health information system has been identified as one of the key challenges of the country's health sector including an inadequate capacity of HMIS staff, unskilled personnel handling data, lack of integration, many parallel data collection systems, and poor coordination, amongst others. The District Health Information Software 2 (DHIS2) software is used to support the HMIS.

There are wide disparities that exist in health status across Kenya and these are closely linked to underlying socio-economic, gender and geographical differences. The burden of disease in Kenya remains predominantly communicable diseases, although there is a growing burden of non-communicable diseases and injuries. As shown in Figure 6.12-1, at the current trend, it is projected that non-communicable and communicable diseases will have an equal burden of disease nationally by 2025, after which the burden from non-communicable diseases will dominate.

Malaria remains a public health problem in Kenya with around 70% of the population at risk of the disease. *Plasmodium falciparum* is the predominant parasite (WHO, 2015). The major *Anopheles* species are *An. gambiae*, *An. arabiensis*, *An. funestus*, and *An. merus*. The country is divided into four malaria epidemiological zones as shown in Table 6.12-36 (KNBS, 2010; NMCP, 2016).

The National Malaria Control Programme in Kenya is responsible for the design and implementation of malaria control strategy. The core vector control strategies are the distribution of long-lasting insecticidal nets (LLINs), indoor residual spraying in targeted areas, and larval source management.

Statistics from the Kenya Malaria Indicator Survey (KMIS) in 2015 indicated a national malaria prevalence of 8% among children, a decline from 11% in 2010) (NMCP, 2016). The burden of malaria has shifted to older children with a prevalence (by microscopy) of 11% among children aged 10-14 years, 10% among children aged 5-9 years and 5% among children aged under-5 years (NMCP, 2016).

HIV/AIDS is a global epidemic, with Kenya ranking among the six high burden countries in the world with an estimated 1.5 million people living with the virus in 2018 (National AIDS Control Council, 2018). The epidemic has evolved, since the first case was diagnosed in 1984, to become one of the major causes of morbidity and mortality in the country, placing tremendous demands on the health system and the economy (UNAIDS, 2014). Following years of intervention, the prevalence has recorded a decline from a high of 10% in the late 1990s, to the current 4.9% (2018 estimate). New HIV infections in Kenya have fallen by 77% from their peak in 1993, and AIDS-related deaths have been reduced by 74% from their peak in 2003, as access to antiretroviral treatment increased. Data from the Kenya AIDS Response Progress Report 2018 shows that the country recorded 52,800 new HIV infections and 28,200 AIDS-related deaths in 2017 (National AIDS Control Council, 2018). A recent spike in number of new infections among young people is threatening to wipe the gains that have been made. The epidemic exhibits extreme geographical and gender disparities. National estimates indicate that 65% of new HIV infections occur in nine of the 47 Counties, mostly in the Western region (NASCOP and NACC, 2015). There is higher prevalence among women at 6.9%, compared to men at 4.2% (National AIDS Control Council, 2018). Heterosexual contact is the primarily route of transmission. The prevalence is higher among most-at-risk populations particularly female commercial sex workers (29.3%), gay men (18.2%) and people who inject drugs (18.3%) (National AIDS Control Council, 2018).

Kenya indicators 2018 (NASCOP Program Data 2018):

- 1.5 million people living with HIV;
- 4.9% adult HIV prevalence;
- 52,800 new HIV infections;
- 28,200 AIDS-related deaths;
- 75% adults on antiretroviral treatment; and
- 84% children on antiretroviral treatment.

Table 6.12-11 shows the leading causes of disease burden in Kenya as measured by Disability Adjusted Life Years (DALYs[34]). HIV/AIDS is the leading cause, followed by perinatal conditions, malaria, lower respiratory infections and diarrhoeal diseases (Institute for Health Metrics and Evaluation (IHME), 2016). Over the past decade, the burden of disease due to HIV/AIDS and malaria has reduced by over half (60%) (IHME, 2016). Tuberculosis, on the other hand, has recorded a significant increase of 18%. The burden from mental illness has also increased.

Table 6.12-11: Leading Causes of Disease Burden (DALYs) in Kenya (2016)

Rank	Disease/Morbidity	% of DALY	%Change (2005-2016)
1.	HIV/AIDS	24.2	-60% (decrease)
2.	Perinatal conditions	10.7	-10% (decrease)
3	Malaria	7.2	-59% (decrease)
4	Lower respiratory infections	7.1	-22% (decrease)
5.	Diarrhoeal diseases	6.0	-28% (decrease)
6	Tuberculosis	4.8	+18% (increase)
7.	Road traffic accidents	2.0	-
8.	Congenital anomalies	1.7	-
9.	Violence	1.6	-
10.	Depressive disorders	1.5	+30% (increase)

Source: IHME Burden of Disease estimates 2016

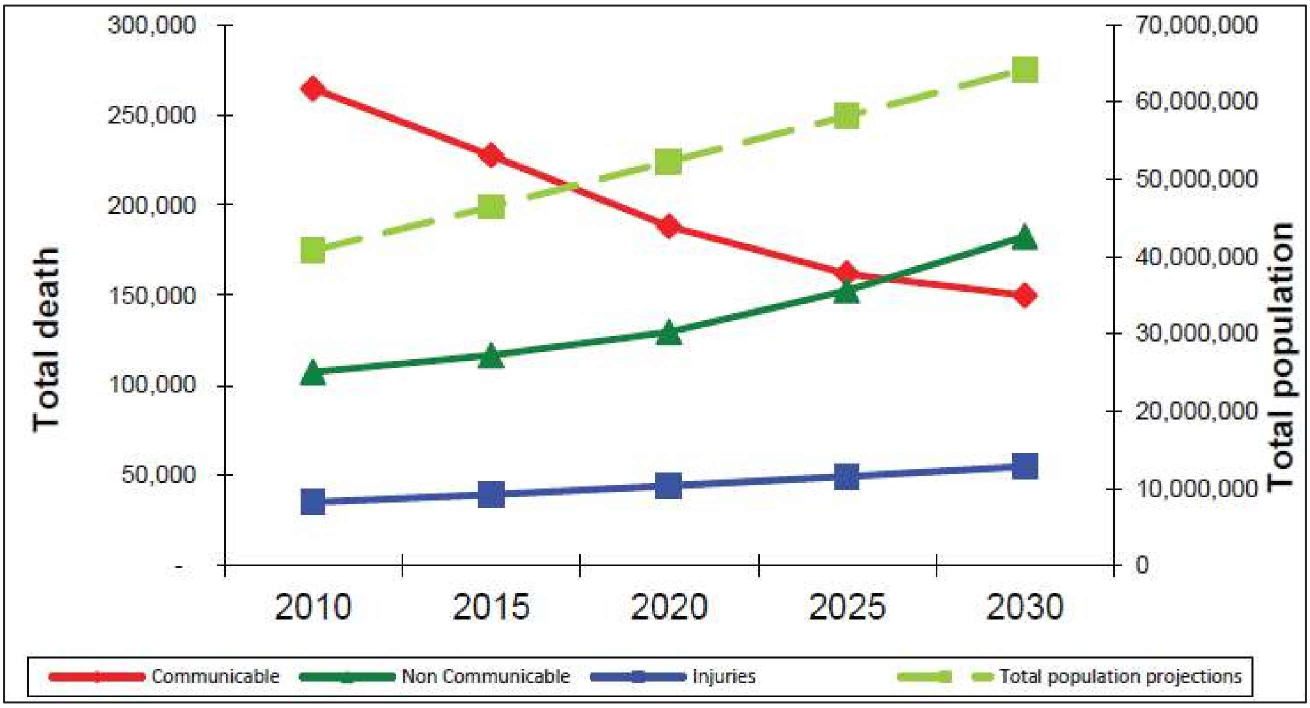

Figure 6.12-1: Projections of Disease Burden in Kenya, 2011-2030
Source: Health Sector Strategic and Investment Plan 2013-2017

34 DALYs refer to time lost due to incapacity arising from ill health.

The leading risk factors for disease burden in Kenya are malnutrition, water-sanitation-hygiene (WaSH) related factors, unsafe sex, air pollution, alcohol/drug abuse, high blood pressure, dietary and occupational risks, tobacco use and high blood sugar (Figure 6.12-2) (IHME 2016).

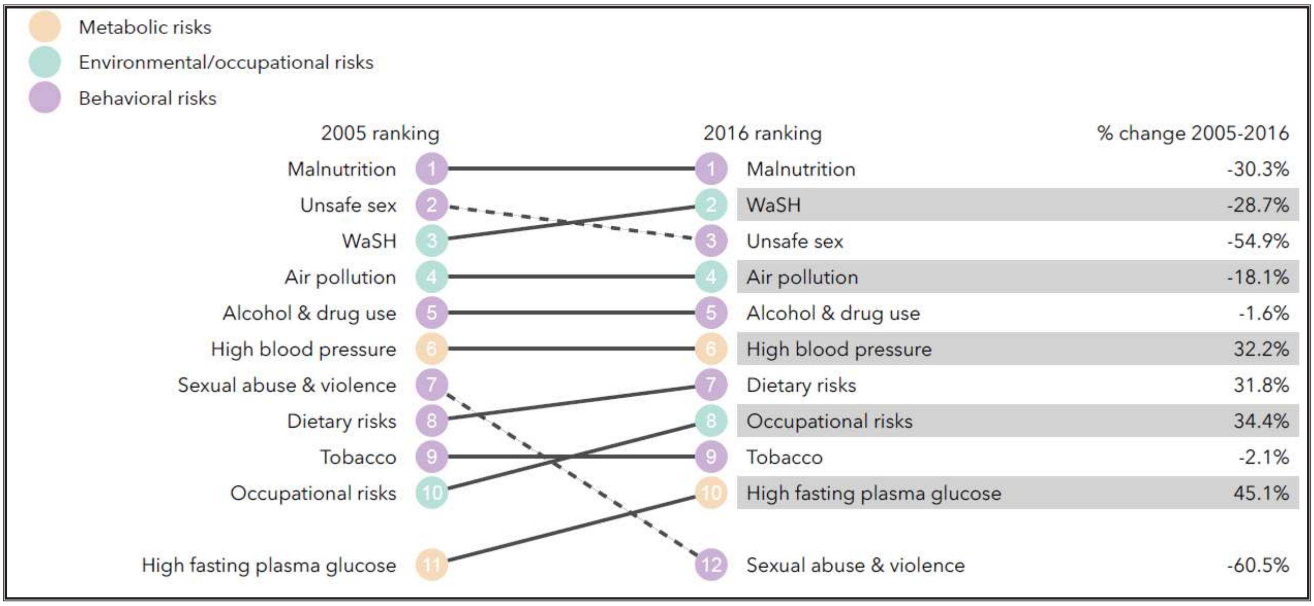

Figure 6.12-2: Leading risk factors for disease burden in Kenya, 2016

Source: IHME Burden of Disease estimates 2016

Although overall emergency healthcare access is high, there are notable differences between counties. Access to the health care services in the counties of Turkana, Wajir, Bomet, Narok, Manderaa, Tano River and Kwala are generally poorer than other counties with smaller health facility densities and budgets (Ministry of Health and WHO, 2016). Health facility density is considered a crude indicator of access to outpatient services and is expressed as number of facilities per 10,000 population. While Kenya's MoH has increased health facility density from 1.9 per 10,000 population in 2013 to 2.2 per 10,000 in 2016, it has not achieved its target of 2.5 per 10,000 population (Ministry of Health and WHO, 2016).

Access to quality healthcare is a constitutional right in Kenya but millions of Kenyans cannot afford to pay for healthcare services. While public health insurance became available in 1966, only an estimated 20% of Kenyans have access to some sort of medical coverage (World Bank, 2014).

Education

Kenya has made strides in improving access to education, abolishing tuition fees for primary education in 2003 and secondary education in 2018. Enrolment has subsequently increased, with the net enrolment ratio for primary education rising from 76.5% to 81.8% from 2008 to 2012 (UNESCO, 2018). Enrolment in secondary education has also risen from 28.9% in 2008 to 51.3% in 2016 (The Conversation, 2017). Over half (51%) of adults aged 25 and over have attained a primary education, while only 29% have attained lower secondary education and 22% have attained upper secondary education (UNESCO, 2017).

Despite progress, challenges remain for students transitioning from primary to secondary school, especially those from low income households. It is considered that additional school fees can prevent many children from attending secondary school, as the unit cost of education generally negatively correlates with secondary school enrolment (Mutegi et al. 2017).

Land Use and Access

As explained in the draft TKBV Land Access & Resettlement Framework (LARF) for the Project, the Constitution of Kenya (2010), and the Sessional Paper No.3 (2009) on the National Land Policy, land in Kenya is classified as Public land[35], Private land[36], or Community land[37]. Land in the Project footprint area is classified as Community Land and remains unregistered and is recognised as belonging to all people of Turkana. It is understood that there is no privately or publicly owned land in the Project footprint area.

Article 63 of the Constitution states that "*Community land shall vest in and be held by communities identified on the basis of ethnicity, culture or similar community of interest*". Community land includes land that is lawfully registered to a specific community, and community land that has not been formally registered to a community or "unregistered community land". Article 63 states that "Any unregistered community land shall be held in trust by county governments on behalf of the communities for which it is held". Beyond Kenya's recognised forms of land tenure, people recognise that land is a shared resource and one that can be characterised as common property. In this sense, land in the Project footprint area is recognised as unregistered community land that belongs to all people.

Elsewhere, in addition to unregistered Community Land, land may be classified (or held) as either private or public land. The majority of private or public land is located in urban settings outside the Project area such as Lodwar (the Turkana County capital) and urban settlements such as Lokichar.

All land areas affected by the Project footprint are classified as unregistered community land. As noted above, Article 63 of the Constitution of Kenya (2010) states that "*any unregistered community land shall be held in trust by County governments on behalf of the communities for which it is held*". In the case of the Project in Turkana and West Pokot, land is owned by the people. People recognise that community land is a shared resource and one that can be characterised as common property.

The portion of land affected by the Project footprint in West Pokot (approximately 8 km of water pipeline route and pumping facilities at Turkwel reservoir) is also community land belonging to the people of West Pokot County.

6.12.2.2 Administrative Divisions and Governance Structure

Turkana County is one of 47 county governments in Kenya and, measuring 77,000 km^2, it is the second largest county in the country, covering 13% of the country. Turkana County shares international borders with Ethiopia to the north, South Sudan to the north-west and Uganda to the west. Within Kenya, the County borders West Pokot and Baringo Counties to the south-west, Samburu County to the south-east and Lake Turkana in the east all the way to the Ethiopia border. Marsabit County forms the entire opposite shore of Lake Turkana.

West Pokot County is situated in the North Rift along Kenya's western border with Uganda. It borders Turkana County to the north and north-east, Trans Nzoia County to the south, and Elgeyo-Marakwet County and Baringo County to the south-east and east, respectively. West Pokot County is also one of the 47 county governments

[35] Public land: *(a)* land which at the effective date was alienated government land as defined by an Act of Parliament in force at the effective date; (*b*) land lawfully held, used or occupied by any State organ, except any such land that is occupied by the State organ as lessee under a private lease; (*c*) land transferred to the State by way of sale, reversion or surrender; (*d*) land in respect of which no individual or community ownership can be established by any legal process; (*e*) land in respect of which no heir can be identified by any legal process;(*f*) all minerals and mineral oils as defined by law; (*g*) government forests other than forests to which Article 63 (2) (*d*) (i) applies, government game reserves, water catchment areas, national parks, government animal sanctuaries, and specially protected areas; (*h*) all roads and thoroughfares provided for by an Act of Parliament; (*i*) all rivers, lakes and other water bodies as defined by an Act of Parliament; (*j*) the territorial sea, the exclusive economic zone and the sea bed; (*k*) the continental shelf; (*l*) all land between the high and low water marks;(*m*) any land not classified as private or community land under the Constitution; and (*n*) any other land declared to be public land by an Act of Parliament (i) in force at the effective date; or (ii) enacted after the effective date.

[36] Private land: comprising: (*a*) registered land held by any person under any freehold tenure; (*b*) land held by any person under leasehold tenure; and (*c*) any other land declared private land under an Act of Parliament.

[37] Community Land: (a) Land lawfully registered in the name of group representatives under the provisions of any law; (*b*) land lawfully transferred to a specific community by any process of law; (*c*) any other land declared to be community land by an Act of Parliament; and (*d*) land that is— (i) lawfully held, managed or used by specific communities as community forests, grazing areas or shrines; (ii) ancestral lands and lands traditionally occupied by hunter-gatherer communities; or (iii) lawfully held as trust land by the County Governments.

in Kenya and measures 9,169.4 km^2, stretching a distance of 132 km from north to south (West Pokot Spatial Plan, 2019).

6.12.2.2.1 Local Administration

Turkana County is divided into seven Sub-counties and West Pokot County is divided into four Sub-Counties. Each Sub-county is further divided into Divisions, Locations and Sub-locations.

The primary focus of socio-economic baseline is the two Sub-counties of Turkana South and Turkana East in Turkana County, plus the four Locations adjacent to the Turkwel Dam, the proposed water abstraction point. These Locations are part of three Sub-counties in West Pokot, Pokot West, Pokot North and Pokot Central.

West Pokot County has four Sub-counties, 13 divisions, 61 locations and 222 sub locations (West Pokot Spatial Plan, 2019). Sub-counties for Turkana and West Pokot are shown in Figure 6.12-3. Figure 6.12-4 shows the Project AoI, including the key Locations that were the primary focus of the baseline research.

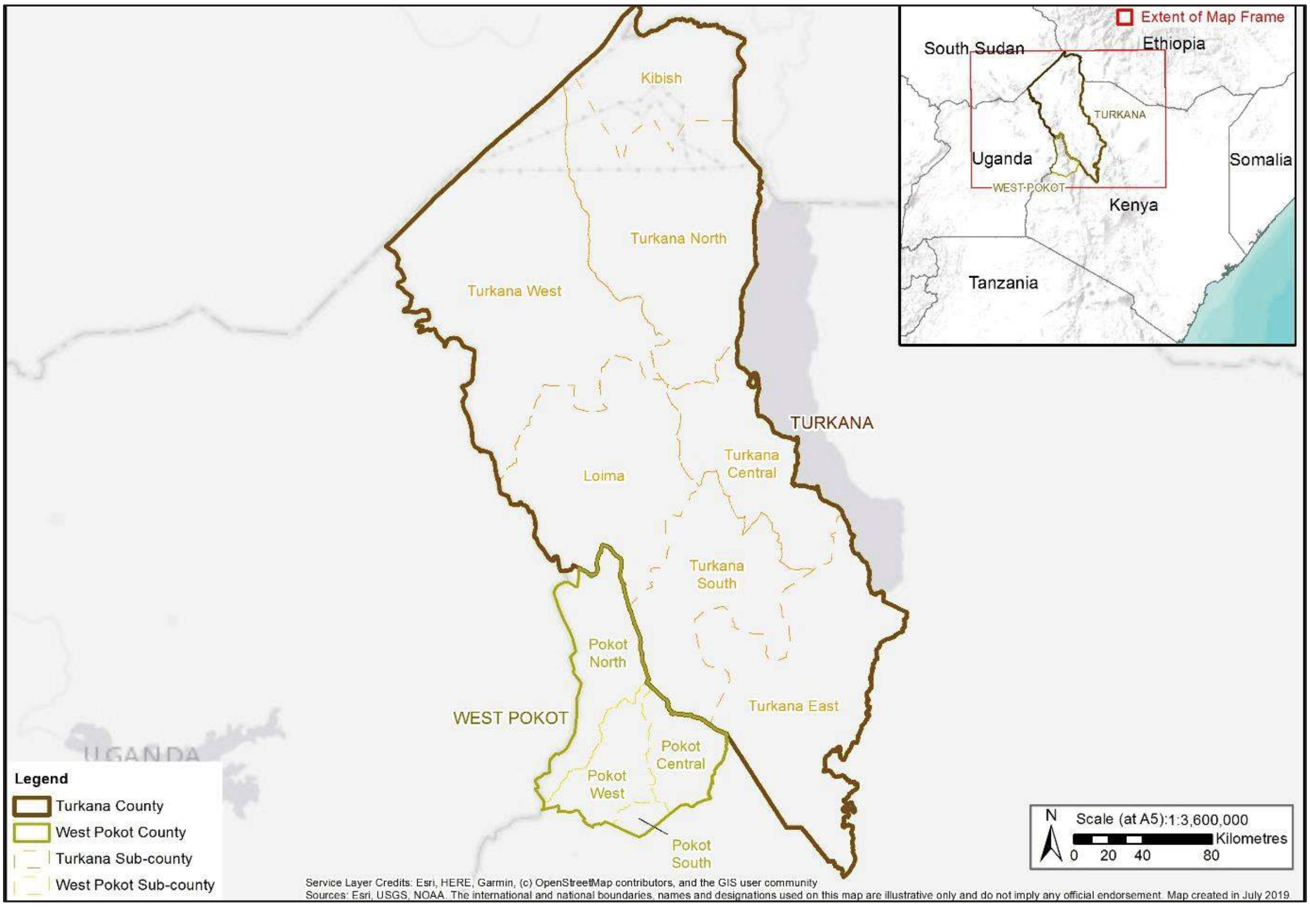

Figure 6.12-3: Administrative Sub-counties for Turkana and West Pokot County

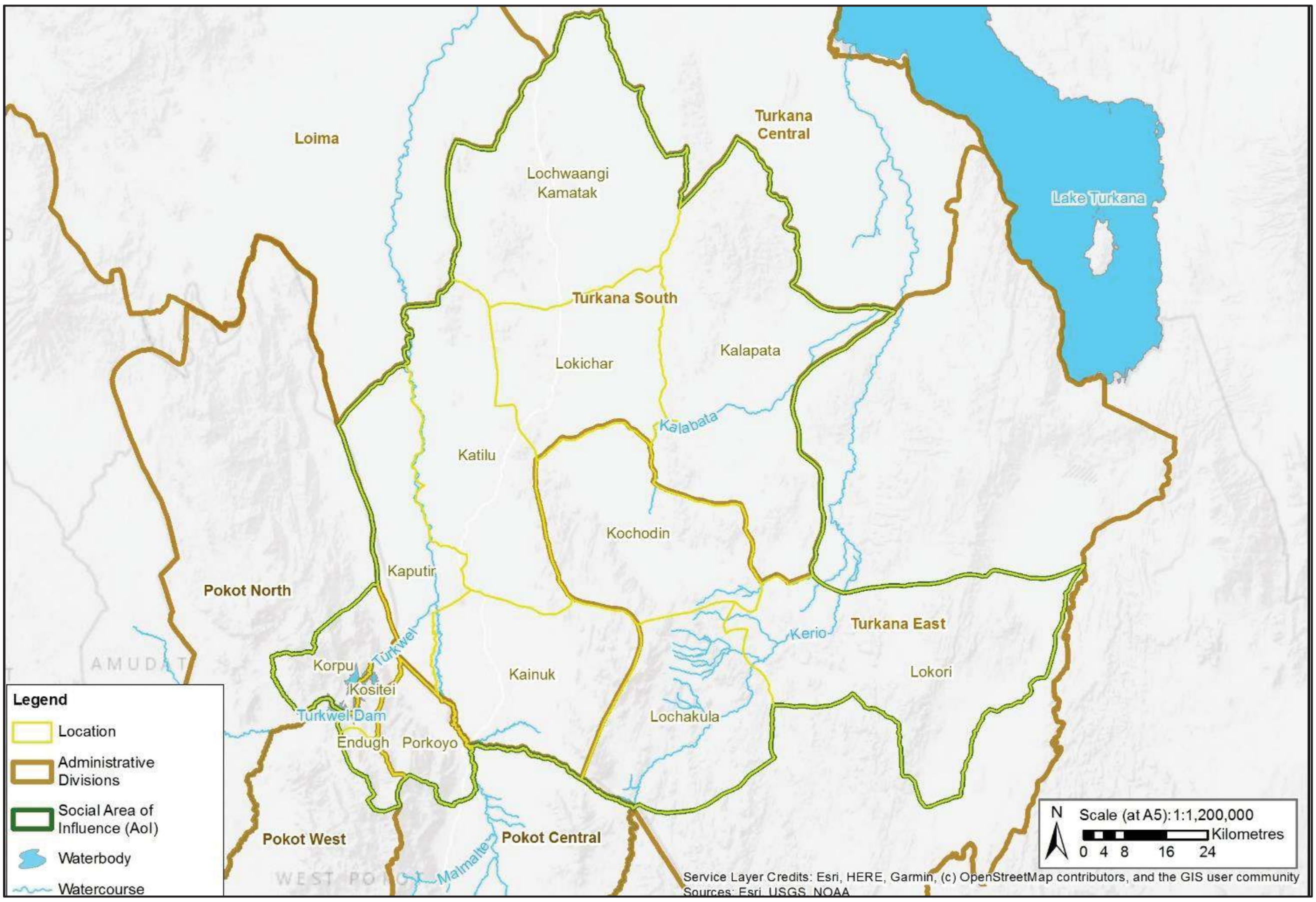

Figure 6.12-4: Project AoI and Key Locations for Baseline Research

A Constituency (often coinciding with the boundary a Sub-county) is represented by one MP, who sits in the National Assembly. Each electoral Ward is represented by an MCA in the County Assembly. There are 30 electoral Wards (Table 6.12-12) in Turkana and there are an additional ten MCAs nominated by political parties, making a total of 40 MCAs in the Turkana Country Assembly. There are 20 electoral Wards in West Pokot (Table 6.12-13).

Table 6.12-12: Wards by Sub-County in Turkana County

Sub-county	Number of Wards
Turkana South	5
Turkana East	3
Turkana Central	5
Loima	4
Turkana West	7
Turkana North (and Kibish[38])	6
Total Number of Wards	30

[38] In this table, Kibish has a special status as the table shows the number of Wards per Sub-county. Kibish was given the status as a Sub-county in 2011 and is considered a special Sub-county. While having this status as a Sub-county, it administered by the same Deputy County Commissioner as Turkana North under the National Government. Under the County Government, Kibish is a single Ward, which has the same boundary as the Sub-county. Kibish has its own Sub-county Administrator. This is often confusing as Kibish has some administrative roles overseen by Turkana North. The Sub-county itself has 3 Locations and 7 Sub-locations with 8 Major Rural Settlements. A map showing Divisions would show Kibish as part of Turkana North.

Table 6.12-13: Wards by Sub-County in West Pokot County

Sub-county	Number of Wards
Pokot West	6
Pokot South	4
Pokot Central	4
North Pokot	6
Total Number of Wards	20

The Kibish Sub-county, located in the northern part of Turkana County on the border with Ethiopia and South Sudan, was created in 2011 by the National Government as a special Sub-county. Kibish consists of three Divisions, but two overlap with Turkana North Sub-county. The Independent Electoral and Boundaries Commission (IEBC) is expected to clarify this situation during its next consideration of the boundaries. This will clearly demarcate a border between Kibish and Turkana North Sub-county (KII, 25 June 2016).

Divisions, Locations and Sub-locations are part of a national government administrative structure. This overlaps with the Sub-county structure, however a Ward is part of the newly instituted devolution process. Sub-county Administrators and Ward Administrators are part of the county government administration structure. The Constitution of Kenya (2010) set up these two levels of government, making a shared mandate between the national government and counties (Turkana County Government, 2013). A full list of the administrative units included in the AoI are listed in Table 6.12-14 to Table 6.12-16.

Table 6.12-14: Sub-County Administrative Units in the AoI: Turkana South

Turkana South			
Division	***Location***	***Sub-location***	***Ward***
Lokichar	Lokichar	Lokichar	Lokichar
		Kapese	
	Lochwaangi Kamatak	Lochwaangi Kamatak	
		Napusmoru	
	Kalapata	Kalapata	Kalapata
		Loperot	
		Nakalei	
Kainuk	Kainuk	Kainuk	Lobokat
		Kakongu	
		Loyapat	
	Kaputir	Kalomwae	Kaputir
		Nakwamoru	
		Lorogon	

Turkana South			
Division	***Location***	***Sub-location***	***Ward***
Katilu	Katilu	Katilu	Katilu
		Lokapel	
		Kalemngorok	
		Kanaodon	

Table 6.12-15: Sub-County Administrative Units in the AoI: Turkana East

Turkana East			
Division	***Location***	***Sub-location***	***Ward***
Lokori	Lokori	Lokori	Lokori/Kochodin
		Kangitit	
		Lotubae	
	Kochodin	Kochodin	
		Lopii	
	Lochakula	Lochakula	
		Kakulit	
		Lokwamosing	

Table 6.12-16: West Pokot County Administrative Units in the AoI

Division	Location	Sub-location	Ward
Pokot West Sub-County			
Sook	Kositei	Kasitei	Endugh (Turkwel Special Ward)
		Chepokachim	
	Endugh	Chewarany	Endugh
		Kriich	
		Cheptram	
North Pokot Sub-County			
Kasei	Korpu	Songok	Kasei (Turkwel Special Ward)
		Sirwach,	
		Chepkondol	
		Kachawa	

Division	Location	Sub-location	Ward
Central Pokot Sub-County			
Sekerr	Porkoyo	Parek	Sekerr (Turkwel Special Ward)
		Nasolot	
		Sarmach	
		Porkoyo	

It was noted through KIIs with Assistant Chiefs and Ward administrators in these areas that there has been a "*special*" Ward demarcated for the Turkwel area. This Turkwel Ward was formed to enable improved governance of the settlements in the Turkwel area that are not easily accessible to the ward administrators in the larger wards of Endugh, Kasei and Sekerr. Turkwel Ward has its own Ward Administrator and incorporates settlements in Sub-locations spanning across the three Sub-counties (KII – Ward Administrators, 11 June 2019).

Reorganisation associated with changes from the 2010 Constitution has caused some challenges in understanding roles and responsibilities among various levels of different government authorities, however, representatives of national and county government structures report that they have cooperated successfully in this time of transition to a devolved government. Golder sought to gather data from representatives of both structures, specifically Assistant County Commissioners (national government officials), who oversee Location Chiefs and their Assistant Sub-location Chiefs, and county officials, such as Sub-county Administrators and Ward Administrators.

New legislation within the Decentralised Administration Bill is expected to further structure administrative units under the County Government into "*Villages*". This is expected to be different to the structure described above. In the new system, each village will have a Land Administrator that will work with Ward Administrators to be the "*person on the ground*" with knowledge of land issues and potential disputes (KII, 9 May 2017). Below the Ward Administrators, new Village Administrators will be created, and these individuals will work with a Village Council.

In Turkana County, a preliminary list of Villages was available. In total, there will be 156 Villages to be administered by Wards as part of the evolving devolved County government. The proposed Villages were organised based on population and geographic size. Data used to develop this structure are linked to the data from the Independent Electoral and Boundary Commission (KII, 31 January 2019).

Table 6.12-17 represents the preliminary list of Villages under consideration in the Turkana locations.

Table 6.12-17: Proposed Villages per Ward in Turkana East and South

Turkana South		
Ward	**Village**	**Number of Villages**
Lokichar	Lokichar Kapese Kasuroi/Lokaburu/Nalemsekon Napusumoru/Kekorisogol Lochwaa/Locheremoit Kakalel/Sopel/Kaaroge	6

Turkana South		
Kalapata	Kalapata Loperot Nakaalei Kootoro Lomeleku	5
Lobokat	Kainuk Kakong Loyapat Namambu/Naakujit	4
Kaputir	Nariomoru/Nakwamoru Lorogon Kaputir Kotamarukon	4
Katilu	Katilu Lokapel Kalemngorok Kanaodon Korinyang	5
Turkana East		
Lokori/Kochodin	Lokori Lotubae Kochodin Lochakula Kangitit Nakukulas Lokwii	7
Kapedo/Napeitom	Lomelo/Katiir Napeitom Kamuge/Ngilukia Kapedo/Silale Nadome/Ekipor	5
Katilia	Katilia Elelea Parkati Lopeduru Lomunyen - Akwaan	5
Total Proposed Villages		41

Source: (KII, 1 February 2019)

The composition of the Village Council will be 5 to 7 elders from the population, with the Chair of the Village Council being the Administrator (KII, 10 May 2017). The Village Council will seek to bring together leadership from both settled and mobile administrative units into one advisory group. This group will be tasked with helping to manage resources and advise on security issues (KII, 31 January 2019).

The new system is intended to alleviate work that is currently managed by Location Chiefs in the National government and Ward Administrators in the County Government (KII, 2 February 2019).

6.12.2.2.2 Changes Driven by Devolution

Research highlights mixed views on devolution, as the National Government transfers more responsibilities to the county governments.

Devolution is said to have brought services and decision-making closer to people, in contrast to the pre-devolution situation where much of the decision-making was done from Nairobi.

Some have also seen an increase in the number of early childhood development (ECD) facilities and the construction of health dispensaries and health centres. Devolution is also said to have had an impact on infrastructure, with more roads being paved and street lights being put in population centres. It is also said to have improved security through inter-county peace initiatives (KII, 28 June 2016).

However, key informants in the NGO sector observe similar trends to those above, prior to devolution, in which diversity is concentrated in urban areas. While there is agreement that some services have improved, the disparity in terms of services for those close to urban areas and those even 5 km away from urban settlements is still large. In some situations, poorer people are being pushed farther away from urban areas as land in and around towns, such as Lodwar, become used for non-communal purposes (KII, 27 June 2016).

6.12.2.2.3 Settlement Categorisation

TKBV stakeholder engagement undertaken during E&A phase identified key settlements within the AoI. Table 6.12-18 lists the major settlements in Turkana that are most likely to experience environmental and social effects, including their relationship to other national and county government administrative units.

Table 6.12-18: Urban and Rural Settlements

Sub-county	Location	Sub-location	Urban/Major Rural Settlement	Ward
Turkana South	Lokichar	Lokichar	Lokichar (urban) Lokichar Moruongor internally displaced person (IDP) camp Nalemsekon Kamarese Kaakali	Lokichar
		Kapese	Kapese Lomokamar Kasuroi	
		Lochwaangikamatak	Lochwaangi Kamatak Kaaroge Locheremoit Napusimoru	
	Kainuk	Kainuk	Kainuk	Lobokat

Sub-county	Location	Sub-location	Urban/Major Rural Settlement	Ward
			Lorogon	
	Kalapata	Loperot	Loperot Nalemkais	Kalapata
		Nakalei	Nakalei	
	Katilu	Kalemngorok	Kalemngorok	Katilu
		Katilu	Katilu	
	Kaputir	Nakwamoru	Kaputir	Kaputir
		Lorogon	Lorogon	
Turkana East	Lokori	Lokori	Lokori (urban) IDP Lokori	Lokori/Kochodin
	Kochodin	Kochodin	Nakukulas Lokicheda	
		Lopii	Lopii	

In West Pokot County, the main urban centre is Kapenguria in West Pokot Sub-County. It also acts a trading centre. The improvement of market centres and establishment of new ones is a priority in West Pokot, due to their contribution to the economic development of the county (West Pokot Spatial Plan, 2019).

6.12.2.2.4 Traditional Social Units

Turkana

Within the AoI in Turkana, the majority of land is unregistered community land. Generally, it is recognised that unregistered community land is owned[39] by all people of Turkana and is held in trust by Turkana County Government on behalf of the people who hold customary rights to the land. The Turkana have specific geographical affiliation with land including *ere* and *ekitela* or territorial Sections.

Key terminology related to the Turkana traditional social units include:

- ***Awi (pl: ng'awiyei) or household:*** The most fundamental unit of social aggregation is the family unit, which is headed by a male head of household with one or multiple wives, children and often other dependent women. Households may cluster and travel with two to five other households to form a large *Awi* or *Awi Apolon* (McCabe, 2004);
- ***Ere (pl: ng'irerera):*** describes the ancestral domain of a family. An *ere* may be described by the current household (including grand-parents, siblings and children) as the location from where the family derives and, to a variable extent, may live (seasonally or more permanently for the old, women and children) and graze their livestock. The *ere* is not necessarily a place of permanent abode or settlement in so far that seasonal migration may take the *ere* family away from their *ere*. The *ere* family may claim authority over, and preferential access to, natural resources (e.g. trees and seasonal grazing) located within the *ere*, but this claim does not convey (land) ownership rights and failure to exercise such rights may result in other

[39] Within the South Lokichar area, the vast majority of land is unregistered community land. Generally, it is recognised that unregistered community land is owned by all people of Turkana and is held in trust by Turkana County Government on behalf of the people who hold informal rights to the land.

parties using these resources. As such, Turkana can access land within a family's *ere* for temporary grazing purposes but it is understood that permission must be sought. The person with the right to speak on behalf of people in the *ere* is the man who heads the *ere* family. Borders of the *ere* are usually delineated by features such as a *luggas,* ridgelines, livestock tracks (for moving stock long distances), roads and occasionally certain species of trees. These borders are generally known by everyone living in the vicinity, however opinions can vary within an administrative unit over where *ere* boundaries lie and the geographic scale of an *ere*, with *ere* boundaries identified by one person sometimes differing or being superimposed upon an *ere* identified by others.

- ***Ekitela (pl: ng'itela)* or territorial Section:** All herd owners are members of a territorial Section, geographic areas, often with overlapping boundaries (Müller-Dempf, 2014). Sections differ in various ways, such as environmental conditions or characteristics. Though once a territorial unit in a socio-political system, their role is diminished by government administration (Müller-Dempf, 1994);
- ***Emacar (pl ngimacarin)* or Clans*:*** Non-territorial social organisation related to kinship and stock associations. All Turkana are born into the clan of one's father and women join the clan of their husband upon marriage. Clans are exogamous (i.e., a man may not marry a woman from his clan) and membership is symbolised by brands that appear on animals in a herd (McCabe, 2004);
- ***Adakar (pl. ng'adakarin):*** A clustering of *awi* or homesteads sometimes referred to as "cattle camps" even if the herd does not specifically contain cattle. Golder's research indicates that *adakar* is often used interchangeably with the term *kraal*, a term more commonly used in South Africa; and
- ***Arumrum: (pl. ng'arumrumio)***: New form of social organisation starting from the mid-1990s consisting of a large encampment of multiple herd owners under the leadership of a single man. Concentrically built thorn fences and heavy armament was designed to fend off attacks. (McCabe, 2004). This clustering could include up to 100 households (Eriksen, S, and J Lind. 2009).

The relationship between national, county and traditional leadership is complex and evolving as county governments implement changes toward more devolved government under the new Constitution. Location and Sub-location leadership, Chiefs and Assistant Chiefs, are aided by their Chief's Elders, individuals who live in settlements throughout a Location or Sub-location and assist the Chief in his or her duties. In the Kanamkemer Sub-location in Turkana Central, the Assistant Chief allocated two Chief's Elders for each settlement. These individuals may carry out her functions when she is absent (KII, 24 June 2016).

This system has been observed in numerous other Locations, though the number of Chief's Elders seems to vary. According to one Sub-county Administrator, such Chief's Elders are considered part of traditional governance structures and the traditional, county and national governance systems are interdependent. The Chief's Elders work with *adakar* or *kraal* elders and Seers (diviners), *Emerons*, who are also part of a traditional government system. While not legally recognised, the main functions of the traditional governance structure relate to pastoralist issues, including the management of security, disaster and pasture management (KIIs, 24 June 2016 and 30 January 2019). A Location Chief further explained that elders work with the Chiefs to understand who has migrated into an area and support the Chief in solving petty domestic issues that can arise, from the household to the wider *adakar* level. The Seers also work with the Chiefs to foretell the future (KII, 28 June 2016). Chief's Elders in Lokori explained that their role served as a bridge between the settlements within a Chief's Location or Sub-location. They disseminate information from the Chiefs and help to monitor the number of people in each settlement, as well as the number of animals in and around the settlement (Focus Group Discussion, 31 January 2019).

The Decentralised Administration Bill also takes into consideration traditional social units. The planned "*Villages*" will be supported by a Village Council (KII, 23 January 2019). Village Councils, where relevant, will include representatives of the *mobile pastoralists* in a given area. This allows the *mobile groups* to communicate with the Village Administrators. When a group moves, communication between the Village Administrators ensures the effective management of any issues arising from this migration (KII, 31 January 2019).

The tree of men, or "*Ekitoe a Ngikileok*"[40] in the Turkana language, is explained as an "*institution being of an ancient establishment linked to the history of organisation of Turkana People*" (Turkana Council of Elders, 2012). The tree of men is both an institution and a place, being the location where elders from a given area meet and deliberate in the implementation of their work. Many research interviews were held "under the tree of men". This place is also used for ceremonial feasts, initiations and gatherings (Müller-Dempf, 1994). Chief elders in Lokwamosing explained that they gather at the tree of men to solve disputes over stolen animals, adultery, negotiations over a dowry and other offences, such as fighting (Focus Group Discussion, 2 July 2016).

In 2012, a group called the Council of Elders was formed as part of a county initiative to improve communication with rural pastoralists. This organisation has its own administrative structure outlined in a constitution approved in June 2012. According to representatives of the Ministry of Public Service (Decentralised Administration and Disaster Management), the Council of Elders serves as an intermediary between the county government system and traditional governance structure. Even though many members are said to live in more urban and populated settlements, they derive their strength from consulting elders based in *adakar* and who sit under the tree of men (KII, 28 June 2016). However, while closely connected to *adakar*, the Council of Elders does not directly represent the mobile pastoralists (KII, 29 January 2019).

The Council of Elders Constitution explains that they promote the principles of Turkana leadership, from the basic social unit of family to communal leadership (Turkana Council of Elders, 2012). Unlike other tribes in East Africa that follow kinship organisation in the form of lineages, the Turkana can be described as a gerontocracy – governed by old people. In the family unit, this means the head of the household has the authority. In the community, it is the elders. These positions are not only old men, but rather individuals who also have wealth, and who display generosity and wisdom. This does not mean that the power of elders is unquestioned; those who do not perform well can be ignored and replaced through public opinion (Müller-Dempf, 1994).

Members of the Council of Elders are separate from the Chief's Elders, who primarily focus on the tasks related to the Location and Sub-location, which are overseen by the national government. However, the Chairman of the Council of Elders explained that there are frequently topics that require cooperation (KII, 26 June 2016).

Chief's Elders in Lokwamosing Sub-location explained their different roles and responsibilities in the *adakar*. Specifically, they said that Chief's Elders do not deal with land and water management issues, which are managed by the *adakar* elders. They only get involved in difficult cases that require government intervention, particularly issues related to security and peace around the *adakars* (Focus Group Discussion, 2 July 2016). A member of the Council of Elders in Turkana East Sub-county explained that members in his area know leaders from *adakar* in a given place. He identified at least five traditional leaders – *adakar* elders – who are linked to specific clans and sections. He said the inclusion of territorial section leaders is important for the discussion of issues around land, as they have a good understanding of the importance of *ere* and how grazing patterns are managed in different and overlapping territorial sections (KII, 4 July 2016). Similarly, in another example of how government leaders work with traditional elders, the Katilia Ward Administrator in Turkana East described how they cooperate closely with *kraals* in the area by inviting the leadership and ex-warriors to participate in peace talks (KII, 3 July 2016).

[40] Sometimes referred to as *Ekitoe a Ngikasukou*, literally tree of old men or elders.

West Pokot

Traditional governance structure in West Pokot County is based on the Pokot ethnic group, which predominates the county population. The terminology differs to that of Turkana but there are similarities in decision-making processes and communication.

All information in the list below is from a KII with a Pokot cultural specialist on 4 February 2019. Key terminology related to Pokot traditional social units includes:

- ***Kau or household***: This is the family unit headed by a male head of household, with one or multiple wives, children and often other dependent women. Households may cluster and travel with two to five other households to form a large *Kau*;
- ***Manyatta (plural, mongot)***: A group of *Kau* or households with familial ties. These mongot could be mobile units or small settlements (or villages). A *Mongot* representative is chosen by the settlement to attend the traditional parliament or gatherings on behalf of the village. These *Mongot* representatives are selected by members of the settlement, based on their effective communication, good judgement, intelligence and quick thinking;
- ***Clan:*** Non-territorial social organisation related to kinship and stock associations. All Pokot are born into the clan of one's father and the women join the clan of their husband upon marriage. There are 36 main clans in Pokot. Each clan has sub-clans, with 330 sub-clans in total. Clan heritage plays a part in determining roles within the traditional structure, with clan lineage associated with certain divine powers that are bestowed on individuals. For example, certain clans have been associated with the abilities of *Kirwook* and *Werkoy*. Certain clans also play specific functions at large gatherings, like *Kokwo* or *Mpoy*;
- ***Kirwook (Judges)***: This is a group of powerful and influential individuals who are perceived to have been bestowed with divine power from their deity. They are the ultimate authority in the traditional leadership structure. Individuals come from various clans and they are considered to have been gifted with wisdom, sense of justice and ability to solve problems. They command respect from all other sectors of the traditional structure. The clans associated with the abilities of a *Kirwook* are *Siwotoy* (buffalo), *Sotot* (sun), *Ngisurot* (rain), *Kasera* (dove), *Pkomor* (wild pig) and *Soko* (lion);
- ***Karoyok (Intestine readers):*** These individuals are believed to have the ability to read prophecies from animal intestines when animal sacrifice is done. If called upon, they usually provide guidance to the *Kirwook* leaders;
- ***Werkoy or "Laibon" (Seers)***: These are individuals who are believed to be gifted with spiritual insight and prefer to remain unknown (invisible) due to security reasons. Thus, they live apart from the settlements, mostly in the mountains and, if needed, they come to provide the Kirwook with guidance and knowledge. They have to be summoned through a messenger and these people are known in the area. A seer is bestowed their power through clan lineage and only specific clans are known to produce seers. *Werkoy* are uncommon and can be women, depending on their gifts;
- ***Kokwo (Tree of Men) (Elders gathering)***: This is considered the Pokot Parliament where decisions are deliberated on by *Kirwook* Elders. The size and representation of the gathering depends on the magnitude of the issue to be deliberated. Nearby *Kirwook* Elders (one or two people) and representatives from affected *Mongot* (homesteads) will convene at *Kokwo*. *Kokwo* is convened under special trees significant to the area. These are either fig trees, sycamore trees or tamarin indica trees; and
- ***Mpoy (Gathering of women)***: This gathering occurs to disseminate the information and the decisions made at *Kokwo* to the women. This group has no decision-making authority. However, this group deals with the discipline of men who abuse women. They are allowed to enact justice for any crime a man

commits against women. They have power to arrest, fine or beat men, depending on the crime and irrespective of the man's position in society.

The Pokot traditional structure aligns with the national and county administrations through the Location Chiefs and Assistant Sub-location Chiefs. According to a Key Informant on Pokot Culture, the chiefs are government messengers to the community and are seen as administrators of the government arm. Chiefs cannot make important decisions on their own, rather they would consult with a *Kirwook* elder. A village identifies elders based on their wisdom and respect in the community. Most elders are identified based on the powers associated with a *Kirwook.* If someone with this level of respect is not residing in the village, the nearest one is identified and consulted in matters pertaining to the whole sub-location or location. Communities are aware of who the traditional leaders are and will direct Chiefs to the correct person. Thus, there is a linkage between the government administration and traditional leadership (KII, 4 February 2019).

It was further reiterated that the linkage between the government administration and traditional leadership is through the village or settlement elder. This elder is chosen from the community and acts as the liaison between the Assistant Chiefs and the traditional leadership (*Kirwook*). The elders arbitrate over livestock disputes and social affairs such as adultery, abuse or assault. If issues are not of a cultural nature, the elder will refer issue to the Assistant Chief of the Sub-Location (KII with Pokot Cultural Specialist, 15 June 2019).

6.12.2.3 Demographics

The most recent census data from the Kenya Population and Housing Census (KPHC) was conducted in 2019. A summary of that information by Sub-county is presented in Table 6.12-19, including data from the 2009 census for comparison.

Table 6.12-19: Total Population of Turkana and West Pokot County

	2009 (Census)	2019 (Census)
Turkana County Total	**855,399**	**926,976**
Kibish	NA	36,769
Loima	119,932	107,795
Turkana Central	134,674	185,305
Turkana East	90,466	138,526
Turkana North	129,087[41]	65,218
Turkana South	135,913	153,736
Turkana West	245,327	239,627
West Pokot County Total	**512,690**	**621,241**
Pokot Central	85,079	119,016
Pokot North	156,011	134,485
Pokot South (includes Kipkomo)	132,100	183,294
Pokot West	139,500	184,446

*Source: Turkana County Government; West Pokot County Spatial Planning, 2018; *Projection figure provided by West Pokot County Planning Unit; Kenya National Bureau of Statistics, 2019.*

[41] 2009 figure includes Kibish.

In comparison with data from the 2009 census, these figures indicate some differing trends. The census conducted in 2009, counted a total population of 855,399 in Turkana County. This represented 2.2% of the total population of Kenya, which totalled just over 38.6 million people. The census counted a total of 988,592 ethnic Turkana in the whole country, indicating that 86% of the Turkana people reside in Turkana County. By comparison, the population of ethnic Pokot in Kenya was 632,557 and population of West Pokot County was recorded as 512,690 in the 2009 census.

At that time, the population of Turkana County was expected to be over 1 million in 2012, but precise official statistics were not available. Table 6.12-20 provides the projections for population figures in Turkana and West Pokot County based on a predicted and steady population growth rate of 6.4% a year (Turkana County Government, 2013; West Pokot Spatial Plan, 2019).

Table 6.12-20: Total Population of Turkana and West Pokot County

	2009 (Census)	2012 Projection	2015 Projection	2017 Projection
Turkana County	855,399	1,036,586	1,256,152	1,427,797
West Pokot County	512,690	631, 231	700,414	777,180*

*Source: Turkana County Government; West Pokot County Spatial Planning, 2018; *Projection figure provided by West Pokot County Planning Unit*

However, the new figures from 2019 suggest that projections were incorrect, especially in Turkana County.

Population figures for Turkana County are frequently presented with a note of caution given that there is unreliable data due to the movement of pastoralist communities, making it difficult to count and track population figures. The 2019 data has drawn the attention of the Turkana County Government and raised questions as to the accuracy of the count. In November, the governor sought a response from the central government as to the preliminary indication of a reduction in three Sub-counties: Turkana West (2.3% decrease), Turkana North (38.6% decrease) and Loima (10% decrease). He suggested that the discrepancies are linked with the inability of migrant pastoralists to be enumerated accurately at the time of the census (County Government of Turkana, 2019).

In addition to the figures highlighted by the Turkana officials, the Sub-county figures suggest movement within Turkana County, especially to Turkana East where TKBV has most of its infrastructure. This area, in contrast to the Sub-counties that have decreased in population, has shown an increase of over 50%. While these numbers are being called into question, they indicate a shift towards the Project AoI.

No figure for the number of ethnic Pokot or other ethnic minorities living in Turkana County is available and no data obtained in either county disaggregate population by ethnicity. The relationship between ethnic Pokot and Turkana residing in Turkana County is described in more detail in Section 6.12.2.11 on Social Capital, Security and Conflict.

No data for the 2019 census if available for administrative units below the Sub-county. In 2009, the two Turkana Sub-counties in the AoI, there are approximately 225,000 people. Table 6.12-21 and Table 6.12-22 show the results of 2009 census at the Sub-location level.

Table 6.12-21: Population of Turkana South Sub-county

Turkana South					
Division	**Population**	**Location**	**Population**	**Sub-location**	**Population**
Lokichar	67,742	Lokichar	23,452	Lokichar	10,820
				Kapese	12,632
		Lochwangi Kamatak	20,781	Lochwangi Kamatak	14,561
				Naposumuru	6,220
		Kalapata	23,509	Kalapata	8,941
				Loperot	7,384
				Nakalale	7,184
Kainuk	26,247	Kainuk	11,128	Kainuk	7,151
				Kakongu	1,883
				Loyapat	2,094
		Kaputir	15,119	Kalomwae	3,634
				Nakwamoru	9,080
				Lorogon	2,405
Katilu	41,924	Katilu	41,924	Katilu	17,686
				Lokapel	7,475
				Kalemngorok	8,531
				Kanaodon	8,232
Total Population Turkana South Sub-county					**135,913**

Source: 2009 census

Table 6.12-22: Total Population of Turkana East Sub-county

Turkana East					
Division	**Population**	**Location**	**Population**	**Sub-location**	**Population**
Lomelo	25,438	Lomelo	2,900	Lomelo	1,144
				Katir	1,756
		Napeitom	6,305	Napeitom	6,305
		Nadome	4,572	Nadome	2,975
				Ekipor	1,597
		Kamuge	8,651	Kamuge	5,104
				Ngilukia	3,547
		Kapedo	3,010	Kapedo	1,415
				Silale	1,595
Lokori	65,028	Lokori	32,682	Lokori	8,261
				Kangitit	6,400
				Lotubae	18,021
		Kochodin	4,849	Kochodin	2,039
				Lopii	2,810
		Lochwaakula	6,514	Lochwaakula	1,566
				Kakulit	2,029
				Lokwamosing	2,919
		Katilia	20,983	Katilia	7,747
				Elelea	3,907
				Parkati	9,329
Total Population Turkana East Sub-county					90,466

Source: 2009 census

Turkana County is characterised by clustered settlements. Rural areas are settled by nomadic pastoral communities on a temporary basis as they move in search of water and pasture for their livestock (Turkana County Government, 2013). Rural settlements are often dispersed along luggas, with the community taking their name from the lugga closest to the location. This means that such settlements are linear as they grow alongside the luggas.

Lodwar town, Kakuma and Lokichggio are the three main urban centres in Turkana County. In recent years, this list has expanded to include Lokichar in Turkana South, Lokori in Turkana East, Lokitaung in Turkana North, Kalokol in Turkana Central and Lorugum in Loima, which are the only centres reported to have any urban plans (KII, 4 February 2019). Lodwar town had the largest population of the urban centres, with a total of 35,897 people according to the 2009 census. Figures for urban centres are not yet available from the 2019 census. Kakuma is unique in that it hosts a refugee camp sheltering people fleeing from Sudan, Ethiopia, Uganda, Somalia and Burundi (Turkana County Government, 2013).

Multiple efforts have been made to obtain comparative data on demographics in Turkana East and South Sub-counties. While many Location Chiefs do have written documents or the ability to estimate their population, it is clear that hand-written data and statistics should be treated with caution. Some cite the same figures as the 2009 census and others have typed documents without any clear source or data. No data was obtained from Assistant County Commissioners, Sub-county Administrators or Ward Administrators. Efforts to obtain data from County authorities in Lodwar are linked to food aid distribution. However, these figures are based on multipliers related to the 2009 census, not actual data (KII, 31 January 2019) and 2019 data for the Sub-counties suggest that the multipliers were inaccurate predictors of the demographic change.

During KIIs in May 2017, Sub-location Chiefs provided population estimates for their jurisdictions. These figures were explained to be the data used in the distribution of food aid, which is provided throughout the area and based on population size (KII, 17 May 2017). Table 6.12-23 compares the data provided by Sub-location Chiefs with the data from the 2009 census.

Table 6.12-23: Total Population of Key Locations in the AoI

Location	Population (2009 census)	Estimated Population	Sub-location	Population (2009 census)	Estimated Population
Lokichar (TS)	23,452	36,275	Lokichar	10,820	17,068
			Kapese	12,632	19,207
Kochodin (TE)	4,849	6,410	Kochodin	2,039	3,972
			Lopii	2,810	2,438

Source: 2009 census; KII, 17 May 2017

Assuming the Location Chief's estimates are accurate, comparisons can be made with the expected rate of growth from the County Integrated Development Plan, which suggested an approximate increase of 67% by 2017 (Turkana County Government, 2013). Kochodin is the only Sub-location estimated to exceed the expected increase, almost doubling its population size. The Sub-location of Lopii within the Kochodin Location is estimated to have reduced its population by 13%, with insecurity bring the most likely cause. Such predictions contradict the 2019 Sub-county data, which shows Turkana East growing at the fastest rate in the County.

There are many reasons to question the information in the Table 6.12-23. While the rate of growth indicated is close to the projections made after the 2009 census, unpublished reports have suggested that the figures are actually much higher, with some suggesting that the population of areas of Kochodin, including some of the closest villages to the TAN field areas, may be over 15,000 people alone. During research in 2019, opinions varied widely among key informants. There was a broad consensus that the population has increased, especially in key areas in the vicinity of existing TKBV operations. However, most also agree that there has been a slowing, or even a reversal, of influx after TKBV scaled back operations in 2017 (KII, 29 January 2019). KIIs in 2019 also suggested that migration patterns, in general, show people moving toward larger settlements, making it very difficult to determine if the observed influx into places like Lokichar differs to that observed at other urban areas of the county.

Anecdotal information collected in primary research suggests that population figures shift because of the availability of grazing land and water, as well as security concerns. The Sub-location Chief of Lochwaangi Kamatak in Turkana South said this is the case with the oasis in his area, where water was good for animals but not fit for human consumption (KII, 29 June 2016). The Sub-location Chief of Kakongu, also in Turkana South, described a similar dynamic. In his Sub-location, he said influx of pastoralists can increase the population tenfold in a short span of time. This results in problems as groups fight for water and, in some cases, increases crime, including the theft of animals and even the rape and abduction of girls (KII, 1 July 2016).

In Kamuge Location of Turkana East, the Chief confirmed that, even though the population has increased since the 2009 census, much of the population has temporarily moved to more urban centres, such as Lokori, due to insecurity. This, he explained, creates a situation in which they set up new permanent areas of residence, but still desire the chance to go back to their traditional home or *ere*. In many situations, some members of a household will stay in the population centres, but families will still keep their animals within Kamuge in *arumrum*, the mobile pastoralist groups set up to improve security in rural areas (KII, 1 July 2016).

The population of West Pokot County in the 2009 was estimated to have a rural population of approximately 117,413. The proportion of people living in urban areas was estimated to be 22.9% of the total population. The rest of the population resides in the periphery of towns and in rural settlements, where agriculture and livestock production are dominant activities (West Pokot Spatial Plan, 2019).

Urban areas and high potential agricultural areas have high population distribution and density. The population density for the county was expected to increase from 69/km^2 in 2013 to 85/km^2 in 2017, due to the high population growth.

The AoI includes a small area of West Pokot Sub-county, including the Endugh Ward, Kositei Location and the Kasitei and Chepochachim Sub-locations (refer to section 6.12.2.2.1). The population of the Endugh Ward is 17,502 (West Pokot Spatial Plan, 2019). Based on the 2018 estimates of the Assistant Chiefs, the population of Kasitei is 1,052 and Chepochachim is 1,080 people (KII, 2 February 2019).

6.12.2.3.1 Migration

Migration is at the heart of the way most residents of Turkana County live. Raising animals is the main part of social and economic life. Studies of Turkana life written in the 1950s are still relevant today, where a person is said to grow up and pass through the stages of life being accompanied at every stage by livestock. As soon as one is able, boys begin to herd their father’s stock. Girls learn to water, milk, skin and cut up carcasses, cook meat and work skins (Gulliver, 1951). The severe hazard of erratic rainfall is a critical influence on the main economy of the region, predominantly animal husbandry. Those living in Turkana have adopted strategies to exploit scattered resources that vary unpredictably, causing people to adopt flexible strategies of mobility. This mobility of people and their herds is a prerequisite for survival for a large majority of the Turkana people (Müller-Dempf, 1994). One anthropologist with extensive research experience in Turkana said a general rule of thumb is that most Turkana operate on the assumption that two of every five years is “far from being good”, one year is a drought and every ten years there is a catastrophic drought when two or more drought years happen in a row. As a result, Turkana exploit the harsh environment with herd management and adaptability (Müller-Dempf, 1994).

The pastoralist communities of northern Kenya, which includes areas of West Pokot Sub-county, migrate as part of their livelihood, moving their homes and animals to utilise natural resources in the difficult natural environment. This traditional migration is distinct from a second type of migration that is driven by external factors. In Turkana and West Pokot Counties, this includes conflict and a search for security, as well as migration for economic opportunities. The second type of migration, economic migration, may ultimately improve trade, employment, infrastructure and services, but it can also negatively affect "host" communities in relation to environmental, social and health issues.

Primary research illustrated how many households move on a seasonal basis and how varied their routes can be. Pastoralist culture is nomadic, and people migrate with their herds for better grazing lands and to water sources during the different seasons of the year.

As an example of the second type of migration, one Lodwar based NGO explained that there is a trend in rural-to-urban migration, which they attribute to people dropping out of pastoralism because of conflict, prolonged droughts and loss of animals to disease. Such migration generates informal settlements in major towns like Lodwar. This trend was observed as early as the mid-1980s when the UN set up camps to support refugees in Lokichoggio Urban Settlement, Turkana West Sub-county. Refugees supported by these camps were from civil wars in neighbouring countries (KII, 22 June 2016). In Turkana Central, one Sub-location Assistant Chief attributes population increase to displacement of people from post-election violence in 2007, as well as natural causes, like flooding (KII, 24 June 2016). Multiple interviews in 2019 highlighted that infrastructure development, such as roads, and oil discoveries have led to migrants arriving from Kitale, Eldoret and even as far as Nairobi. This influx has a mixed effect, with some reporting that outsiders "bring chaos" (KII, 30 January 2019), while others, particularly in the business community, say that the outsiders bring new ideas and business (KII, 30 January 2019).

As in Turkana, migration in West Pokot is driven by seasonal changes due to the same pastoral culture and lifestyle. Migration of pastoralists and livestock to seek better water sources leads to increased competition for these available resources especially in times of limited rainfall. It was noted during fieldwork interviews that migration into the West Pokot and Turkana borderline areas by Turkana and Pokot respectively have also been the basis of insecurity and conflict in these areas. The level of insecurity and instability increases during times of limited rainfall when migration occurs, and scarce resources increases conflicts between migrants and residents (KII, 14 June 2019).

6.12.2.3.2 Vulnerable Groups

The consideration of "*vulnerable*" groups must be considered in the context of the term throughout Kenya. Article 260 of the 2010 Constitution makes specific provisions for "marginalised groups", by which it defines marginalised as:

- A community that, because of its relatively small population or for any other reason, has been unable to fully participate in the integrated social and economic life of Kenya as a whole;
- A traditional community that, out of a need or desire to preserve its unique culture and identity from assimilation, has remained outside the integrated social and economic life of Kenya as a whole;
- An indigenous community that has retained and maintained a traditional lifestyle and livelihood based on a hunter or gatherer economy; or
- Pastoral persons and communities, whether they are (i) nomadic; or (ii) a settled community that, because of its relative geographic isolation, has experienced only marginal participation in the integrated social and economic life of Kenya as a whole.

The Constitution further states that "*marginalised group*" means a group of people who, "*because of laws or practices before, on, or after the effective date, were or are disadvantaged by discrimination…*". By such Constitutional definitions, the Turkana people can be considered marginalised or vulnerable.

Other common criteria for assessing vulnerability are poverty rates. In 2013, the County Integrated Development Plan estimated that 90.8% of the population of Turkana live below the poverty line (Turkana County Government, 2013). Such rates are extremely high and further suggest that the entire County can be considered vulnerable.

Another factor in assessing poverty, sometimes left out of standard measurements of income, are whether households are non-pastoralist, as distinguished from those that still practice pastoralism. This distinction can influence the pattern of poverty, with most poverty being found in settled or town-based ex-pastoralists, casual labourers and traders (Little, 2014).

While it is clear that, by definition in the Constitution, the Turkana people are marginalised, traditional criteria for assessing poverty need to be considered in the pastoral context. When asked about vulnerability during field research, key informants frequently cited common factors that are used for targeting additional aid or humanitarian assistance to individuals within a Location or Sub-location. Commonly cited groups are:

- Orphans and Vulnerable Children (OVCs);
- Elderly;
- Widows;
- People with disabilities; and
- People with HIV.

According to the Assistant Sub-location Chief of Lochwaangi Kamatak, vulnerable groups are sometimes identified using criteria established by groups intending to assist vulnerable groups (KII, 29 June 2016).

The NDMA in Kenya is the governmental body that coordinates all matters relating to drought risk management and establishes mechanisms, either on its own or with stakeholders, that will end drought emergencies in Kenya and promote sustainable livelihoods. The NDMA was established to develop project-based interventions at a time when drought periods were becoming increasingly frequent and intense, directly affecting the household food security and livelihoods of more than ten million people (NDMA, 2017).

The NDMA, working with World Vision and Oxfam, identified vulnerable households by registering poor households on a database in 2012. A system of wealth ranking was used to generate a database of “poor” households. Through this database, they were able to assess the eligibility of households to receive benefits from a cash transfer program as part of a hunger safety net sponsored by the government and the UK Department for International Development (KII, 27 June 2016). An estimated 39,000 households, or roughly 20% of those assessed, were considered to be vulnerable or living on $1 or less per day (KII, 1 February 2019).

The NDMA also produces monthly reports on drought early warning and address socioeconomic indicators related to livestock conditions and market performance (crop prices for maize and beans, terms of trade), vegetation cover, access to water sources and food consumption. The assessment is focused on several livelihood zones, being these Pastoral, Agro-pastoral and Fisher folk for Turkana, and Pastoral, Agro-pastoral and Mixed farming for West Pokot.

In terms of vulnerability, pastoralism is considered as the most vulnerable of these livelihood zones given that it is based on a single livelihood (KII, 14 June 2019). The population proportion for this livelihood zone is 60% for Turkana and 33% for West Pokot. NDMA also assess vulnerability based on anticipated natural disaster affecting households, where food and nutrition security indicators report less favourable conditions for pastoral livelihoods, when comparing with the other livelihood zones during both the short and long rains assessment. Table 6.12-24 provides an overview of the differences between livelihood zones assessed by NDMA for Turkana and West Pokot and compares three indicators during short and long rains where pastoral livelihoods zones present less favourable conditions when water consumption or distance to grazing is assessed (in comparison to the other two livelihood zones).

Table 6.12-24: Food Security Trends for Turkana and West Pokot 2019

Indicator	Turkana [a]		West Pokot [b]	
	Short Rains Assessment Feb 2019	Long Rains Assessment July 2019	Short Rains Assessment Feb 2019	Long Rains Assessment July 2019
Livestock body condition	Pastoral: Fair	Pastoral: Good	Pastoral: Fair	Pastoral: Good
	Agro-pastoral: Fair	Agro-pastoral: Good	Agro-pastoral: Fair	Agro-pastoral: Good
	Fisher folk: Fair	Fisher folk: Fair	Mixed Farming: Good to Fair	Mixed Farming: Good
Water consumption (litres per person per day)	Pastoral: 10 litres	Pastoral: 10 litres	Pastoral: 5 to 10	Pastoral: 8 to 10
	Agro-pastoral: 10 to 15 litres	Agro-pastoral: 20 litres	Agro-pastoral: 10 to 15	Agro-pastoral: 10 to 15
	Fisher folk: 15 litres	Fisher folk: 10 litres	Mixed Farming: 15 to 20	Mixed Farming: 15 to 20
Distance to grazing (km)	Pastoral: 5 to 15 km	Pastoral: 5 km	Pastoral: 6 to 8 km	Pastoral: 3 to 4 km
	Agro-pastoral: 3 to 5 km	Agro-pastoral: 4 km	Agro-pastoral: 2 to 4 km	Agro-pastoral: 1 to 2 km
	Fisher folk: 2 to 7 km	Fisher folk: 4 km	Mixed Farming: 2 km	Mixed Farming: <1 km

Source: [a] Turkana County 2019 Long Rains Food and Nutrition Security Assessment Report, NDMA 2019a; [b] West Pokot County 2019 Long Rains Food and Nutrition Security Assessment Report, NDMA 2019b.

The County Government notes that people with disabilities have been marginalised in all sectors of development within the county. They explain that such people have been treated with disdain and are seen as dependents who cannot add value to developmental processes. There has been a national campaign to recognise that people living with disabilities should not be treated with contempt but should be given equal opportunities, similar to those given to other special interest groups, such as women and young people. A major challenge in Turkana County is that there are only a few institutions that take care of the needs of persons with disabilities (Turkana County Government, 2013).

Vulnerable groups receive aid from a variety of sources, depending on the groups in need. For young people and women, for example, the government has set aside 6.9 million KES (~$65,400 USD). This has assisted over 1,200 registered groups who have aided in the development of business ideas. Managed via the Ward Administrators, the programme awards anywhere from 70,000 KES up to 1.1 million KES (~$700 up to ~$10,400 USD) for projects related to shore management along Lake Turkana (KII, 29 June 2016). Vulnerable people are also assisted by NGOs and organisations, such as the NDMA. The Sub-location Assistant Chief of Kakongu listed the Red Cross and World Vision as known NGOs that have provided assistance to vulnerable groups (KII, 1 July 2016).

6.12.2.4 Infrastructure and Services

In general, by nature of its location, climate and relatively neglected history since independence, the infrastructure and services of Turkana County are poor. However, there are recent signs of improvement.

A representative of the German NGO GIZ (Gesellschaft für Internationale Zusammenarbeit) stated that infrastructure and services are improving as a result of the devolved system of government. Health facilities are improving and the distance to health facilities has been reduced. There are more ECD facilities, which has allowed more access to education for small children. Improvements have been generally more noticeable in Lodwar, as a result of increased employment from devolution and the activities of key NGOs. However, some areas have not seen much improvement at all, especially in areas affected by the lack of security along the A1 highway (KII, 25 June 2016).

West Pokot County infrastructure is similar to that of Turkana County, with poor waste and sanitation systems. Education facilities are also limited, especially for those living as pastoralists. Facilities, including schools, are minimal unless they are funded by churches or NGOs (KII, 31 January 2019).

6.12.2.4.1 Waste

Waste disposal is a major contributor to environmental degradation in Turkana county. Local authorities collect only 0.2% of the waste generated communities. Only 20,000 households in Turkana County are thought to use latrines. This situation contributes to water, soil and air pollution and poses a health threat to communities (Turkana County Government, 2013). One NGO in Lodwar that has monitored waste management notes an overall lack of facilities to manage waste and poor infrastructure, especially in the informal settlements in the town of Lodwar, which is considered to be the only settlement in Turkana with waste management services. The group reported that, even in Lodwar, there is no legal site to dump waste. There are only two solid waste collection trucks, which collect waste from a limited number of locations in Lodwar town. These trucks make one trip a day and this constitutes the only waste management service in the entire town. The trucks use the existing dump site for waste but have recently received a permit by improving the location and fencing it. The overall lack of waste facilities causes people to dump illegally, including in the Turkwel River, which runs through Lodwar (KII, 22 June 2016).

The Lodwar Water and Sewerage Company (LOWASCO) is the only service to collect and manage liquid waste, which mainly consists of sewage discharge from septic tanks across Lodwar. Most of this sewage comes from hotels and septic tanks (KII, 22 June 2016).

In West Pokot County, there is no sewerage network system. Septic tanks and pit latrines are the most common waste water disposal systems. A majority of households in rural areas use pit latrines, while urban sanitation comprises septic tanks and pour and flush systems of sanitation. According to the latest survey conducted in the County in 2013, completed by Action Against Hunger (AAH) in collaboration with MoH, West Pokot had latrine coverage of 18%. This has since increased to 48.7%. The number of households with latrines stands at 30,449, representing 33% of the population. There are 156 households using septic tanks for disposal of sewage and wastewater, 1,922 households with ventilated improved pit (VIP) latrines, 28,527 households using pit latrines and a majority of 62,901 households, representing 67% of the population, using bushes (especially in the rural areas) (West Pokot Spatial Plan, 2019).

6.12.2.4.2 Water

Turkana County has inadequate water for domestic use, livestock and crop irrigation. Rainfall is inadequate and too unreliable to meet demand. About 88% of Turkana's residents depend on surface and sub-surface dams for water, which often do not hold sufficient water due to the high evaporation rate during the dry seasons. According to the County Government, the main water sources in Turkana are hand dug shallow wells, piped water and river water. Access to quality water is a critical problem for the County, although a recent programme managed by the National Government and United Nations International Children's Emergency Fund (UNICEF) has benefited some communities with new wells dug to improve assess in schools. Some of these wells generated high yields. There is just one water supply company, LOWASCO, which operates only in Lodwar. All other areas get their water from the main sources noted above (Turkana County Government, 2013).

The distance to the closest water point varies throughout the County but averages between 5 and 10 km. In urban settlements and some market centres, Water User Associations have developed piping systems that move water closer to settlements. However, this is the exception. In remote areas of the County, people can travel 10 to 20 km to reach their closest water source (Turkana County Government, 2013).

Across Turkana East and Turkana South, TKBV has contracted a supplier to use water bowsers to fill the water storage tanks daily. The Location Chief of Kochodin indicated that there is a government plan to drill a borehole in Nalemsekon for purpose of irrigating 500 acres of land, which has already been fenced. It will benefit about 100 households. One borehole was drilled by TKBV in Nakukulas area and a hand pump in Karuko. The furthest distance people travel in Nakukulas settlement to get water is 500 m (KII, 4 July 2016).

The households in West Pokot County with access to borehole/spring/well water stands at 26,259, which translates to 28% of the population. There are also 8,563 households with access to piped water, while 1,210 households piped water in their dwellings. However, the majority of households (59% of the population) still use rivers/streams as their source of water. The average distance to the nearest water point is 5 km. In summary, water resources in the county are unevenly distributed (West Pokot Spatial Plan 2019).

The Turkwel Dam has a maximum design capacity of 1.5 million cubic metre per day (m^3/d) yield. It is used for hydro-electric power generation. The dam borders North Pokot and West Pokot Sub-counties and falls within the Turkwel Ward of West Pokot Sub-county (KII, 1 February 2019).

In the Kositei Location, Pokot West Sub-county, water is sourced from the Suam River, Malmalte River and the Turkwel dam itself. There are no boreholes in Kositei Location. However, the closest borehole is in the Kour Sub-location in Pokot North Sub-county and was drilled by TKBV. People who are close to the water source have regular access, but others can walk for a distance of 8 km, up to 4 hours, to the source. Residents from the most distant village, Kamurio, can walk up to 23 km to fetch water. The people, domestic animals and wild animals all depend on these water sources throughout the year (Focus Group Discussion, 2 February 2019).

6.12.2.4.3 Electricity

The challenges facing the power sector in Turkana include weak transmission and distribution infrastructure, high cost of power, low per capita power consumption and low Country-wide electricity access. Only 1% of households have access to electricity in the home, even with the close proximity of the Turkwel dam hydroelectric facility (Turkana County Government, 2016). Hydroelectric power only connects to Kainuk, and recent efforts have connected Kalemngorok, Katilu, Kakongu and Lokichar to the main grid. Lodwar settlement is powered by diesel generators and several other projects are underway to connect larger population centres. Within the household, 95% use kerosene and firewood for lighting. Similarly, cooking is done with wood, kerosene and charcoal. Some solar energy has been used for pumping of water and lighting, especially in schools (Turkana County Government, 2016). Kenya Power is also piloting the use of solar energy. It has installed panels at the Lodwar station to complement diesel production. In addition, the Ministry of Energy has installed 98 solar panels on schools and government buildings (Turkana County Government, 2013). Some households near Lodwar were observed to have solar panels and wired electricity, but supply was said to be intermittent and data on such infrastructure was not available.

The Location Chief in Kochodin confirms that there is no electricity supply in the area, with most people using torches for lighting purposes (KII, 4 July 2016).

Wind is seen as a potential resource for the future. This potential has led to the development of the Lake Turkana Wind Power project in neighbouring Marsabit County. This project comprises 365 wind turbines and will connect to the national grid. It is expected to generate 310 MW (approximately 15% of the country's installed capacity). As of October 2016, the project was expected to input its first 90 MW of wind power into the national grid by the second quarter of 2017 (Lake Turkana Wind Power, 2017).

In West Pokot County, the main source of energy is fuel wood, which accounts for 90% of the energy needs of the county population. Petroleum energy is another source, accounting for 5% of energy needs. Only 2% of the population accesses electricity and only 10% are connected with power. Electricity power outages are also prevalent in the county. Paraffin, which is another source of energy, is used by 8% of population. Other sources of energy in the county include charcoal and solar. The county has high potential for solar energy, which remains untapped (West Pokot Spatial Plan 2019).

In the Kositei Location, West Pokot Sub-county, there is no electricity in Chepokachim Sub-location, but there is in Kasitei Sub-location, specifically in the Kampi Village (Turkwel camp) and Turkwel Secondary school (KII, 2 February 2019). Electricity is also connected to the Riting Primary School, but the rest of the location's schools and villages are powered by solar power systems provided by the national government and the use of firewood (KII, 30 January 2019).

6.12.2.4.4 Roads and Transport

The Turkana County road network is poorly developed. There are 5,496 km of existing roads, of which only 489 km are bitumen. Key challenges for road development are seasonal rivers that cut through roads and poor soils that increase the cost of construction and maintenance. Many roads are not passable during rainy seasons (Turkana County Government, 2013).

There are 22 air strips for air transport, 4 of these being tarmacked facilities: Lodwar, Lokichoggio, Kakuma and Kalokol (Turkana County Government, 2013).

The poor condition of roads was mentioned in numerous interviews. The roads are corrugated and badly weathered with potholes. Many sections are impassable in wet conditions and vehicles get stuck for days. In Kalemngorok, livestock traders blame the road conditions on their ability to meet supply orders (Focus Group Discussion, 5 July 2016). In Lokori Ward, the Ward Administrator explained that the dry season allows for greater access to surrounding areas, linking the area to other trading centres not available in the rainy season (KII, 1 July 2016).

In West Pokot County, road transport is the major mode of transport. The road network is relatively well developed. It is predominantly earth and gravel surfaces, which make up 87% of the road network. The gravel surface roads cover a distance of 349 km, while the earth surface roads cover 697 km. The total length of tarmac road is only 151 km. The general status of the road network in West Pokot County is poor. There is an airstrip at Kishaunet but, apart from this, air transport is non-existent (West Pokot Spatial Plan, 2019).

The road network in the Kositei Location, Pokot West Sub-county, is mostly in poor condition. The road to Turkwel from the Kainuk junction is tarmacked but other areas of the road network are not as well maintained. As a result, access to most parts of Kositei Location and the broader Turkwel Special Ward area is very difficult. There is even the use of motor boats to cross the dam as a means of transport (KII, 29 January 2019, 11 June 2019).

6.12.2.4.5 Media

Radio is one of the few forms of media available in Turkana. Radio Turkana, one of the main stations, covers about 75% of the county and has broadcast information on oil and gas exploration. Coverage of the station is mostly in Turkana East, Turkana South, Turkana Central, and Loima. While this is a commercial entity, it works with charitable organisations to support development initiatives, such as encouraging testing for HIV (KII, 25 June 2016).

There are no newspapers printed in Turkana County, however journalists work as freelancers for Nairobi based media and they report for national media outlets (KII, 1 February 2019).

There are three main local radio stations in West Pokot. Each transmit from the town of Mukutano and the language used is primarily in Swahili and the local Pokot language. These cover the entire County and can also be received in neighbouring Counties like Turkana, Trans Nzoia and Elgeyo Marakwet. Radio is the main and preferred media in rural areas while more urban residents tend to watch national television.

6.12.2.5 Economics and Livelihoods

The majority of people in Turkana County and West Pokot County depend on nomadic pastoralism and crop farming, as well as fishing and weaving for their livelihood. Types of livestock bred in the AoI are cows, goats and sheep (shoats), camels, donkeys, and poultry (mainly chicken). Most of these are indigenous breeds. The Kerio River and Turkwel River are key sources of water to support animal husbandry. Farming is mainly practiced at household level through irrigation along the Rivers Turkwel and Kerio. The main crops produced in Turkana are sorghum, millet, maize, and vegetables, like kales. Fishing is also practiced in Lake Turkana (Turkana County Government, 2013).

In West Pokot County, apart from agricultural and livestock enterprises, transport, trade and small-scale gold mining is increasing in economic importance. The trade in the market centres is increasing, especially at Makutano, Chepareria, Ortum and Marich townships. Small-scale gold mining activities are present in parts of the county and support thousands of people (West Pokot Spatial Plan, 2019).

In response to a drought and increase in food prices that took place in 2010 to 2011, Oxfam led a group of development agencies in trying to improve early warning systems, differentiate between chronic and acute vulnerability and better understand livelihoods, in order to better understand how to respond to emergencies. This generated a division of Turkana County into six zones in a livelihood framework. Each zone is defined as an area within which people generally share the same patterns of access to food, such as they grow the same crops or keep the same types of livestock. They also share the same access to markets. Patterns of livelihood clearly vary from one area to another. Local factors, such as climate, soil and access to markets, all influence livelihood patterns (Oxfam Save the Children, 2012).

West Pokot County has three main livelihood zones, namely pastoral (60%), agro-pastorial (20%) and mixed farming (20%). The county is divided into these zones with the high potential agricultural land being predominantly in the south of the county.

The AoI falls mainly in the Turkana central pastoral (TCP) livelihood zone. Within this zone, 80% of the population rely on livestock to provide the main source of food and cash income. The remaining 20% depend on a combination of self-employment (e.g., charcoal, mat and basket making, brewing), wild food and relief. This zone has relatively less grassland than the Turkana border pastoral (TBP) livelihood zone but is more secure and has better access to key markets in the County, as well as to government services. There is no agriculture, nor any cash crops in the TCP (Oxfam Save the Children, 2012).

Areas on the border of Turkana and West Pokot Sub-counties are part of the Turkwel agro-pastoral (TAP) livelihood zone where some irrigation schemes have been developed (Oxfam Save the Children, 2012).

6.12.2.5.1 Pastoralism and Agro-pastoralism

Turkana County has about 2.5 million hectares of arable land. Land has been under-exploited for agricultural production. Only 31% of land in the high and medium area is under production, which represents only 5% of the land in the county. ASAL which represents 84% of the land also remains largely underutilised. The agricultural yield is limited by factors like water, soil nutrients and skilled labour, as well as pest, animal disease and post-harvest wastage (Turkana County Government, 2016).

In West Pokot County, pastoral livelihoods are predominantly practiced by the population. The livestock industry contributes to the food and cash needs of the pastoralist and provides employment to 90% of the population of

512,690 (Census: 2009). It is also used as a medium for social exchange in the payments of bride price, fines, and gifts (West Pokot Spatial Plan 2019).

High potential agricultural land is found in three divisions located in the South of West Pokot, these are: Kapenguria, Chepareria and Sigor. While rain fed crop production is possible only in parts of Kapenguria and Chepareria, farming in Sigor depends on irrigation. A large variety of crops is grown, including maize, finger millet, sorghum and beans and the main cash crop production is based on coffee, pyrethrum and cotton. The County Agricultural Office reports that 60% of the farmers in Kapenguria division can be classified as modern farmers while in Chepareria 20% can be classified as modern. Modern farmers use certified seeds, fertilizer, chemicals and to some extent, machinery on their farms. These modern farmers also adopt good crop husbandry practices, which reflects a gradual move towards market-oriented production (West Pokot Spatial Plan 2019).

There is limited quantitative data that allows for socio-economic trend analysis. The NDMA monitors the spread of diseases amongst livestock and some biophysical and socio-economic indicators. NDMA has 9 monitors (reduced from 21 monitors in 2016) in each livelihood zone. Each month, each monitor conducts 30 individual surveys in order to get data for the whole County (KII, 27 June 2016 and 1 January 2019).

Aggregated information is used each month to determine an overall status in the early warning system. Based on the overall aggregated determination, NDMA raises a flag at various state institutions such as schools in order to inform residents of the current status (KII, 27 June 2016). NDMA have reported several drought alerts towards 2018 (Table 6.12-25 and Table 6.12-26). The drought conditions have changed for 2019, though. Where Turkana reports an “alarm” status for March and April 2019 and West Pokot an “alert” status from February to June 2019.

Table 6.12-25: Livelihood Zone and Turkana County Status for Drought Early Warning September 2018 to August 2019

Zone	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Pastoral - All species	Norm	Alert	Alert	Alert	Alarm	Alert	Alarm	Alarm	Alert	Alert	Norm	Norm
Agro-Pastoral	Norm	Norm	Norm	Alert	Alert	Alert	Alarm	Alarm	Alert	Norm	Norm	Norm
Fisheries	Norm	Norm	Alert	Alert	Alert	Alert	Alarm	Alarm	Alert	Norm	Norm	Norm
County	Norm	Norm	Alert	Alert	Alert	Alert	Alarm	Alarm	Alert	Norm	Norm	Norm

Source: NDMA Drought reports September 2018 – August 2019

Table 6.12-26: Livelihood Zone and West Pokot County Status for Drought Early Warning September 2018 to August 2019

Zone	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Agro-Pastoral	Norm	Norm	Norm	Norm	Norm	Alert	Alert	Alert	Alarm	Alert	Norm	Norm
Pastoral	Norm	Norm	Alert	Alert	Alert	Alert	Alert	Alarm	Alert	Alert	Norm	Norm
County	Norm	Norm	Norm	Norm	Norm	Alert	Alert	Alert	Alert	Alert	Norm	Norm

Source: NDMA Drought reports September 2018 – August 2019

NDMA also monitor Terms of Trade (ToT), a livestock price ratio that measures the proceeds from the sale of a goat in relation to the amount of maize that can be purchased. West Pokot has presented a solid growth on its ToT during the last quarter of 2018, meaning that individuals are able to purchase more maize (kg) per every goat sold. Turkana shows lower and slight variations for the last reporting year. While higher terms of trade, West Pokot reported a drop in the first part of 2019, though it remains higher than in Turkana at the last reporting period in August of 2019 (Figure 6.12-5).

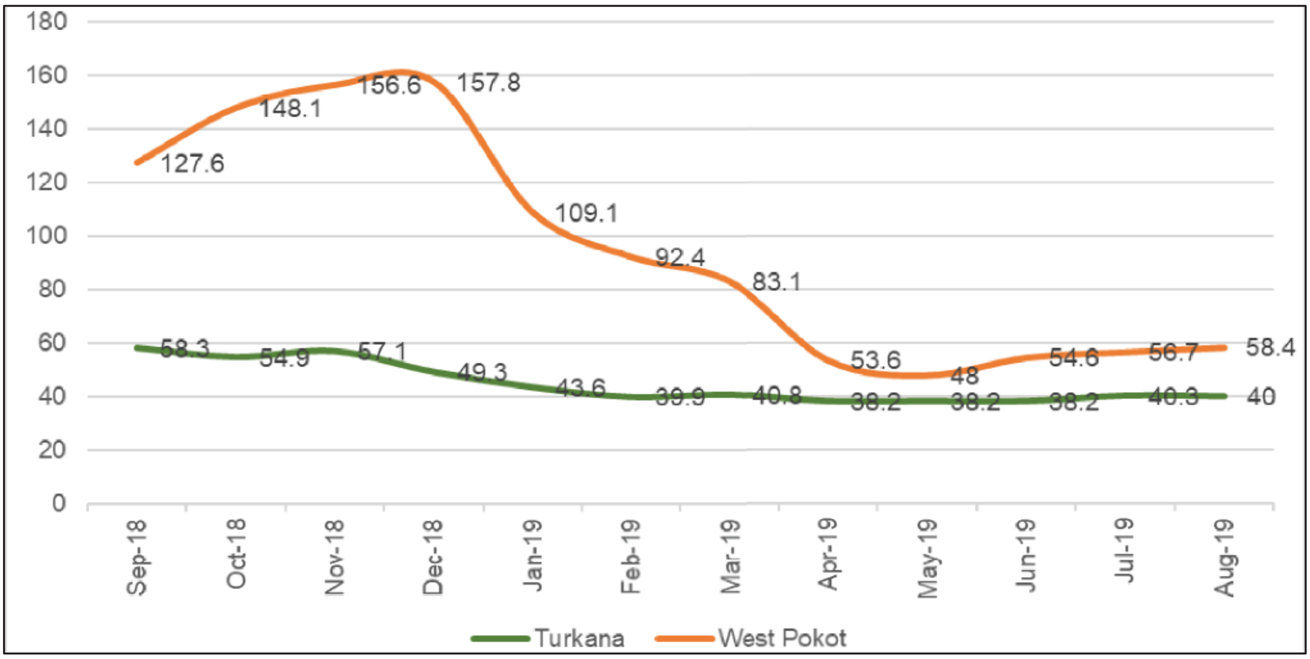

Figure 6.12-5: Price Ratio/Terms of Trade September 2018 to August 2019
Source: NDMA Drought reports September 2018 – August 2019

When comparing long term data in Figure 6.12-6, both counties show a stronger ToT in 2018 than the average recorded during the reporting period from 2015 to 2017.

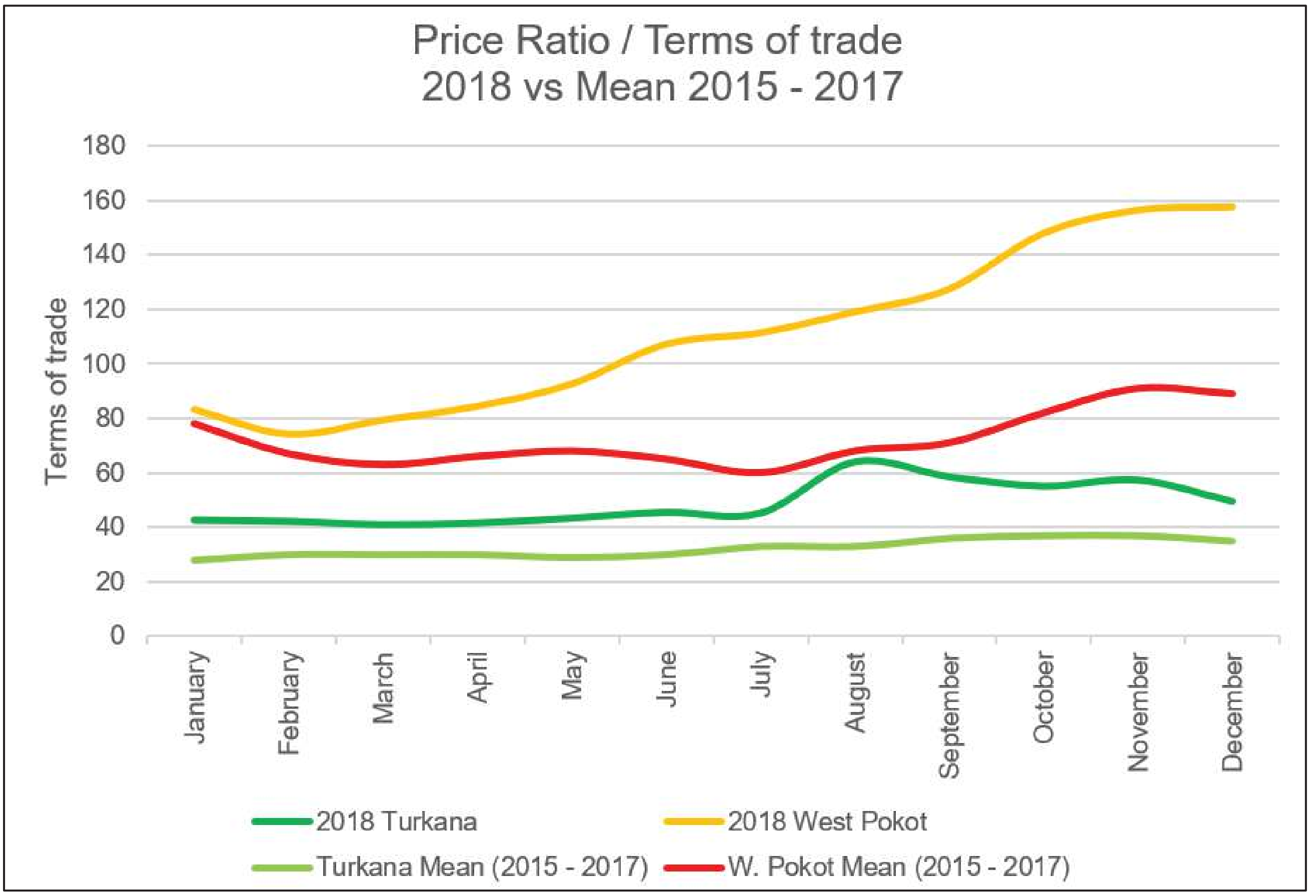

Figure 6.12-6: Long Term Data Price Ratio/ToT 2018 vs Mean 2015 to 2017.

Source: NDMA Drought reports 2015 – 2018.

The ToT is impacted by the cost of other key goods such as maize itself. The less favourable ToT reported in Turkana might respond to a higher maize price (with respect to the maize price reported in West Pokot) during September 2018 and August 2019. This means that individuals in Turkana have received less kilograms of maize for each goat sold due to higher price in maize throughout the reporting period (Figure 6.12-7). Maize prices for Turkana have seen slightly variations from KES 60 to KES 70 per kg of maize during the first half of 2019 whilst in West Pokot that maize prices have double during the same period.

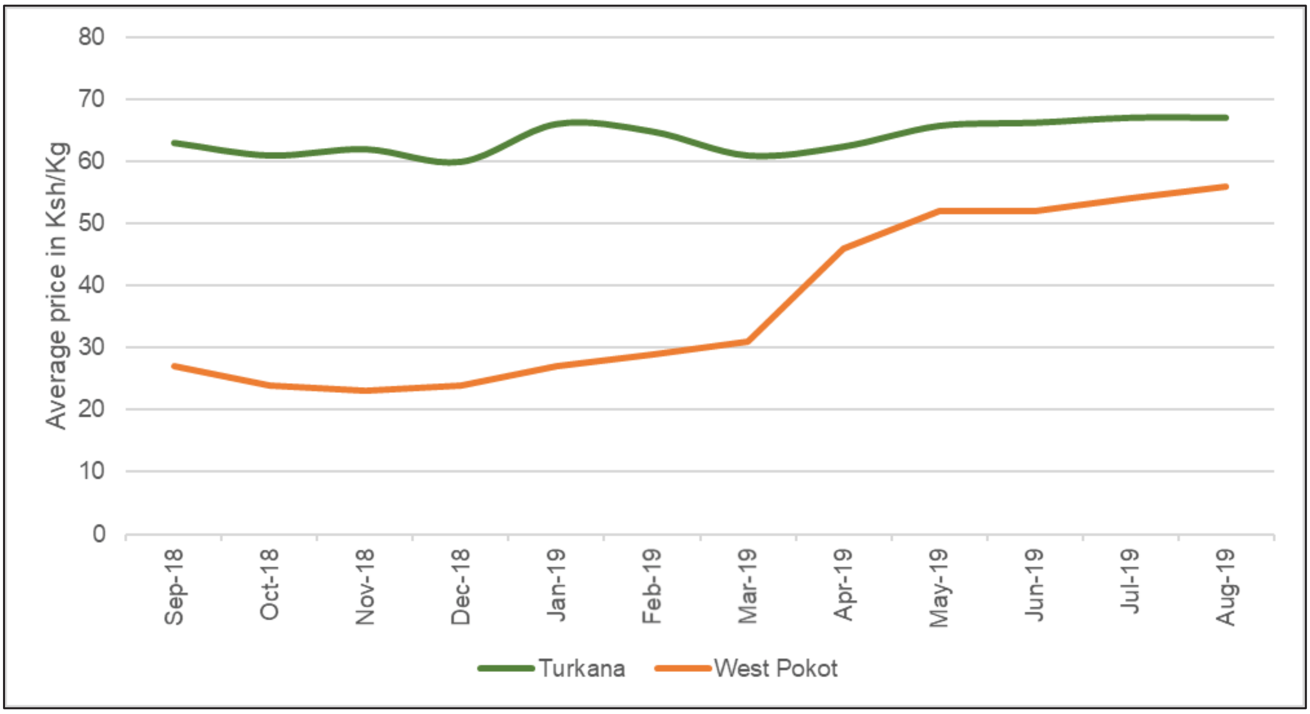

Figure 6.12-7: Maize Prices September 2018 to August 2019.

Source: NDMA Drought reports September 2018 to August 2019

When analysing the dynamics of cattle prices, it is been noted that the cattle prices of small rumiants (goats) have remained constant during the reporting period September 2018 to August 2019, being the average price Ksh 2,881 in Turkana and Ksh 3,034 in West Pokot (NDMA Drought reports September 2018 – August 2019).

Other indicators of stress on pastoralists are low levels of milk production and consumption. The lower levels of milk production and milk consumption during the first quarter of 2019 among West Pokot households were a response to a lower level on foraging access to traditional grazing areas (Figure 6.12-8). In Turkana, the negative trend presented during the same period is associated with a reduced milking herd, which is linked to a low calving rate and out migration of lactating livestock searching for water sources and pasture (NDMA Drought reports September 2018 – August 2019).

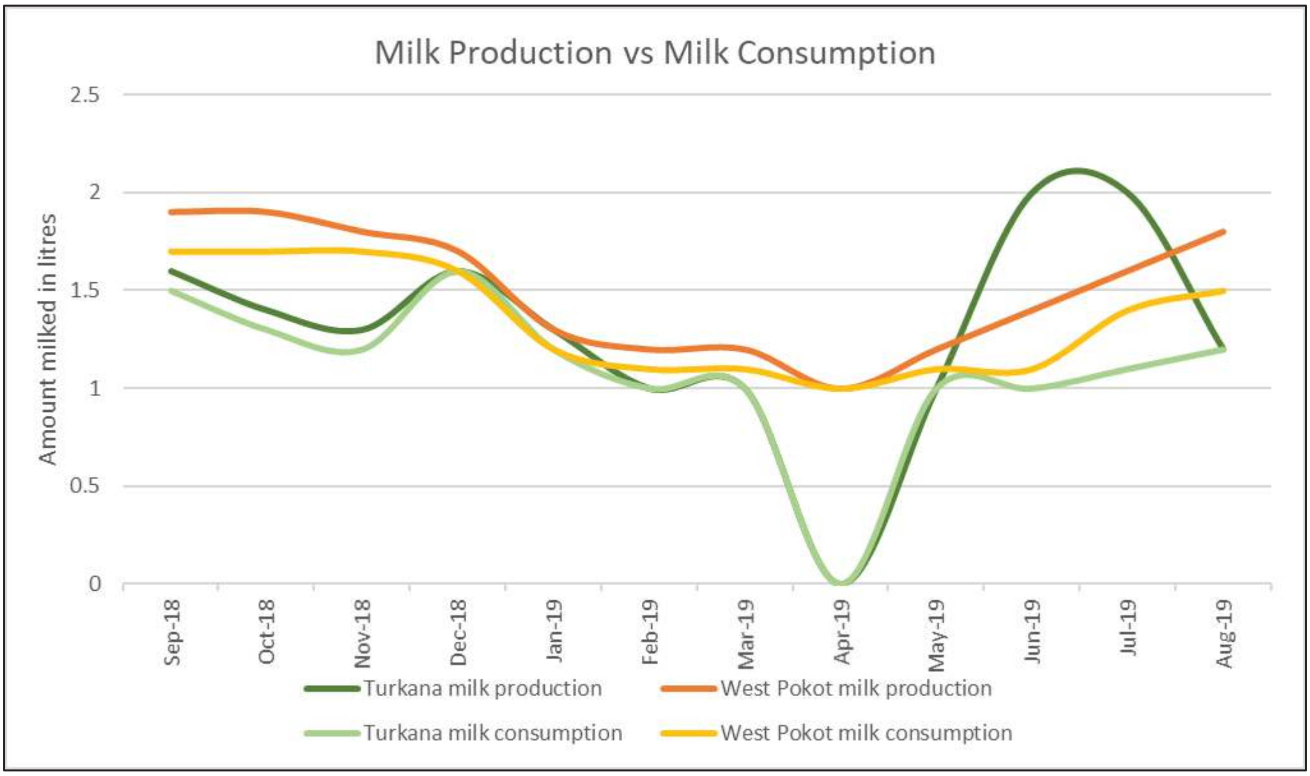

Figure 6.12-8: Milk Production vs Consumption September 2018 to August 2019.

Source: NDMA Drought reports September 2018 to August 2019

From qualitative research, Golder sought to understand the dynamic and current trends of the main livelihoods in the Project area. In general, the majority of KIIs and focus groups describe a general downturn in economic opportunities. Commonly cited reasons are drought, but almost all described a downturn linked to TKBV scaling back operations starting in 2017. This is said to have reduced purchasing power and caused reductions in everything from the number of small traders seeking licenses, to the demand for charcoal.

Although pastoralism is still the main source of livelihood for people in the Project area, efforts are being made to encourage diversification, primarily through complementary livelihoods such as livestock trading, which requires the development of more financial skills (KII, UN Women, 23 June 2016). Some pastoralists have diversified their livelihoods by opening kiosks or getting involved in livestock trade (KII, 31 January 2019). However, barter trade is still being practiced by many pastoralists where there is no money (Focus Group Discussion, 03 July 2016).

The Turkana County Government has been implementing programmes to support pastoralists in diversification of their livelihoods and creating more permanent settlements and market opportunities. These efforts include encouraging pastoralists to register in order to obtain data related to household size, gender and identification numbers. This register is used at Final Distribution Points (FDPs) for food in cases of emergency, but also helps to inform government programmes in providing essential services like health and education to enable people to have some sort of permanent settlements (KII, 25 June 2016). In the Kochodin Location, livestock traders noted that one main challenge is the inadequate knowledge on how to conduct the livestock business (Focus Group Discussion, 04 July 2016), which was also echoed by traders in Lokichar who cite literacy as one of the key challenges with improving business (KII, 30 January 2019).

In Lochwaangi Kamatak, the Sub-location Assistant Chief estimates that roughly 60% of the youth in his area have left nomadic life and gone to towns and larger settlements in search of salaried employment, particularly with oil exploration. For those who did get hired for a brief period during the E&A phase, they do not want to return to traditional pastoralist livelihoods. They prefer to find work as a livestock merchant or other small trade. The disruption to households is that they are less able to move with livestock since youth had previously been the family member who travelled long distances with livestock (KII, 29 June 2016).

In Kalemngorok, pastoralists describe a similar change in pastoralism. Because of drought and raids people are trying to shift into alternative livelihoods, which might include charcoal production and petty cash trade. Overall, they see a reduction in livestock per household (KII, 01 February 2019). Charcoal production has been a means of livelihood for women in particular.

Livestock traders in Nakukulas explained that the market fluctuates based on seasons and requirements of buyers. They usually buy animals at a cheaper price in the dry season, especially in January. This is because some pastoralists need food, but also because it is harder to find pasture, so more are willing to give up their livestock. The risk of buying at such times is that the animals themselves can lose value, causing them to lose money if they lose weight, the basis of price. They also consider distance to pasture when they buy. Having to travel 20 km or more can cause goats and sheep to miscarry. Another factor is whether they can graze animals close to established settlements as migrating longer distances increases the risk of theft and raiding (Focus Group Discussion, 4 July 2016).

In the Kositei Location, West Pokot Sub-county, 70% to 80% of the community practice pastoralism. This is the keeping and breeding of animals (goats, cows, camels, sheep, and donkeys) for meat, milk, skin, transport and labour (donkeys). According to reports from the Kositei Location Chief and his Sub-location Assistant Chiefs, there are no reported agricultural activities upstream as the earlier construction of the dam consumed previous farm lands. Now there are small subsistence agricultural activities downstream of the dam (towards the Turkana boundary) and garden farms growing crops like cabbages, kale, green grams can be found. Under the leadership of the current county government, irrigation activities have been initiated in the villages of Karon (Kasitei Sub-location, West Pokot Sub-county), Kases and Takaywa (Korpu Location, North Pokot Sub-county) (KIIs, 30 January 2019 and 2 February 2019).

6.12.2.5.2 Small Business and Trade

Turkana County has three urban centres namely Lodwar, Kakuma and Lokichoggio. Lodwar is the most developed with more infrastructural and social amenities. There are nine market centres in the entire County (Turkana County Government, 2016). The main market in the AoI is in Lokichar town. In Kangakipur, for example, business traders explain that they travel approximately 60 km to Lokichar to buy and sell their items, they hire a vehicle (paid evenly) to transport their food stuffs to the area (KII, Pastoralist business lady, Kangakipur, 4 July 2016).

Principal markets are located and comprise traders from Kitale, Nairobi and Webuye, an industrial town in Western Kenya, South West of Kitale. Exhibitions and major county events also provide a platform for sales. Small businesses rely on these activities to increase their sales. Transport is a challenge as some markets are further without having access to vehicles (KII, 28 June 2016).

Traders in Lokichar describe an overall situation for businesses that changed substantially in 2012 after TKBV arrived in Turkana County. In the mid-90s, only businesses were local. In 1999 to 2005, there were some new wholesalers who changed the market, but it was 2012 when businesses grew with a population increase. Non-Turkanas came with a lot of business ideas that brought business competition thus the locals were stimulated to venture in to a variety of business opportunities (KII, 30 January 2019).

The arrival of TKBV has had mixed affects. On the positive side, youth have been trained with practical skills and youth have been incentivised to take on education programmes as well as to seek employment. Local workers used new skills to open businesses like welding. Competition is good and encourages traders to explore more business networks, which has also had a positive impact for women. However, it has been noted that influx has made it hard for locals to compete, and which has also triggered inflation (KII, 30 January 2019). For instance, in terms of land prices, a parcel of land 50 x 100 m might have sold for 50,000 KES prior to TKBV's arrival but may now sell for up to 500,000 KES for the same plot (KII, 30 January 2019).

There are few lending institutions due to the unfavourable business environment, which has limited access to financial services and a lack of properly organised marketing. Where financial services are available, the cost of credit has been unfavourable resulting in the lack of capital to finance enterprise development. Limited access to financial services has greatly affected trade, livestock and agriculture sub-sectors (Turkana County Government, 2013). The County Government supports groups interviewed during baseline research although it is reported by some stakeholders that the support is not enough. (Focus Group Discussion, 01 July 2016). Other sources of funding are related to microcredits, these are promoted by NGOs looking to improve household welfare conditions.

6.12.2.5.3 Wages and Salaries

Wage earners constitute only 6% of the population in Turkana County. Unemployment levels are estimated at 70% in contrast to national figures of 42% (Turkana County Government, 2013). The devolved government structure has produced more employment opportunities at county government level (KII, 22 June 2016). The county department structure has created diverse job opportunities, which contributes to wages and salaries. However, the unemployment rate remains much higher compared to national levels. A large proportion of this labour force remains untapped due to inadequate skills/training for the locals, and also fewer employment opportunities (Turkana County Government, 2013).

Wage earners in West Pokot County constitute only 5% of the population. This is attributed to low education levels among the county residents, historical injustices, lack of technical skills and limited job opportunities. Informal sector employs a good proportion of the County population through farming and pastoralism (West Pokot Spatial Plan, 2019).

There is very limited data on salaries and the contribution of cash salaries to household incomes.

6.12.2.5.4 Industrial Sectors

While the predominant economic activity is related to pastoralism, other contributions to the Turkana County economy are the use of natural resources from trees (agro-forestry), mining and tourism (Turkana County Government, 2013).

Similarly, in West Pokot the main economic activities are agriculture and livestock enterprises. These main areas are complemented by transport, trade and small-scale gold mining (West Pokot Spatial Plan, 2019).

Agro-Forestry

The income generating activities derived from the local indigenous forests in Turkana include aloe vera processing for soaps and shampoo by two groups, one in Namoruputh in Loima Sub-county and Kalemngorok in Turkana South. This activity also includes charcoal production, a practice that is done through the collection of fallen trees and regulated by a license program managed by the Forest Department in the County Government (Turkana County Government, 2013).

In West Pokot, high potential agricultural land is found only in the southern part of the County. Rain fed crop production is only possible in parts of the Kapenguria and Chepareria Divisions while irrigation is used in the Sigor Division. Crops grown include maize, millet, sorghum and beans. The only cash crops are coffee, pyrethrum and cotton (West Pokot Spatial Plan, 2019). Field research confirms that the locations closest to the Project area are limited to pastoralism given that rainfall does not sustain agriculture (KII, 29 January 2019).

Mining

There are many on-going mining activities in Turkana County. These include mining of gold although on a small scale but in various locations within the county (Turkana County Government, 2013).

West Pokot too has mining activities with limited gold deposits along river beds and limestone (West Pokot Spatial Plan, 2019). The limited mining in the Project area is said to have been disrupted due to the construction of the Turkwel dam (KII, 30 January 2019).

Tourism

Tourism accounts for close to 10% of Kenya's GDP and the County government estimates that this has great potential to generate employment in the future (Turkana County Government, 2016). The main tourism attractions in Turkana County are Lake Turkana, which is protected by UNESCO as a World Heritage Site, Central Island Marine parks within the lake, and the South Turkana NR. The National Government, as part of the Vision 2030 Development Plan, has earmarked the construction of a resort city at Eliye Springs, one of the landing beaches along Lake Turkana (Turkana County Government, 2013).

The main wildlife found in the County are in the South Turkana NR. There are also hippos and crocodiles in Lake Turkana in addition to the various fish species. There exists various bird species, key among them the flamingos in Lake Turkana (Turkana County Government, 2013).

Tourism in West Pokot is unexploited with the main site being the Nasolot NR. This reserve has elephant, buffalo, hyena, impalas, leopard and lions but this and other scenic sites are undeveloped (West Pokot Spatial Plan, 2019).

Other Industries

Fieldwork highlighted other small trade and industry that are practiced in both Counties.

In Turkana, another of the main activities in Kamuge is salt harvesting, said to engage 3,000 people in harvesting, packaging and retailing of this salt. At the beginning, the salt was sold in Lokori. However, the entrepreneurs have grown their market to cover Lokichar, Katilia, Lodwar, Katilu, Kalemngorok and Kainuk. The salt is mainly used for treating camels and for chewing with tobacco. One kg of salt sells at Ksh. 150. There are four types of salt harvested in Kamuge. Tobacco salt, Livestock salt (salt lick), Vegetable salt and "Prias" which is mostly preferred by camels (KII, 1 July 2016).

In Kangakipur Sub-location, mats are woven by women and girls and sold in local shops and in Lokichar. Woven mats are also used to settle bills in local shops. Shop keepers receive mats of equivalent value to food rations bought and later sell the mats in Lokichar. (KII, 4 July 2016).

In West Pokot, other industries include bee-keeping and fishing near the dam. This is said to be an industry that involves 10 to 20% of the population (KII, 30 January 2019).

6.12.2.5.5 Poverty

Turkana has some of the highest levels of poverty in the country. Kenyan National Bureau of Statistics (KNBS) reports poverty at 94%. However, such figures need to be considered in context described in Section 6.12.2.3.2. As discussed in that Section, many consider wealth through the context of herd size and a household ability to maintain their animals. Livestock traders in Nakukulas said they would characterise a wealthy person as someone who has 20 camels, 500 small stock, 30 heads of cattle and 50 donkeys (Focus Group Discussion, 04 July 2016). By contrast, poverty is considered to be when someone has no animals. Such distinctions are relevant when understanding the relatively high poverty rates.

The poverty rate in West Pokot County currently stands at 68.7%, represented by approximately 433,656 people. West Pokot County contributes approximately 2.1% to national poverty. There has been increase in poverty levels within the county triggered by higher living standards, increase in population and unstable sources of income (West Pokot Spatial Plan, 2019).

6.12.2.6 Land Use and Ownership

The following describes the baseline land use across the areas affected by the Project footprint, covering:

- TAN field areas;
- Interconnection routes between the fields; and
- Water pipeline route.

As explained in the baseline methodology section (Section 6.12.1.4), during the lands baseline surveys features such as homesteads, animal shelters, graves and community assets were recorded as GPS coordinates, photographed and details recorded. A similar classification of homesteads was used in all the lands baseline surveys from 2015 to 2019, as shown in Table 6.12-27, with examples of homesteads shown in Figure 6.12-11 and Figure 6.12-12 below.

Table 6.12-27: Categories of Homesteads

Category	Description
Long term homesteads (‘permanent’)	Either currently occupied or unoccupied. Long term homesteads are occupied in an area over an extended period covering both wet and dry seasons (see Figure 6.12-9) and typically for a period of a year or more. The elderly and young members of the household often remain at this homestead all year round. The location of these long-term homesteads is sometimes within an ere linked to the family, and the precise location within an area may periodically change every few months to avoid issues such as livestock dung build up in animal shelters, ticks and animal disease. If a long-term homestead is vacated for a short period (a few weeks) and is in a good state of repair, a household may sometimes re-use the homestead structure on their return. Otherwise it will not be re-used and the household will construct a new homestead structure. Only the household who constructed a homestead is able to use it and it is considered ‘taboo’ amongst the community to use someone else’s homestead structure.
Short-term homesteads (seasonal)	Typically used for 2 to 3 months, e.g. during wet season grazing (see figure Figure 6.12-9), either currently occupied or unoccupied. Short-term seasonal homesteads are not re-used once vacated.
Very short-term homesteads (migratory)	Used for a few nights en route to other areas, either currently occupied or unoccupied. Very short-term migratory homesteads are not re-used once vacated.

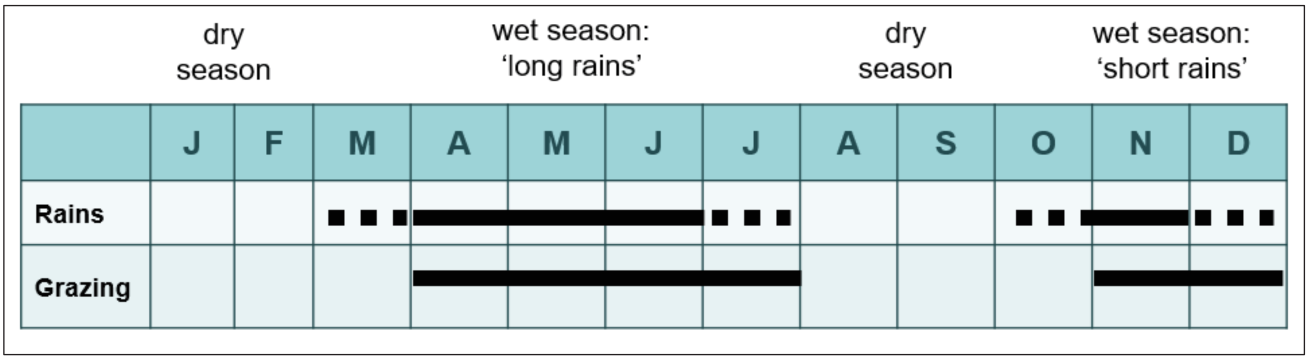

Figure 6.12-9: Typical Seasonal Rains and Grazing in the AoI

6.12.2.6.1 Twiga Field Area

The Gazetted Twiga field area covers approximately 550 ha and is located in Turkana South Sub-county, Kapese Sub-location, 5.5 km north-east of Lokichar town and 2 km east of the Lomokamar settlement. The field measures approximately 2 km north to south and 3 km east to west – see Figure 6.12-10. All land in the Twiga field is classified as unregistered community land.

There are currently three existing wellpads in the Twiga field area (Twiga 1, Twiga 2 and Twiga 3) constructed during the E&A phase between 2013 and 2015. There are existing murram access roads running to the three wellpads, which branch off a road that runs north to south through the middle of the Twiga field.

Land Character: The Twiga field area is a flat, largely open area of livestock grazing land vegetated with grass, small shrubs and occasional *eregai* trees (*Acacia reficiens*), and large *ewoi* trees (*Acacia tortilis/ewoi*) alongside a large lugga in the north-west corner of the field. The lugga is dry throughout the year apart from occasional short periods during the seasonal rains: the ‘long rains’ of April to June and the “short rains” around November (see Figure 6.12-9).

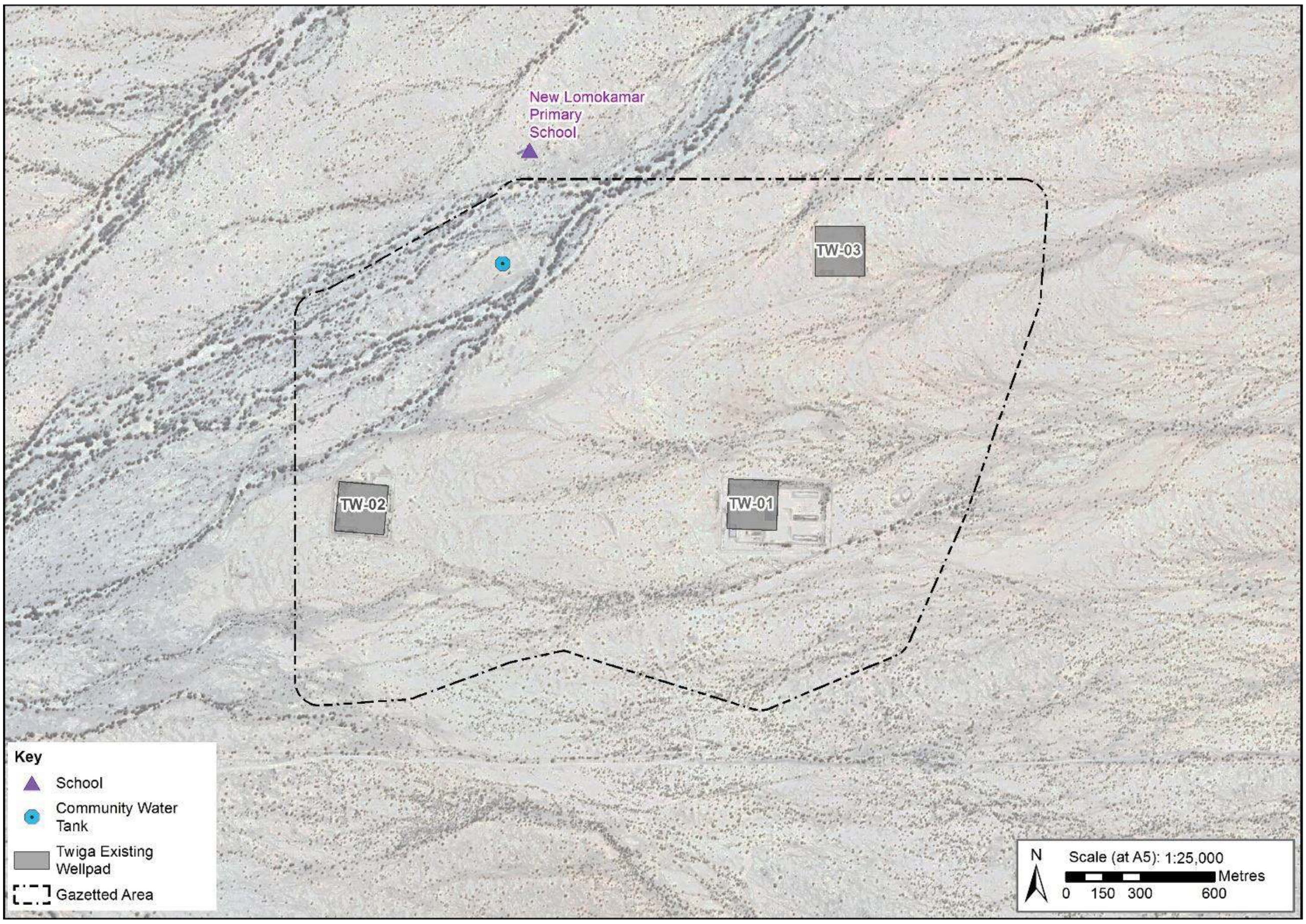

Figure 6.12-10: Aerial image of the Twiga Field Area (July 2019)

Livestock Grazing: Vegetation in the Twiga field provides grazing for the livestock of local households and occasional migratory households, mainly camels and goats, throughout the year, though during drier periods livestock is taken towards the hills and Turkwel River approximately 30 km to the west. The vegetation is also used by households to construct their traditional homesteads as illustrated in Figure 6.12-11 and Figure 6.12-12, typically made from Ewoi, Ekalale or Elim branches, bark from Ewoi and sometimes plastic sheets or tarpaulins, and animal shelters (Figure 6.12-13) made from acacia/Eregai branches. Goats also feed off seed pods shaken from Ewoi trees along the luggas (Figure 6.12-14).

Figure 6.12-11: Homesteads in the Twiga Field (Nov 2018) photo 1

**Occupied Long-term Homestead in north-west part of Twiga Field (Nov 2018)*

Figure 6.12-12: Homesteads in the Twiga Field (Nov 2018) photo 2

**Long-term Homestead under construction in north-west part of Twiga Field (Nov 2018)*

Figure 6.12-13: Animal Shelter for Goats or Camels

Figure 6.12-14: Goats and Camels Grazing in the Twiga Field Area (Nov 2018)

Figure 6.12-15: Open area in centre of Twiga Field Area

Community infrastructure: The only community infrastructure within the field area is a community water point, supplied by TKBV. The only other community infrastructure in the vicinity of the field is the new Lomokamar Primary School classroom, constructed in 2018 and which came into use in 2019, located 120 m north outside the Twiga field area. The community uses large trees along the lugga to the north-west of the field as community meeting points.

Homesteads: The patterns, types and numbers of homesteads within Twiga field area recorded in baseline surveys from 2015 to 2019 have been generally consistent. As summarised in Table 6.12-28 and shown Figure 6.12-16, Figure 6.12-17, and Figure 6.12-18, the baseline surveys identified the following patterns of homesteads:

- The November 2015 baseline survey identified four occupied homesteads in the Twiga field area, all of which were classified as long-term homesteads inhabited by families linked to the Lomokamar settlement and who stated during the surveys that they had lived in the area for many years. Three of these homesteads were located near the large lugga to the north-west of the field and one homestead was located 320 m to the east of the Twiga 1 wellpad.
- The November 2018 baseline survey identified six occupied long-term homesteads in the Twiga field area and one under construction soon to be occupied. These homesteads were at locations close to the occupied homesteads identified in November 2015, near the large lugga to the north-west and one just east of Twiga 1. The homestead families reported that they had been living in the area over several years and since before Tullow commenced activities in the area in 2012.
- The July 2019 baseline survey identified only one occupied homestead within the Twiga field area, close to the location of occupied homesteads identified in November 2015 and November 2018 towards the large lugga in the north-west part of the Twiga field.

All the homesteads identified in the baseline surveys were traditional Turkana homestead structures as illustrated in Figure 6.12-15 above. No occupied or unoccupied short-term (seasonal) or very short (migratory) homesteads were identified within the Twiga field area during the three baseline surveys. However, one vacated seasonal homestead was identified in the November 2018 baseline, used around May 2018, which was located 680 m south-east of Twiga 1, just outside the field area.

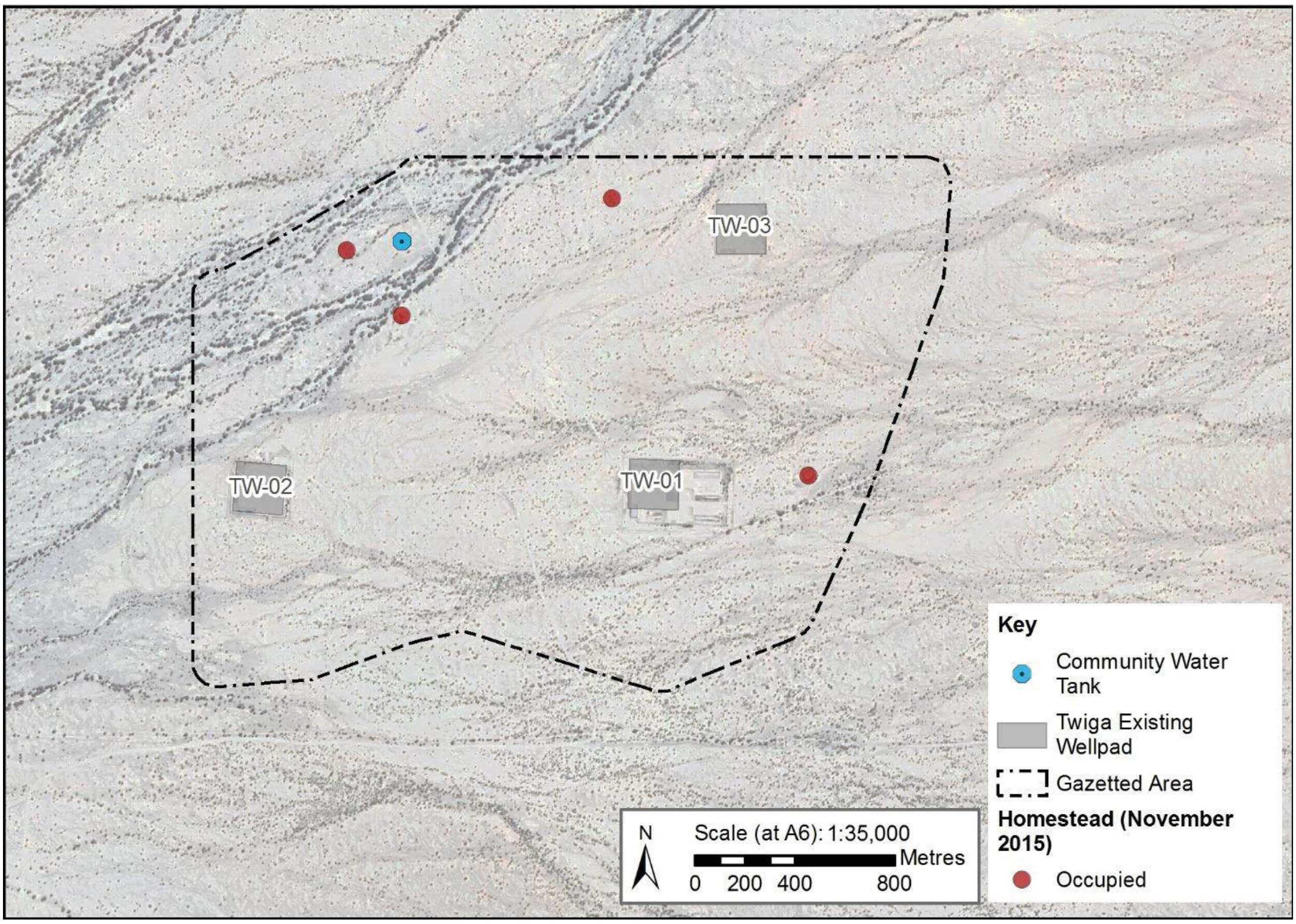

Figure 6.12-16: Locations of Occupied Homesteads in the Twiga Field Baselines November 2015

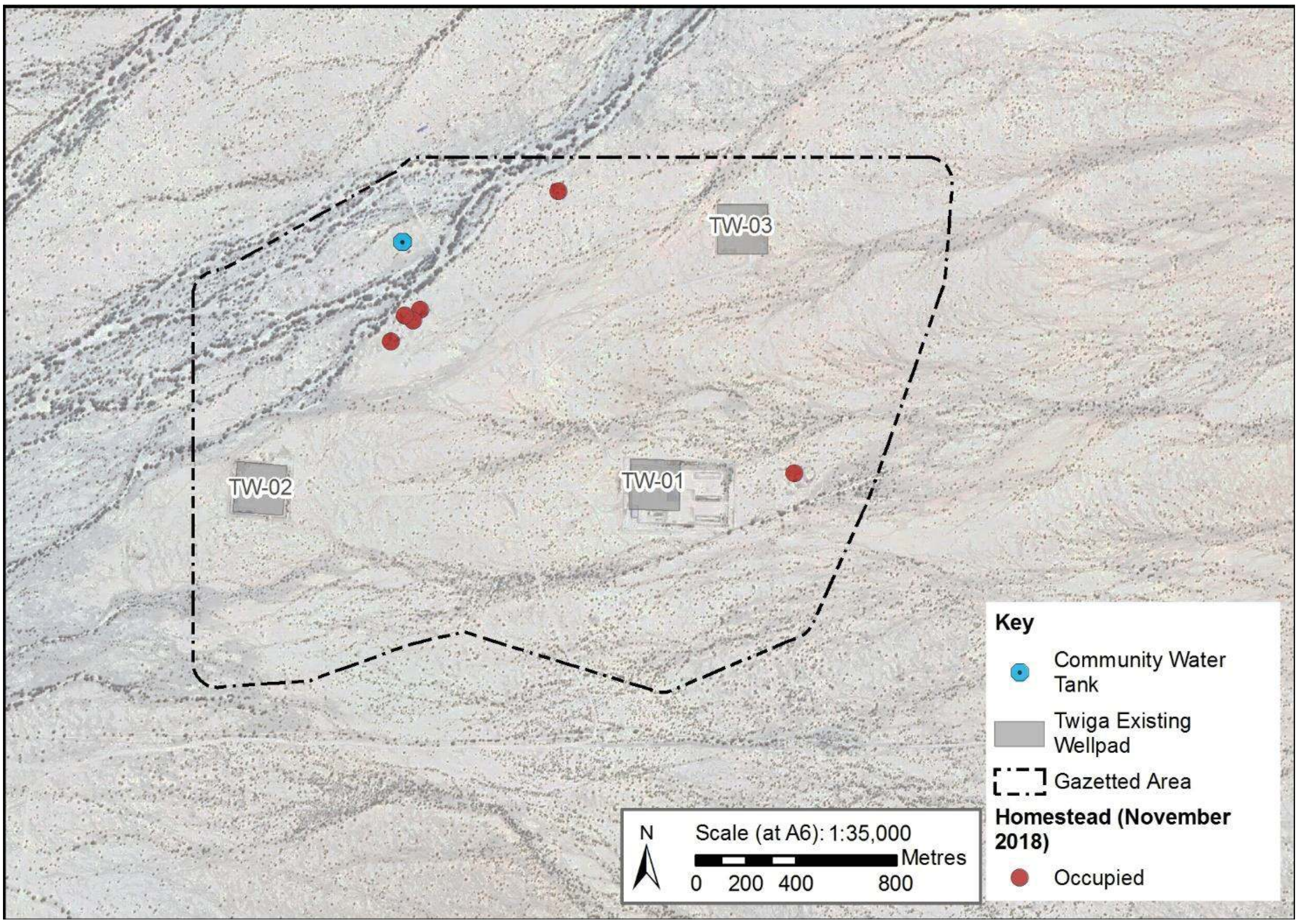

Figure 6.12-17: Locations of Occupied Homesteads in the Twiga Field Baselines November 2018

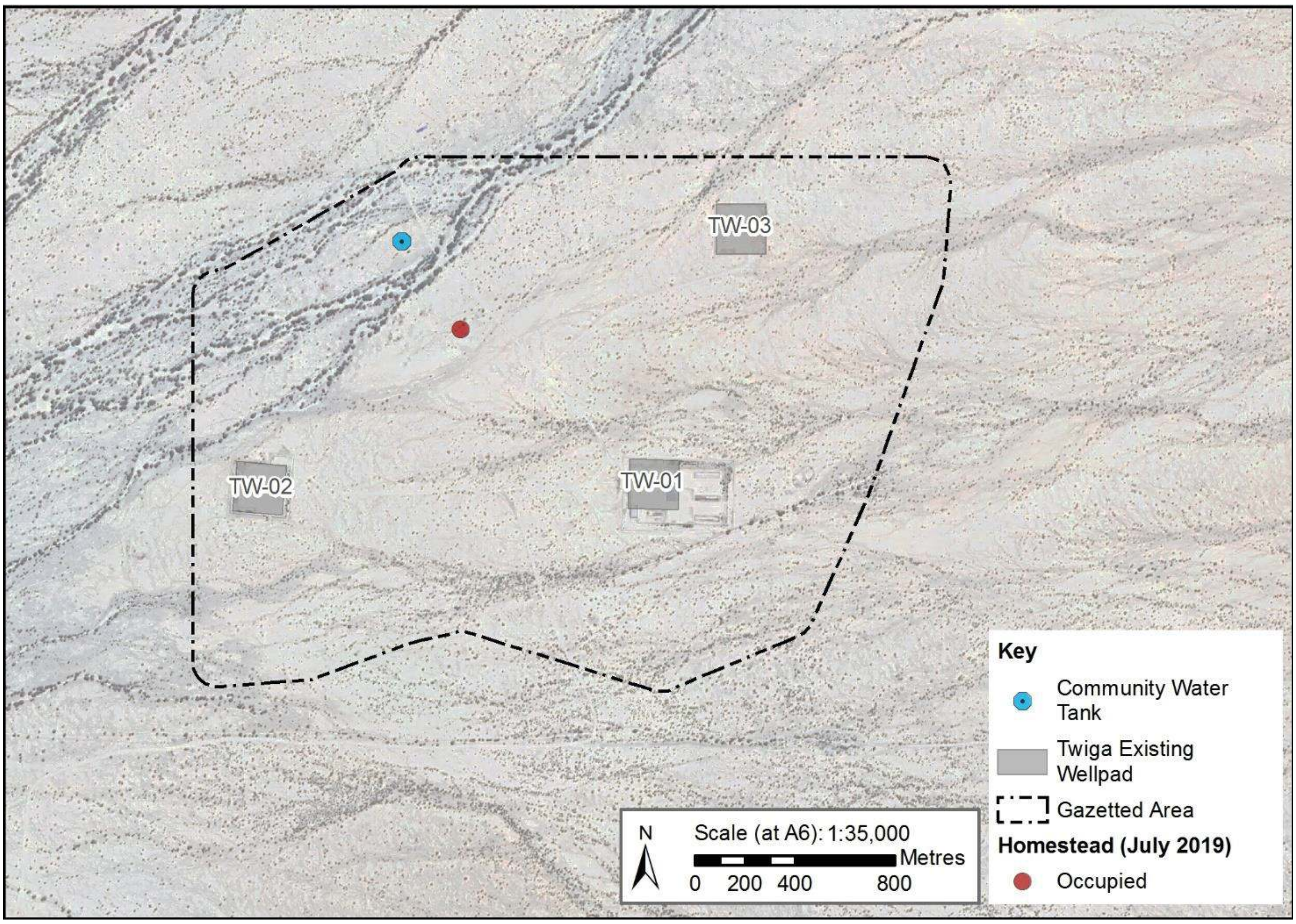

Figure 6.12-18: Locations of Occupied Homesteads in the Twiga Field Baselines July 2019

Information gathered on the households living in the occupied households includes the following:

- Households: A relatively small number of households have lived in or near the Twiga field area in recent years (see Table 6.12-28). During the November 2018 survey, interviewed residents stated that these households had been living in the area for many years and before TKBVs arrival in 2012.
- All the homesteads identified in the Twiga field area have been long-term homesteads used by households all year round. They graze their livestock in the local vicinity and occasionally, during drought periods, take their livestock towards the hills and Turkwel River approximately 30 km to the west, though elderly and young children remain in the homesteads. No short-term (seasonal) or very short-term (migratory) homesteads have been observed within the Twiga field area.
- Settlement Links: All the households who live in or close to the Twiga field area are part of Lomokamar settlement. Children from the households attend school in Lokichar or the new Lomokamar Primary School classroom which was constructed in 2018 and came into use in 2019.
- Security: The year round occupation of homesteads reflects the fact that the Twiga area is considered to be safe and is not subject to livestock raiding that affects residents further south in the Ngamia and Amosing areas.
- Other land users: Households reported during the November 2018 survey that they do not see many people from outside the area using the land, only the occasional migratory herders passing through or some households living there temporarily during wet season grazing periods. This is supported by the fact

that apart from animal shelters constructed near to long term homesteads, there have been few other animal shelters identified in the Twiga field during the three baseline surveys.

- Water sources: Households obtain water from the TKBV supplied community water point located in the Twiga Field area. Prior to the supplied water point, households obtained water from dug water holes in the large lugga towards Lokichar to the west of the field.

Table 6.12-28: Occupied Homesteads in the Twiga Field during Baseline Surveys 2015 to 2019

Baseline survey:	Coverage of the Project Field Area	Occupied Long-Term Homesteads	Occupied Short-Term (Seasonal) Homesteads	Occupied Very Short-Term (Migratory Homesteads	Total Occupied Homesteads	Comments
Nov 2015	100%	4	0	0	4	3 homesteads near large lugga to north-west of Twiga field and one homestead 320 m to east of Twiga 1.
Nov 2018	100%	6	0	0	6	5 homesteads near large lugga to north-west of Twiga field and one homestead 320 m to east of Twiga 1.
July 2019	100%	1	0	0	1	1 homestead near large lugga to north-west of Twiga field

6.12.2.6.2 Ngamia Field Area

The Gazetted Ngamia field area (see Figure 6.12-19) covers 4,055 ha and is located in Turkana East Sub-county, Kochodin Sub-location, 19 km south-east of Lokichar town and 1.3 km south-west of Nakukulas settlement. All land in the Ngamia field is classified as unregistered community land.

There are currently eight existing wellpads in the Ngamia field (Ngamia 1, 2, 3, 4, 7, 8, 9 and 10) constructed during the E&A phase between 2012 and 2016. There are existing murram access roads running to these wellpads, which branch off the main Lokichar to Lokwamosing road which runs through the centre of the field.

Land Character: The Ngamia field area is generally flat with a gentle slope west to east, comprising a combination of open areas with grass, small shrubs used for livestock grazing, large tree lined luggas and some areas of denser shrub/small tree vegetation. The luggas are dry throughout the year apart from occasional short periods during the seasonal rains: the “long rains” of April to June and the “*short rains*” around November.

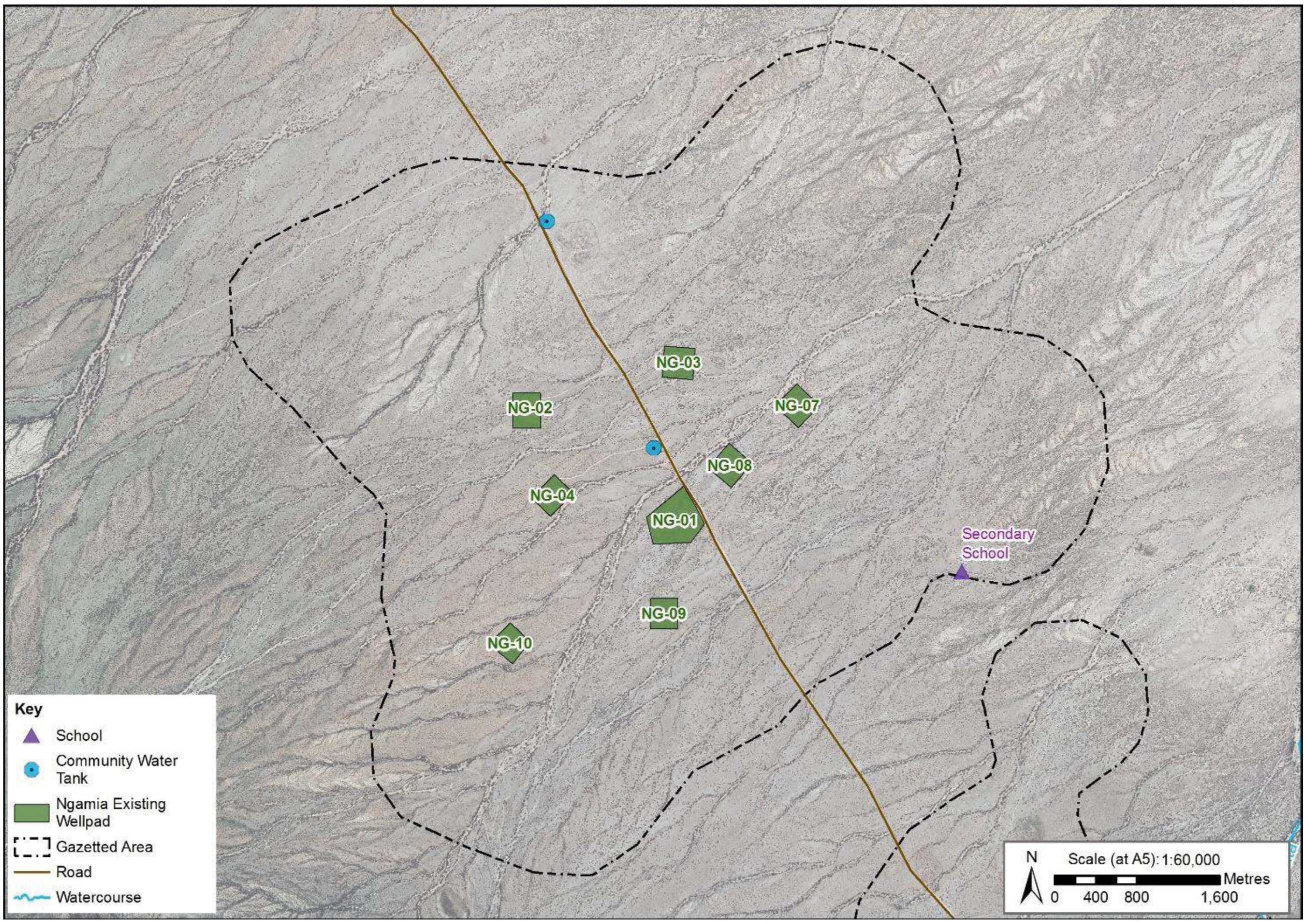

Figure 6.12-19:Ngamia Field (November 2018)

Vegetation in the Ngamia field provides grazing for livestock, mainly camels and goats, especially during wet season grazing periods. During the dry season livestock is typically taken to graze towards the hills to the west. The vegetation is also used by households to construct their traditional homesteads, typically made from Ewoi, Ekalale or Elim branches, bark from Ewoi and sometimes plastic sheets or tarpaulins; and animal shelters (made from acacia/Eregai branches). Goats also feed off seed pods shaken from Ewoi trees along the luggas.

Community infrastructure: Community infrastructure within the Ngamia field area comprises two community water points provided by TKBV, located near the main road 600 m inside the northern boundary of the Ngamia field and 600 m north of the Ngamia 1 wellpad. All people engaged during the baseline surveys stated that they use these water points as their source of water. In 2018 TKBV installed a piped water system for supplying the community water points, including a new raised water tank (see Figure 6.12-20) located just north of Ngamia 1. In addition, the Ngamia Secondary School, which is in use and comprises classrooms and dormitories (constructed in 2016-2017) is located just within the Ngamia field area, 2.4 km south-east of Ngamia 1.

Figure 6.12-20: New Water Tank Linked to the TKBV Piped Community Water System, Just North Of Ngamia 1, Constructed 2018-19.

Homesteads: The numbers of homesteads within the Ngamia field at the baseline surveys from 2015 to 2019 are summarised in Table 6.12-29 and Figure 6.12-21. The baseline surveys identified the following in terms of homesteads:

- The November 2015 to March 2016 baseline survey which covered 90% of the Ngamia field area, identified 20 occupied homesteads within the area, 11 of these homesteads were located to the west of main road and nine to east. Eleven of the homesteads were classified as long-term homesteads, seven were short-term seasonal homesteads and two were very short-term migratory homesteads. The majority of homesteads were located to the north of the Ngamia field and clustered around the northern TKBV supplied community water points. A smaller number, three homesteads, were clustered around the TKBV supplied community water point just north of Ngamia 1 wellpad.
- The September 2016 EOPS Phase II ESIA baseline survey covered a central portion of the Ngamia field, representing 20% of the Ngamia field area. It identified 11 occupied homesteads within or in the close vicinity of the survey area, including several households that had also been present in November 2015. Seven of the homesteads were located to the west of the main road and four to east.
- The May 2017 EOPS Phase II baseline survey covered the same central portion of the Ngamia field as in September 2016, representing 20% of the Ngamia field area. It identified 15 occupied homesteads, all of which were located to the east of the main road, including a cluster of homesteads between Ngamia 1 and Ngamia 8. The higher number of homesteads in this survey compared with the previous November 2015 and September 2016 surveys may have been because of two factors: firstly, the survey took place in the wet season when households access wet season livestock grazing in the Ngamia field area; and because insecurity concerns relating to livestock raiding were high in May 2017 which would have discouraged households from occupying homesteads to the west of the main road.

Table 6.12-29: Occupied Homesteads in the Ngamia Field During Baseline Surveys 2015 to 2019

Baseline Survey:	Baseline Coverage of the Project Field Area	Occupied Long-Term Homesteads	Occupied Short-Term (Seasonal) Homesteads	Occupied Very Short-Term (Migratory) Homesteads	Total Occupied Homesteads	Comments
November/ December 2015 & March 2016	90%	11	7	2	20	11 homesteads to west of main road and 9 to east of road.
September 2016 (EOPS)	20%. Central part of Ngamia field.	11	0	0	11	7 homesteads to west of main road and 4 to east of road. 17 unoccupied homesteads were identified, which were understood to have been occupied sometime between December 2015 and September 2016.
May 2017 (EOPS)	20%. Central part of Ngamia field.	8	7	0	15	All 15 homesteads were located east of road and none to the west. 13 unoccupied homesteads were identified, which were understood to have been occupied sometime between September 2016 and May 2017
Nov 2018	100%	30 to 40 homesteads at Lotiman adakar; plus 20 to 30 at Kode adakar; plus 5 homesteads elsewhere in the field. Total: 55 to 75.	11 located at scattered locations to the east of the main road.	0	66 to 86	Two recently established adakar in the Ngamia field area.
July 2019	100%	Over 40 homesteads at Lotiman adakar; 6 homesteads near Lotiman adakar; over 20 homesteads at Kode Kode adakar. Total 66	9 (1 of which just west of road and 8 east of road)	0	75	The Lotiman and Kode Kode adakar were still occupied at the same locations observed in the November 2018 baseline.

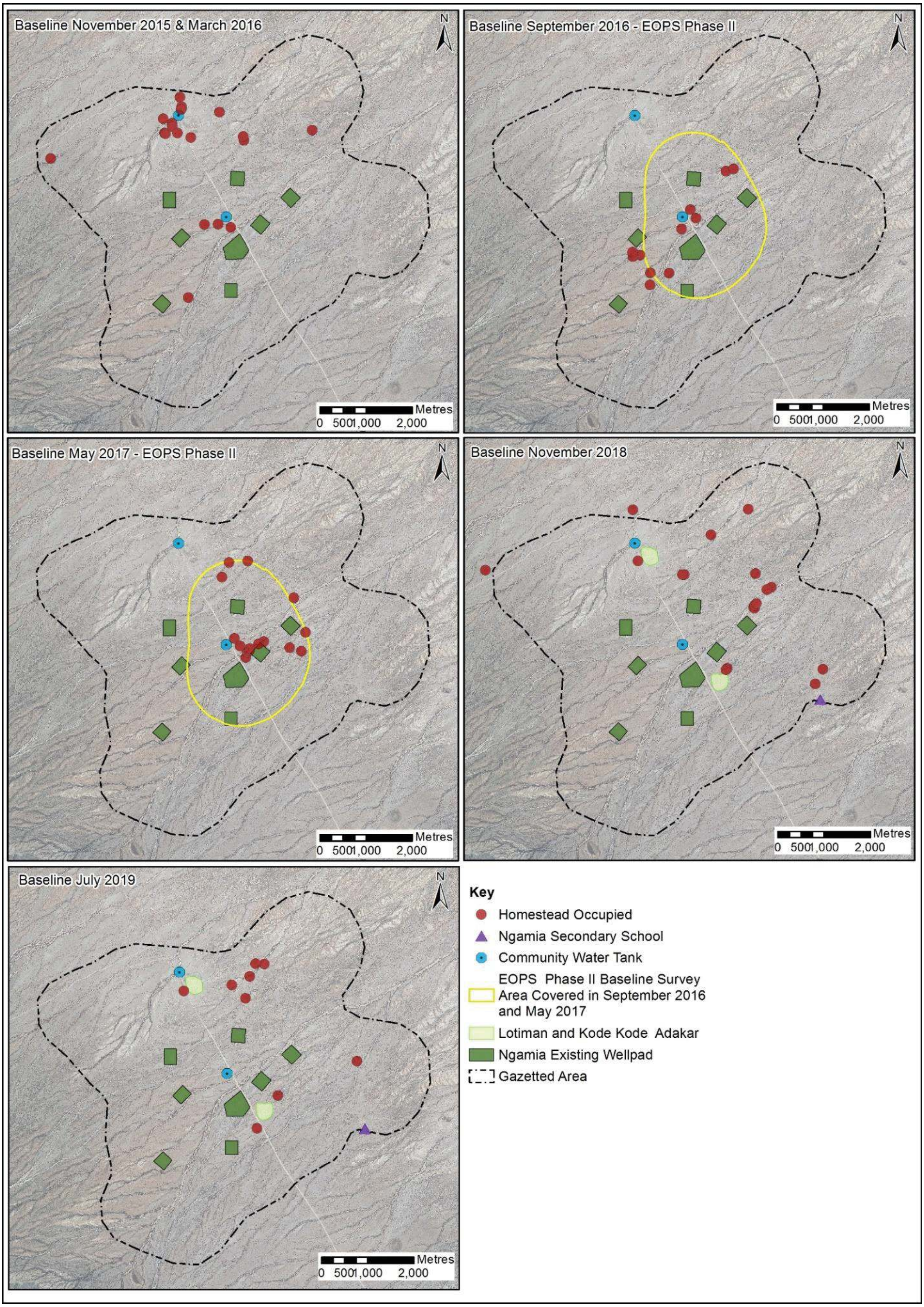

Figure 6.12-21: Locations of Occupied Homesteads in the Ngamia Field in Baselines 2015 to 2019

- The November 2018 baseline covered the whole of the Ngamia field area. The survey found several significant new patterns in the numbers and distribution of homesteads:
  - Some 60 to 80 occupied homesteads were present in the Ngamia field area in November 2018, a significant increase on the numbers recorded from 2015 to 2017.
  - Two large adakar clusters of occupied homesteads were observed for the first time, the Lotiman adakar and Kode Kode adakar, as described below. See Figure 6.12-24 and Figure 6.12-25.
  - Some modern style homesteads with corrugated sheet metal (CSM) roofs had been constructed near or inside these adakar, as well as traditional conical shaped permanent homestead structures with palm tree roofs which had not previously been observed in the Ngamia field area and which are characteristic of traditional homesteads in the Lokicheda and Nakukulas settlements – see Figure 6.12-24.
  - The Ngamia Secondary School had been constructed during 2017 and was in use. This lies just within the Ngamia field area, 2.4 km south-east of Ngamia 1, this will remain and will not be impacted by the Project.
- The Lotiman adakar was located 600 m inside the northern boundary of the Ngamia field, close to the northern TKBV supplied community water point, 1.1 km north-west of the Ngamia 3 wellpad. It covered an area of approximately 11.5 ha, see Figure 6.12-22.
- There were an estimated 30 to 40 households living in the Lotiman adakar in November 2018. The adakar was established around mid-2017 (it was not present during the May 2017 lands baseline survey). Based on discussions with elders in November 2018, households from the local area congregated in the adakar for safety from livestock raiding, with its location selected because of proximity to the main road and TKBV supplied community water points. Being near the main road was said to make it easier to access government support, which is considered especially beneficial in times of drought when communities become more reliant on drought assistance. The elders stated that the community intended to make this location a permanent settlement and had apparently requested Turkana County Government to construct a Lotiman Primary School nearby. At the time of the November 2018 survey the Lotiman adakar was mainly occupied by older and young members of households, whilst youth and young men and women were away with their livestock accessing dry season grazing towards the hills to the west. Only a relatively small number of livestock were staying in or around the adakar. Elders stated that almost all the people living at the adakar were from the local area, with few people from outside the area; and that prior to congregating in the adakar, households used to live in homesteads scattered around the area on the west and east of the road depending on the season and security situation. Before the establishment of the adakar, households would generally move to Lokicheda or Nakukulas in times of insecurity.

Figure 6.12-22: Aerial View of Lotiman Adakar Ngamia Field, November 2018 and July 2019

Figure 6.12-23: View from Inside the Lotiman Adakar, November 2018

Traditional conical shaped permanent homestead structure being built in the Lotiman Adakar

Modern Homestead with CSM Roof and traditional conical shaped permanent homestead just outside the Lotiman Adakar

Figure 6.12-24: Traditional & Modern Permanent Homestead Structures at the Lotiman Adakar, Nov 2018

- In November 2018 the Kode Kode adakar was located around 200 m south-east of Ngamia 1 on the eastern side of the road and was occupied by 30 to 40 households (see Figure 6.12-25).

  In discussions with local elders in November 2018, the survey team was informed that people came to the adakar for safety in the face of Pokot livestock raiding concerns. The location was selected due to proximity to the main road and to TKBV supplied community water points. Being near the main road was also said to make it easier to access government support. The elders reported that they intend to make this location a permanent settlement and said that they had requested Turkana County Government to construct a Primary School and dispensary there.

  The Kode Kode adakar was established at the November 2018 location around March 2018, having moved from two previous sites which were 180 m south of Ngamia 3 (occupied June 2017 to October 2017) and 180 m east of Ngania-3 (occupied October 2017 to March 2018). Elders reported that both these former locations were abandoned due to problems with poor drainage and tick infestation.

  Elders stated that the Kode Kode adakar is mainly occupied by older and young members of households, whilst young men and women are away with their livestock. Only a relatively small number of livestock were staying at the adakar. The elders reported that almost all people living at the Kode Kode adakar were from the local area, with few people from outside the area.

  Prior to moving to the adakar, households used to live in homesteads scattered around the area on the west and east of the road depending on the season. During the wet season they often located east of the road and to the west of the road during the dry season. This was also dependent on the security situation in terms of livestock raiding. Elders advised that households who in previous baseline studies lived in long-term homesteads in the Ngamia 1, Ngami 3 and Ngamia 7 area were now living in the adakar. Before the establishment of the adakar, households would generally move to Lokicheda or Nakukulas in times of insecurity, though a small number of around five households continued to stay in the Ngamia area.

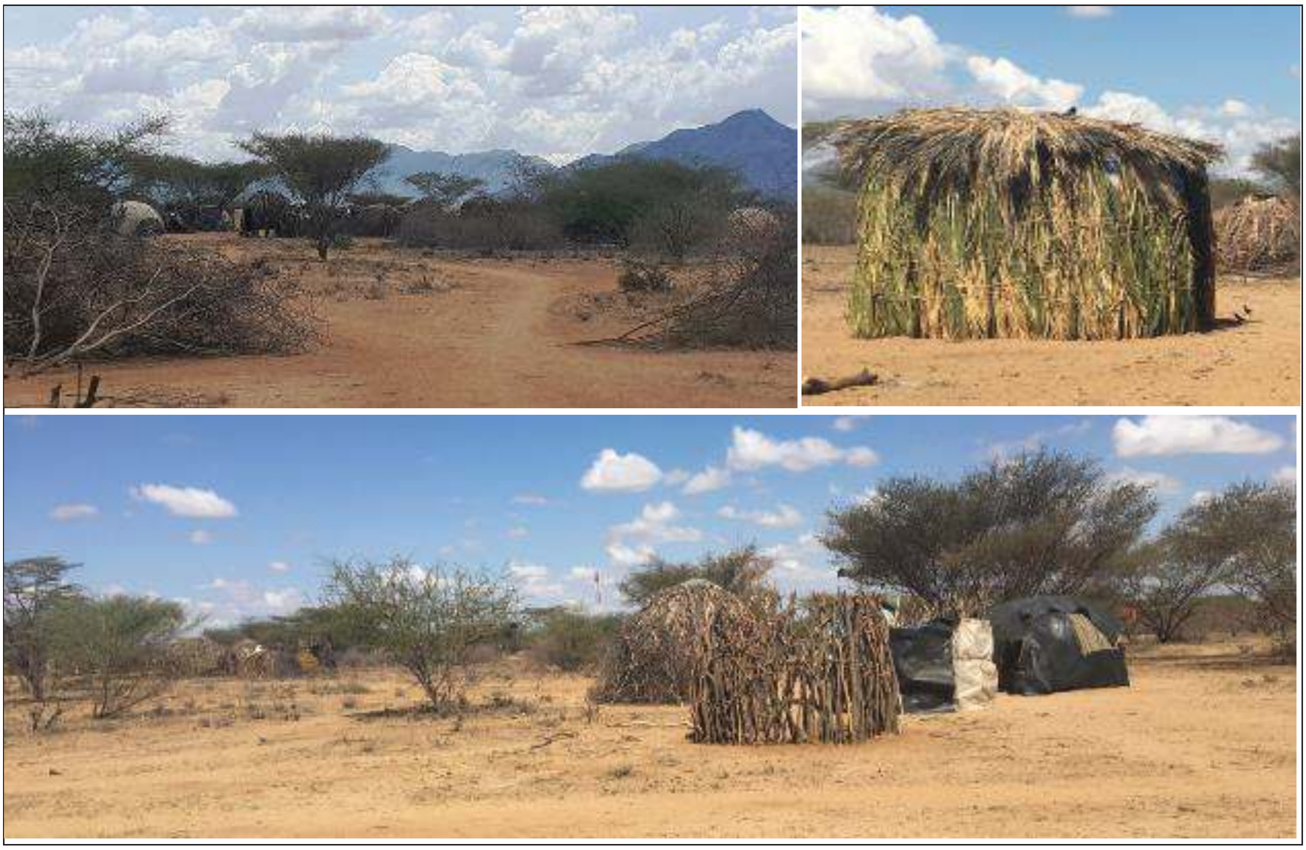

Figure 6.12-25: Views from Outside and Inside the Kode Kode Adakar (Nov 2018)

- Other occupied homesteads in the Ngamia field away from the Adakars: As well as the households living in the two adakars above, 16 other occupied homesteads were identified in the Ngamia field area in November 2018. All of them were located east of the main road apart from one long-term/modern corrugated metal roof homestead on the western side of the road just opposite the entrance to the Lotiman adakar. Of these 16, five were classified as long-term homesteads, 11 were short term seasonal homesteads and there are no very short term / migratory homesteads. In previous years when the risk of livestock raiding was low, dry season homesteads tended to be located to the west of the main road, but due to insecurity concerns in November 2018, households were located to the east of the main road. Several households also said that they had recently moved north from the Amosing area which had higher insecurity concerns than the Ngamia area.
- Other Socio-Economic features: The new Ngamia Secondary School, comprising classrooms and dormitories was constructed in 2017 to 18 and is located 2.4 km south east of Ngamia 1. The two TKBV water tanks in the Ngamia field, one 650 m north of Ngamia 1 wellpad (the Kode Kode water tank) and one just north of the Lotiman adakar (the Lotiman water tank), provide the year round source of water for all households present in the Ngamia field. In November 2018 the tanks were being connected by TKBV to a new piped water system, including the construction of a new raised water tank just north of Ngamia 1 (see Figure 6.12-20). Proximity to the water tanks is clearly one of the factors that has influenced the community's locational decisions for the Lotiman and Kode Kode adakars.
- Vacated Homesteads: The November 2018 survey recorded the locations of 47 vacated homesteads which have been used in recent years, including those identified as occupied in previous surveys (see Figure 6.12-26). These included:

- Fifteen vacated homesteads to the west of the road which were classified as seasonal homesteads and likely to have been occupied during July to October to access dry season grazing areas to the west;
- Thirty two vacated seasonal homesteads located to the east of the main road most of which were thought to have been used for accessing wet season grazing areas April to July and November to December; and
- Two abandoned previous sites of the Kode Kode adakar located within 150 m east and south of the Ngamia 3 wellpad.

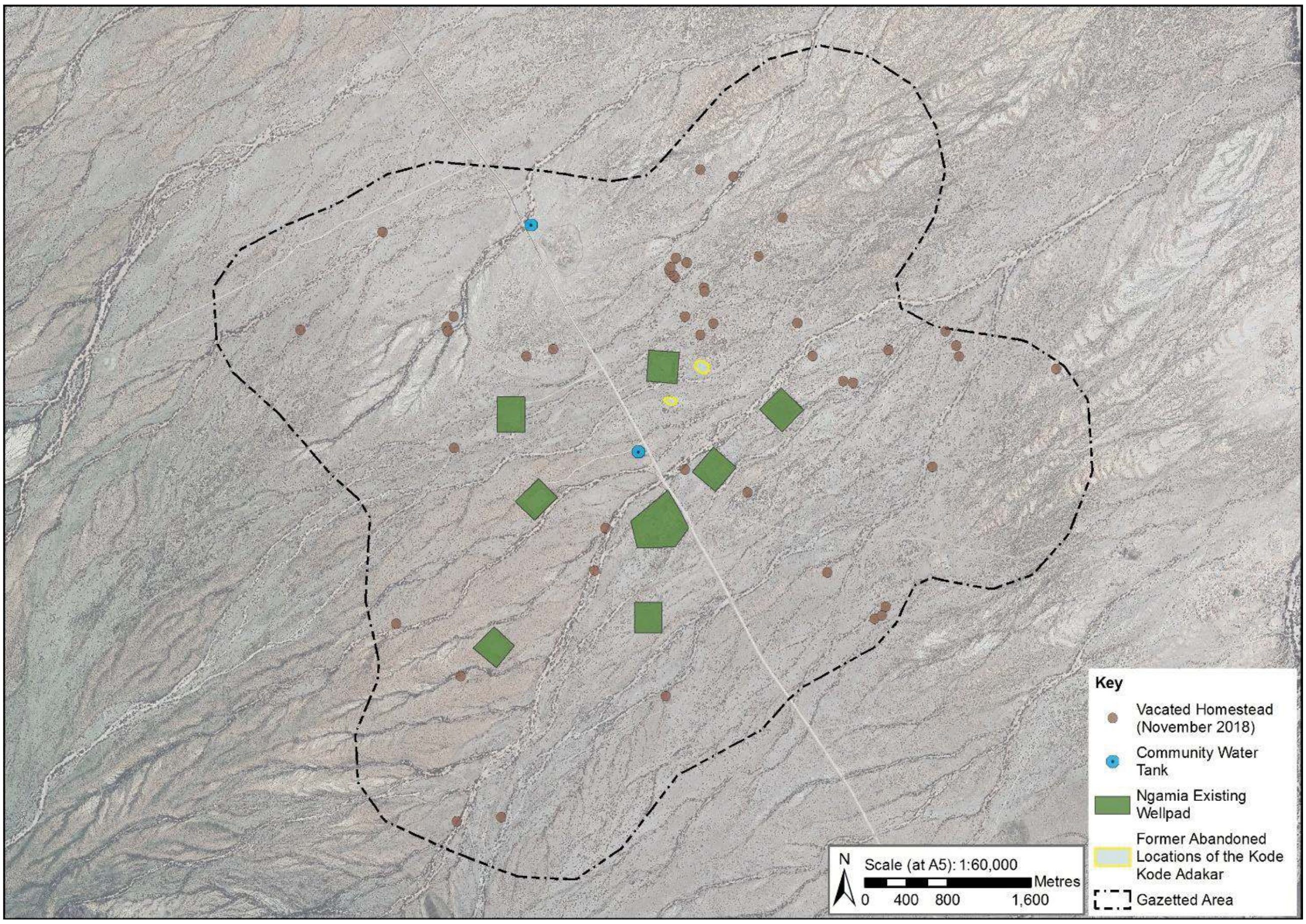

Figure 6.12-26: Vacated Homesteads in the Ngamia Field Identified in November 2018

The July 2019 baseline survey found a similar pattern of occupied homesteads in the Ngamia field to that observed in November 2018, with a total of approximately 75 households occupying homesteads, a broadly similar number to that observed in November 2018. The Lotiman adakar and the Kode Kode adakar were still occupied in the same locations as in November 2018, and in July 2019 contained over 40 and over 20 occupied homesteads respectively.

In addition, nine occupied short term seasonal homesteads were identified in the Ngamia field, including two near the Kode Kode adakar and a cluster of five along a lugga to the east of the Lotiman adakar. Households were using these homesteads for their livestock to access wet season grazing in the Ngamia area.

No additional community assets had been constructed in the Ngamia field compared with November 2018. TKBV's piped water system for supplying community water points had been completed, including the new raised water tank just north of Ngamia 1.

6.12.2.6.3 Amosing Field Area

The Gazetted Amosing field area covers 1,841 ha and is located in Turkana East Sub-county, Kochodin Sub-location, 26 km south east of Lokichar town, 1.5 km south of the Ngamia field area and 1.3 km south-west of Nakukulas settlement. The field measures approximately 6 km north to south and 4 km east to west at the widest points (see Figure 6.12-27). All land in the Amosing field is classified as unregistered community land.

There are currently five existing wellpads in the Amosing field (Amosing 1, 3, 4, 5 and 7) constructed during the E&A phase between 2014 and 2016. There are existing murram access roads running to these wellpads, which branch off the main Lokichar to Lokwamosing road.

Land Character: The Amosing field area is generally flat with a gentle slope west to east, comprising a combination of open areas with grass, small shrubs used for livestock grazing, large tree lined luggas and some denser vegetated areas. The largest lugga runs west to east between Amosing 1 and Amosing 3. Luggas in the area are dry throughout the year apart from occasional short periods during the seasonal rains: the "*long rains*" of April to June and the "*short rains*" around November.

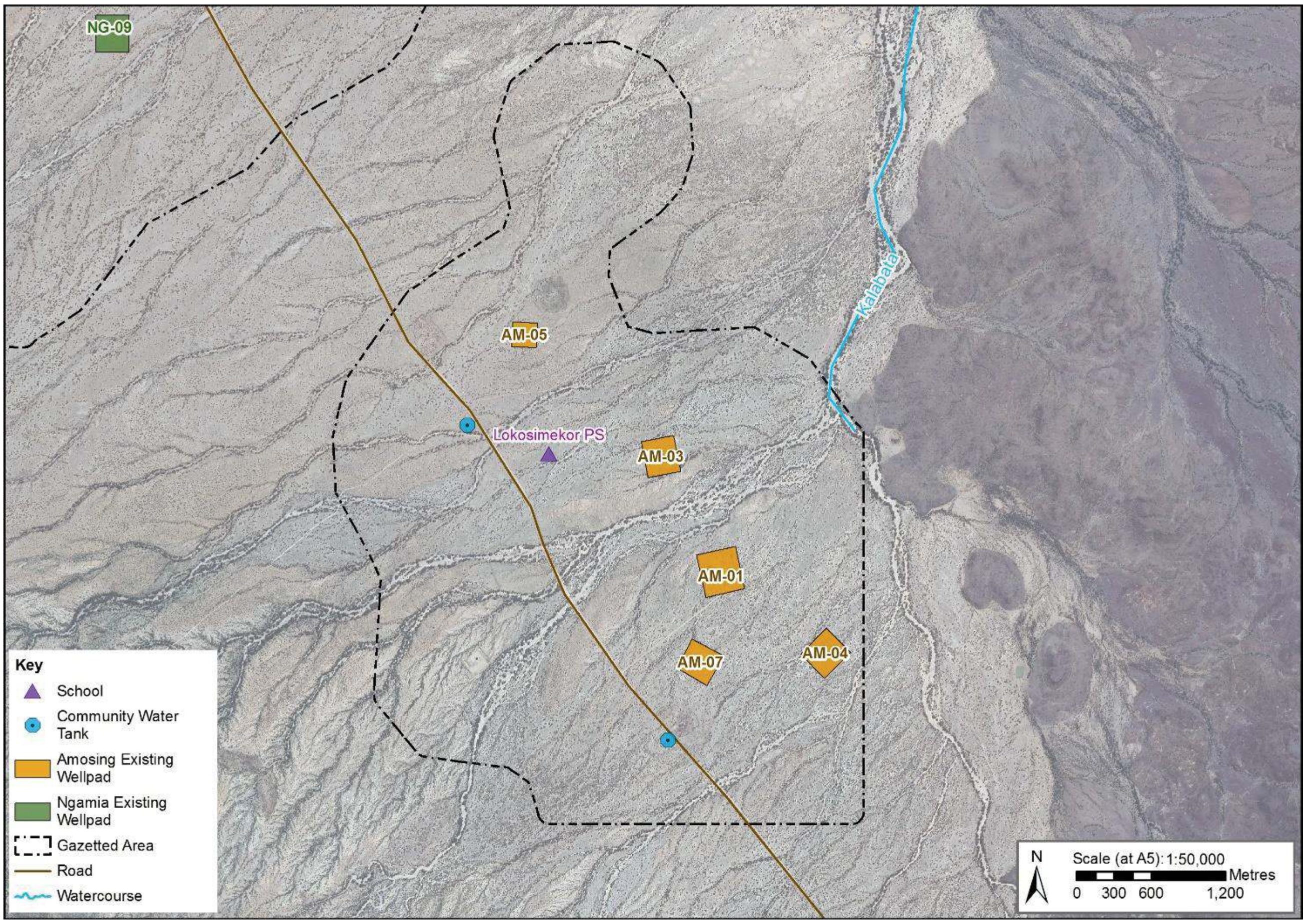

Figure 6.12-27: Aerial Image of the Amosing Field Area, July 2019

Vegetation in the Amosing field provides grazing for livestock, mainly camels and goats, especially during wet season grazing periods. During the dry season livestock is taken towards the hills to the west. The vegetation is also used by households to construct their traditional homesteads, typically made from Ewoi, Ekalale or Elim branches, bark from Ewoi and sometimes plastic sheets or tarpaulins; and animal shelters (made from acacia/Eregai branches). Goats also feed off seed pods shaken from Ewoi trees along the luggas.

Community infrastructure: Community infrastructure within the Amosing field area comprises two TKBV supplied community water points, located just to the west of the main road 1.5 km north-west of Amosing 3 wellpad and 1.3 km south-west of Amosing 1 wellpad. All people met during the baseline surveys stated that they use these water tanks as their sources of water. Prior to the TKBV water points, local households used to obtain water from dug water pits in the Kalapata lugga to the east or the borehole at Nakukulas.

The new TKBV-built Lokosemikori Primary School classrooms (see Figure 6.12-30) are located within the Amosing field 775 m west of the Amosing 3 wellpad, these were constructed in 2018 by the local community using funding from TKBV but were not yet used as at November 2019. These will remain and will not be impacted by the Project.

Homesteads: The numbers of occupied homesteads in the Amosing field identified at the baseline surveys from 2015 to 2019 are summarised in Table 6.12 30 and shown in Figure 6.12-28.

Baseline survey:	Coverage of the Project Field Area	Occupied Long-Term Homesteads	Occupied Short-Term (Seasonal) Homesteads	Occupied Very Short-Term (Migratory Homesteads	Total Occupied Homesteads	Comments
Nov 2015	90%	12	15	0	27	
September 2016 (EOPS)	16%, 1 km around Amosing 1	17 (plus 1 under construction)	0	0	17	13 of the 17 occupied homesteads were just outside EOPS area within the Project Field.
May 2017 (EOPS)	16%, 1 km around Amosing 1	0	0	0	0	Homesteads were unoccupied due to security concerns in April/May 2017.
Nov 2018	100%	Estimated 30 to 40 at the Lokosemikori adakar; plus 10 elsewhere in the field. Total: 40 to 50 homesteads.	2 (in the northern part of Amosing field).	0	42 to 52	30 to 40 homesteads in the Lokosemikori adakar, all classified as long term.
July 2019	100%	Estimated 30 to 40 at the Lokosemikori adakar, 2 nearby, and estimated 20 in the Katamanak adakar. Total: 52 to 62 homesteads.	0	0	52 to 62	30 to 40 homesteads at the Lokosemikori adakar and the 20 homesteads in the Katamanak adakar are all classified as long term.

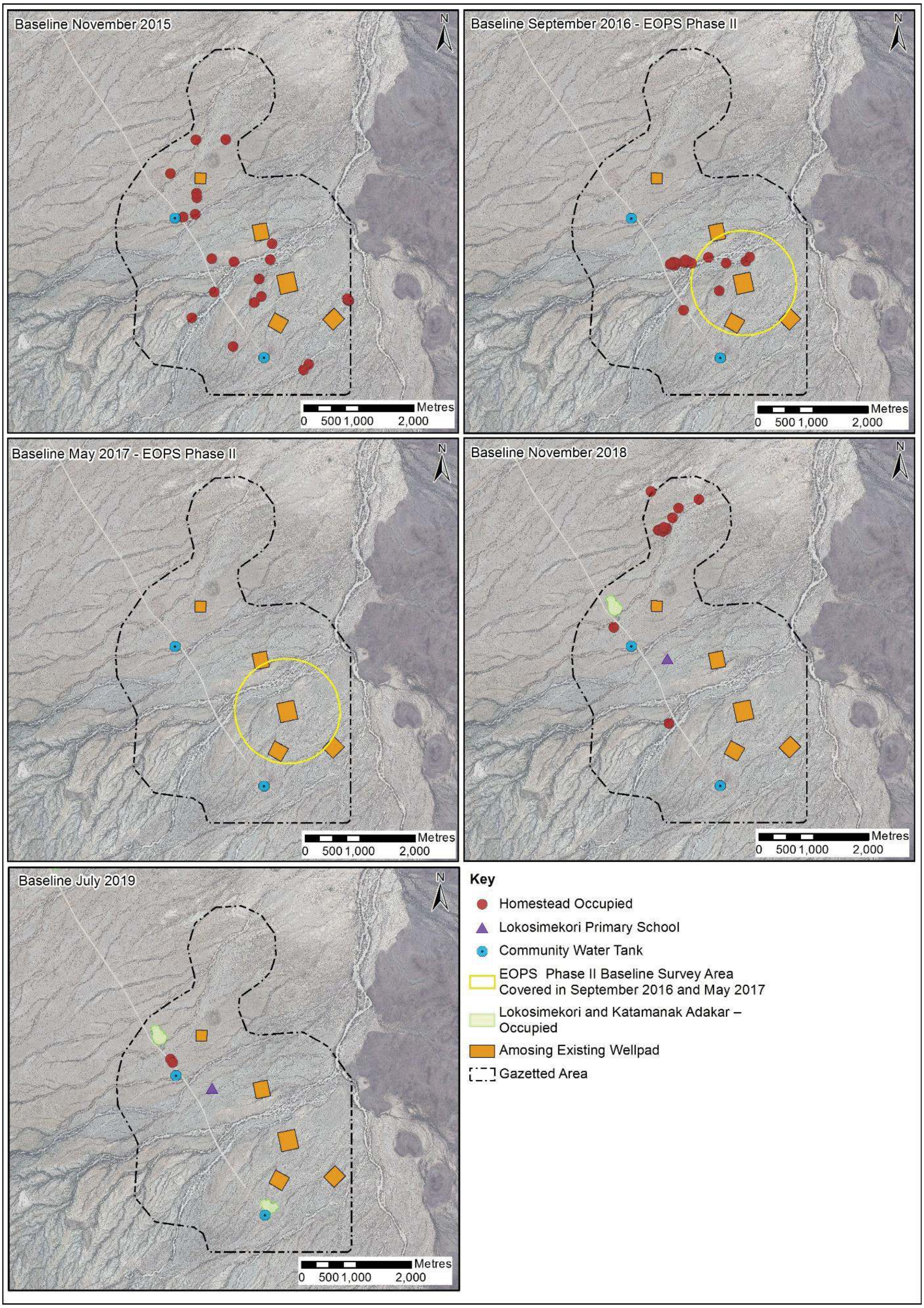

Figure 6.12-28: Locations of Occupied Homesteads in the Amosing Field at Baseline Surveys 2015 to 2019

The baseline surveys identified the following in terms of homesteads:

- The November 2015 baseline survey covered 90% of the Amosing field area and identified 27 occupied homesteads, 12 of which were classified as long-term homesteads and 15 were classified as short-term seasonal homesteads. The occupied seasonal homesteads in the Amosing area are typically used during wet season grazing periods (usually April to July and November to December). During the dry seasons, livestock is moved towards the hills to the west where dry season homesteads are established, with the elderly members of households and children remaining at the long-term homesteads. All but three of the 27 occupied homesteads were located to the east of the main road. Nine of the homesteads (all classified as long-term homesteads) were located along the large lugga just north of the Amosing 1 wellpad. The 15 occupied short-term homesteads were located in various places including to the north and south of the Amosing field in areas of wet season grazing land.
- The September 2016 EOPS Phase II baseline covered a circle of approximately 1 km radius around the Amosing 1 wellpad (representing 16% of the Amosing field area). Within this 1 km circle, there were four occupied long-term homesteads in September 2016, located near the large lugga just north of Amosing 1. In addition, 13 occupied homesteads were located just outside the EOPS Phase II area (but within the larger Amosing field area) in an adakar type cluster towards the main road approximately 1 km north-west of Amosing 1.
- The May 2017 EOPS Phase II baseline covered the same circle of approximately 1 km radius around Amosing 1 (representing 16% of the Amosing field area). During the May 2017 baseline there were no occupied homesteads within the EOPS Phase II area or its vicinity. However, there were five long-term homesteads along the lugga north of Amosing 1 which had only recently been vacated in late April or early May 2017 due to insecurity concerns regarding livestock raiding. The households occupying these homesteads were the same families which occupied the homesteads at similar locations in the 2015 and 2016 baselines. These households were understood to have moved to Nakukulas for safety and were expected to return once the security situation improved.
- The November 2018 baseline covered the whole Amosing field area. The survey found some significant changes to the number and distribution of homesteads involving the development of adakar clusters of occupied homesteads and three modern homestead structures with CSM roofs. In total, there were approximately 40 to 50 occupied homesteads in the Amosing field area. In addition, classrooms had been constructed by the community using TKBV funding earlier in 2018 at the site of the new Lokosemikori Primary School located within the Amosing field area 775 m west of the Amosing 3 wellpad, though these classrooms were not yet in use. The key observations relating to homesteads are as follows:
  - There was one occupied adakar cluster of homesteads, the Lokosimekori adakar, with an estimated 30 to 40 households living there in November 2018. This was located just east of the main road some 200 m inside the north-western boundary of the Amosing field area and 750 m west of the existing Amosing 5 wellpad.
  - Local elders stated that this adakar moved to its current location in late October 2018 and replaced a previous Lokosimekori adakar location 250 m north-east of Amosing 5 (see Figure 6.12-32). This previous site was apparently abandoned earlier in October 2018 because moving closer to the main road was seen by the community as being better in terms of security and accessing government support, especially during drought periods, and closer to the TKBV supplied community water point.
  - Local elders met in November 2018 said that local people plan to make the Lokosimekori adakar a permanent settlement and to make use of the new Lokosemikori Primary School 1.2 km to the south-east.

- A cluster of ten recently built unoccupied long term homesteads, including two modern homestead structures with CSM roofs (see Figure 6.12-30) were identified 250 m south of the occupied Lokosimekori adakar, which indicates that households plan longer-term occupation in this adakar location.
- Elders said that all of the households staying at the Lokosimekori adakar were from the local area. In previous times, these households had been distributed across the area, and during times of insecurity many households from the Amosing area moved to Nakukulas for safety.
- Another site, which elders said had previously been the location of the Katamanak adakar, lay further south just east of the main road 600 m inside the southern boundary of the Amosing field area. This had been vacated in October 2018 due to insecurity concerns over Pokot livestock raiding, and households were reported to have moved to the new Lokosimekori adakar or to Nakukulas, Lokicheda or Kalapata for safety.
- As well as the 30 to 40 households currently living in the Lokosimekori adakar, a further 12 occupied homesteads were identified elsewhere in the Amosing field area in November 2018. Ten of these homesteads were classified as long-term and two classified as short-term seasonal homesteads. Reflecting concerns over livestock raiding from the west, 10 of these 12 occupied homesteads were located east of the main road and in the northern portion of the Amosing field towards Nakukulas settlement which lies approximately 1 km north-east of the field.
- The November 2018 survey recorded the locations of 55 vacated homesteads which have been used in recent years, including those identified as occupied homesteads in previous surveys – see Figure 6.12-32. These included:
  - Vacated homesteads to the west of the road which were classified as seasonal homesteads and likely to have been occupied during the months of July to October to access dry season grazing areas to the west;
  - Vacated seasonal homesteads located to the north and north-east of the Amosing field area for accessing wet season grazing areas to the east of the main road; and
  - Vacated homesteads along the large lugga north of Amosing 1 where occupied long-term homesteads were previously observed during the 2015 and 2016 baselines.

Figure 6.12-29: View of the Former Lokosemikori Adakar – Vacated in October 2018 (Photo November 2018)

Figure 6.12-30: Newly Constructed, Unoccupied Permanent Homestead/Shop Structures Just South of the Occupied Lokosemikori Adakar (November 2018)

Figure 6.12-31: New Primary School Classrooms Constructed in the Amosing Field Area in 2018

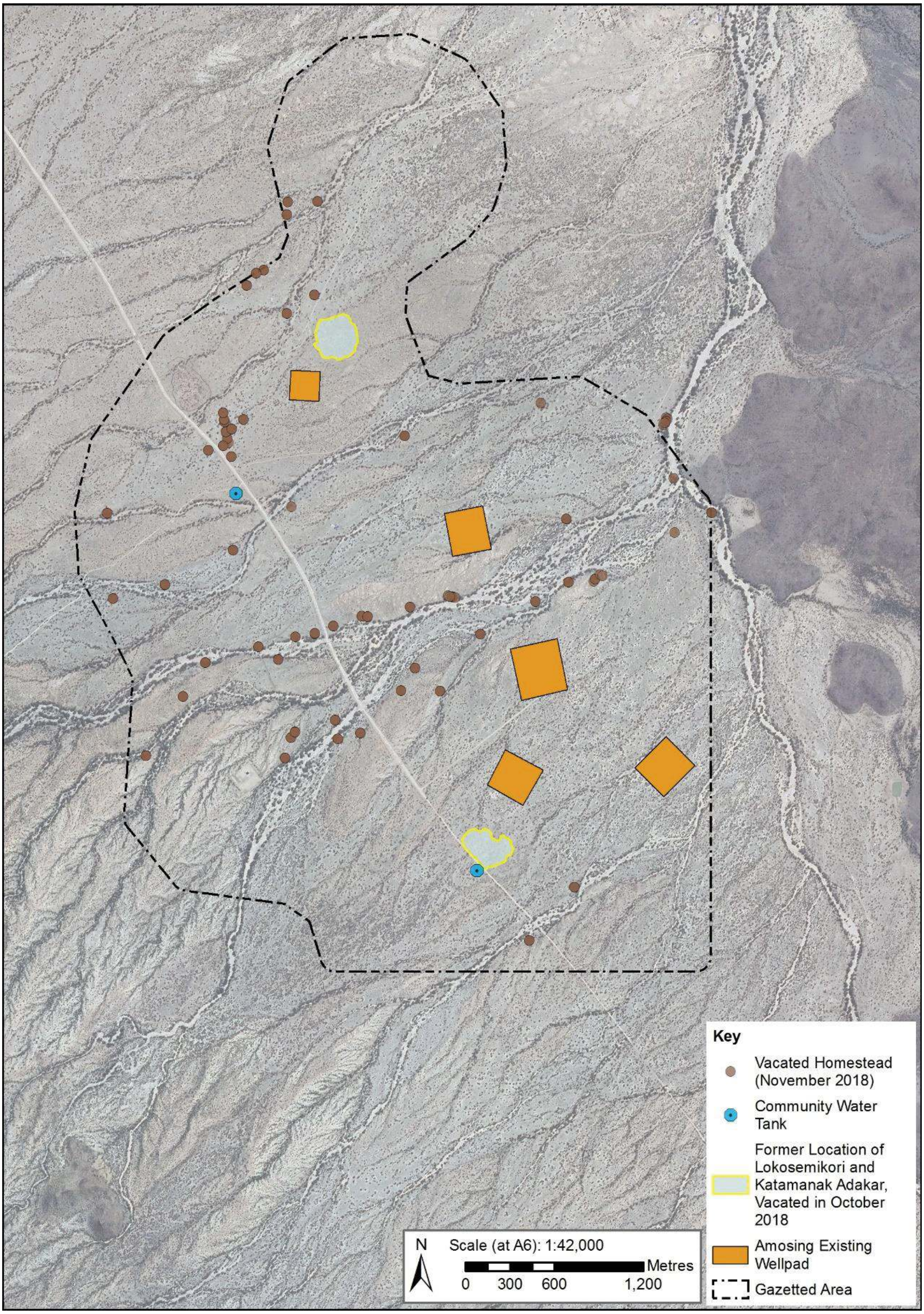

Figure 6.12-32: Vacated Homesteads in the Amosing Field identified in November 2018

- The July 2019 baseline survey observed that the Lokosimekori adakar (see Figure 6.12-28 and Figure 6.12-33) in the north-west part of the Amosing field contained an estimated 30 to 40 occupied homesteads in the same location as in November 2015. In addition, the Katamanak adakar (see Figure 6.12-34) towards the south of the Amosing field was occupied in July 2019 with approximately 20 homesteads. This adakar had been unoccupied in November 2018 due to security concerns over livestock raiding. Apart from two modern CSM roofed homestead structures just south of the Lokosimekori adakar (which were under construction in November 2018) no other occupied homesteads were identified in the Amosing field area. In total, there were approximately 50 to 60 occupied homesteads in the Amosing field area, an estimated increase of 10 since November 2018.

Figure 6.12-33: Aerial Image of Lokosimekori Adakar in Amosing Field, July 2019

Figure 6.12-34: Aerial Image of Katamanak Adakar in Amosing Field, July 2019

6.12.2.6.4 Interconnection Routes Between Fields

The routes of interconnecting buried flowlines and OHTL run for 18.3 km between the Twiga field and the Ngamia field and a shorter 800 m section between the Ngamia and Amosing fields. These interconnection routes fall outside the Gazetted field areas and are shown in Figure 6.12-35. A 30 m RoW will be established for temporary land access during installation of the flow lines and an additional 10 m RoW established for the OHTL.

Baseline data analysis on land use along the RoW for the interconnection routes involved a baseline survey undertaken on the ground by TKBV in July 2019 and review by Golder of aerial imagery taken in early 2018 and July 2019 to identify homesteads and any other community land use or assets along the route.

The findings from this baseline survey work are as follows:

- All land along the interconnection routes is classified as unregistered community land;
- The land is used for seasonal livestock grazing, to varying degrees depending on the nature of vegetation at different points along the routes;
- The routes pass through sparsely populated areas;

- On the Twiga to Ngamia route, only one occupied homestead area is within the 30 m flowline construction RoW, shown as H-04 in Figure 6.12-35 below. This is a long-term homestead located 1 km south-east of the Kapese airstrip facility and 4.6 km south of the Twiga field;
- There are 4 other occupied homesteads near to but outside the 30 m RoW at distances ranging from 66 m to 300 m from the interconnection route, as follows and as shown in Figure 6.12-35:
  - An occupied homestead (H-01) 200 m west of the interconnection route, outside of RoW, located 1.4 km south of the Twiga field.
  - An occupied homestead (H-02) 300 m east of the interconnection route, outside of RoW, located 3 km south of the Twiga field.
  - An occupied homestead (H-03) 66 m west of the interconnection route, outside of RoW, located 3.4 km south of the Twiga field.
  - An occupied homestead (H-05) 95 m west of the interconnection route, outside of RoW, located 8.4 km south of the Twiga field.
- No occupied homesteads were identified within the RoW for the 800 m section of interconnection route between the Ngamia and Amosing fields.

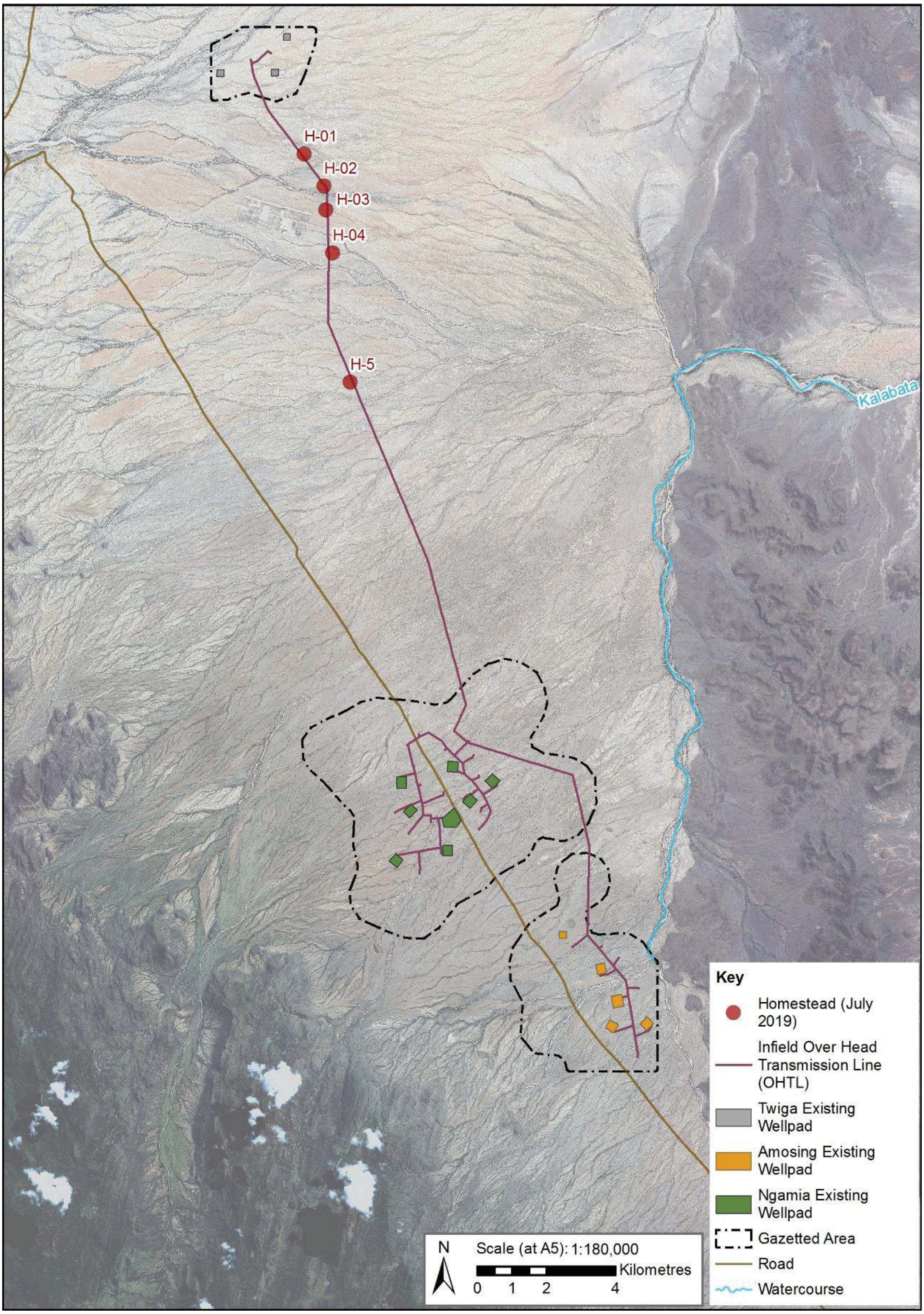

Figure 6.12-35: Interconnection Routes between Fields and Occupied Homesteads

6.12.2.6.5 Water Pipeline Route

The water pipeline runs for approximately 90 km from the Turkwel Dam to the CFA. The pipeline will be buried and pass for 8 km from the Turkwel Dam through land in West Pokot and then for approximately 80 km through land in Turkana County. It will head north towards Lokichar and then south to the Ngamia area and end at the CFA. Land access for the water pipeline will involve temporary access to a 27 m RoW) during construction and a long-term wayleave of 6 m, with the pipeline located on the centreline. The construction RoW will be allowed to revegetate after completion of construction activities. No permanent structures will be permitted within the 6 m permanent wayeave and trees with extensive root systems will be removed.

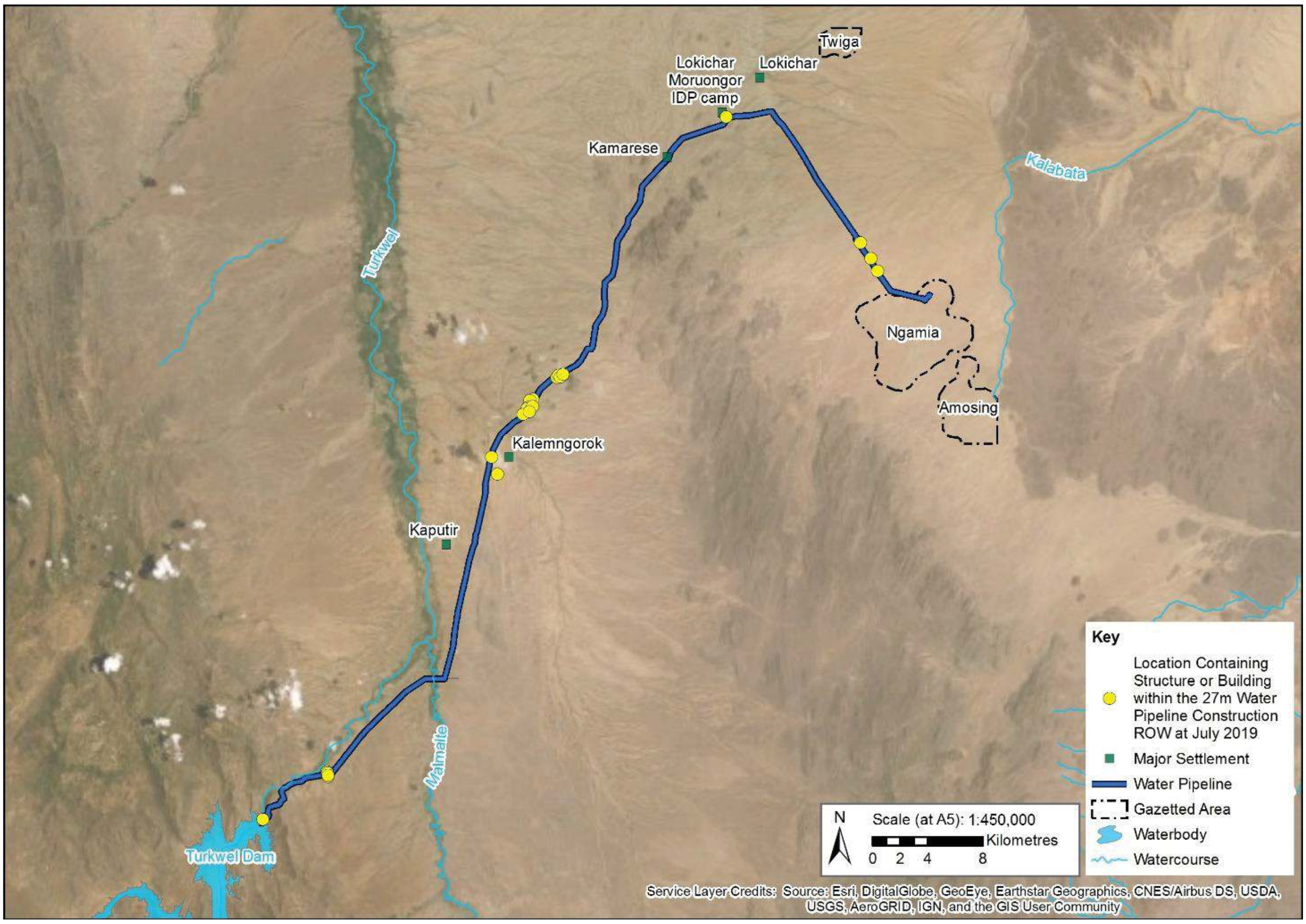

Figure 6.12-36: Water Pipeline Route

Land ownership: All land through which the water pipeline passes in Turkana County is understood to be unregistered community land. The 8 km stretch in West Pokot is also understood to be unregistered community land, with a small area next to the Turkwel Dam understood to be owned by the KVDA.

Land use: The pipeline has been routed to avoid settlements and homesteads and the vast majority of the route passes through remote and arid areas which are sparsely populated with little sign of land use other than occasional animal shelters in areas of communal livestock grazing.

Potentially affected structures: Desk based analysis of the 27 m wide construction RoW using aerial images taken in July 2019 identified just nine polygons along the 90 km route containing buildings or other signs of land use such as animal shelters which overlap into the RoW. Within these nine polygons, 22 land areas with structures overlap with the RoW. The locations of these polygons are shown in Figure 6.12-36 above and Table 6.12-31. Table 12.30 also makes a comparison of the July 2019 aerial images with early 2018 aerial images to identify any significant differences in apparent land use in the water pipeline RoW.

Table 6.12-31: Polygons Containing Buildings or Structures Overlapping with the Water Pipeline RoW, Based on Desk Based Study

County/Sub-county/Sub-location	km from the start of water pipeline at Turkwel Dam	Potential number of homesteads or structures within the 27 m Water Pipeline Construction RoW (based on July 2019 aerial image):	Comparison of 2019 and 2018 aerial images:
West Pokot/ Pokot West	0.4 km	RoW overlaps with 1 building with a CSM roof near to the start of the pipeline at Turkwel Dam	No apparent differences between 2018 and 2019 aerial images.
Kasitei	-	None identified from desk top analysis	None identified from desk top analysis
Turkana/Turkana South:			
Lorogon	7.2 km	RoW passes through land of 4 potential homesteads or structures	Perimeter fences made of branches which cross the RoW in the 2019 image were not present in the 2018 image.
Loyapat	-	None identified from desk top analysis	None identified from desk top analysis
Nakwamoru	-	None identified from desk top analysis	None identified from desk top analysis
Kalemngorok	35 km	RoW passes through land of 1 potential homestead or structure	Perimeter fences made of branches which cross the RoW in the 2019 image were not present in the 2018 image.
	39 km	RoW passes through land of 7 potential homesteads or structures	Perimeter fences made of branches did not cross the RoW in 2018, fenced areas were enlarged to cross the RoW in the 2019 image.
	43 km	RoW passes through land of 5 potential homesteads or structures	Plot fences which cross the RoW in the 2019 image were not present in the 2018 image. New plots of CSM roofed structures observed in 2019.
Turkana/Turkana East:			
Lokichar	67 km	RoW passes through land with 1 potential homestead or structure	No apparent change between 2018 and 2019.
Kapese	-	None identified from desk top analysis	None identified from desk top analysis
Kochodin	82 km	RoW passes through land with 1 potential homestead or structure	Perimeter fences made of branches which cross the RoW in the 2019 image were not present in the 2018 image.

County/Sub-county/Sub-location	km from the start of water pipeline at Turkwel Dam	Potential number of homesteads or structures within the 27 m Water Pipeline Construction RoW (based on July 2019 aerial image):	Comparison of 2019 and 2018 aerial images:
	83 km	RoW passes through land with 1 potential homestead or structure	Perimeter fences made of branches which cross the RoW in the 2019 image were not present in the 2018 image.
	85 km	RoW passes through land with 1 potential homestead or structure	Perimeter fences made of branches which cross the RoW in the 2019 image were not present in the 2018 image.
End of pipeline in Ngamia field	90 km	None identified from desk top analysis	None identified from desk top analysis

The potentially affected structures within the 9 polygons observed in July 2019 images and listed in Table 6.12-31 include one CSM roofed building in West Pokot near the start of the pipeline at Turkwel Dam and 21 potential homestead areas which in the aerial images of July 2019 appear to contain structures such as animal shelters or traditional homestead structures. In seven of the nine polygons where structures (such as branch fence lines) cross the RoW in the 2019 images, these fence lines were not present in the 2018 images. This indicates that these seven locations may be temporary seasonal homesteads and animal shelters which people may possibly have vacated since July 2019.

6.12.2.7 Community Health and Safety

6.12.2.7.1 General Health Profile of Turkana County and West Pokot County

Table 6.12-32 shows the leading causes of morbidity in the two Counties. This is based on secondary data obtained from the HMIS for both Turkana and West Pokot, and primary data from KIIs and health facility assessments in Turkana County. Data is disaggregated into children under 5 years of age and children above 5 years of age and adults. There is no specific disaggregation for children and adolescents aged 5 to 15 years.

The leading causes of morbidity in the area are predominantly communicable and infectious diseases particularly upper respiratory tract infections, malaria, diarrhoeal diseases, skin diseases, and pneumonia. Malnutrition and anaemia also featured among child morbidities, but the burden could be underestimated given that most of the cases (mild-moderate) remain undetected at the community level. Eye and ear infections were also common as were intestinal worms, animal bites and injuries. HIV/AIDS and tuberculosis also cause significant morbidity and mortality, especially among adults. Non-communicable diseases are emerging, particularly hypertension, but these are still overshadowed by the high burden of communicable diseases. Predisposing factors to disease burden in the area include favourable environments for mosquitoes to proliferate, dust that contribute to respiratory ailments, poor access to safe drinking water and sanitation, high levels of poverty and food insecurity, as well as cultural practices that affect health seeking behaviour and practices.

A detailed description of the morbidities is provided under specific EHAs (Section 6.12.2.8.1). Notably, the health indicators in the AoI are generally worse than the national average. This is reflected in the poor access to health services, poor access to safe drinking water and sanitation, limited health knowledge and awareness, poor maternal health and child health indicators, etc.

Table 6.12-32: Leading Causes of Morbidity in the Turkana and West Pokot Counties, 2018

Project area	Morbidity (children <5 years)	Morbidity (children >5 years and adults)
Turkana South Sub-county	■ Upper respiratory infections (43.1%); ■ Malaria, confirmed (25.2%); ■ Diarrhoeal diseases (15.7%); ■ Pneumonia (5.2%); ■ Skin diseases (4.1%); and ■ Other diseases (other diseases of respiratory system, unspecified fevers, eye and ear infections, urinary tract infections, malnutrition, anaemia etc.).	■ Upper respiratory infections (30.1%); ■ Malaria, confirmed (27.4%); ■ Diarrhoea diseases (6.6%); ■ Other respiratory diseases (6.4%); ■ Skin diseases (5.1%); ■ Pneumonia (4.4%); and ■ Other diseases (unspecified fevers, urinary tract infections, arthritis, injuries, typhoid fevered).
Turkana East Sub-county	■ Upper respiratory infections (42.1%); ■ Diarrhoeal diseases (15.1%); ■ Malaria, confirmed (12.1%); ■ Pneumonia (5.3%); ■ Skin diseases (3.8%); and ■ Other diseases (other respiratory diseases, ear and eye infections, unspecified fevers, anaemia, bites/injuries, malnutrition, intestinal worms, etc.).	■ Upper respiratory infections (30.3%); ■ Malaria, confirmed (19.4%); ■ Other respiratory diseases (6.4%); ■ Diarrhoea diseases (5.8%); ■ Skin diseases (4.2%); ■ Pneumonia (3.3%); and ■ Other diseases (injuries, urinary tract infections, typhoid fever, eye infections, animal bites, arthritis, etc.).
West Pokot County	■ Upper respiratory infections (51.1%); ■ Diarrhoeal diseases (15.2%); ■ Malaria, all cases (14.1%); ■ Eye infections (10.2%); ■ Pneumonia (6.0%); ■ Skin diseases (4.9%); and ■ Other diseases (unspecified fevers, malnutrition, intestinal worms, other respiratory diseases, ear infections, etc.).	■ Upper respiratory infections (32.0%); ■ Malaria, all cases (12.5%); ■ Pneumonia (5.9%); ■ Skin diseases (5.9%); ■ Diarrhoea diseases (4.7%); ■ Typhoid fever (4.5%); and ■ Other diseases (urinary tract infections, eye and ear infections, injuries, unspecified fevers etc.).

Source: HMIS 2018 and primary baseline data

6.12.2.8 Health Infrastructure and System Challenges

Health service provision in the Counties is centred around the tenets described by both the KEPH and Schedule IV of the Kenya Constitution (2010). These define mandates, roles and responsibilities for interventions and service delivery at Level 1 (community), Level 2 (dispensary), Level 3 (health centre), Level 4 (Sub-county hospital) and Level 5 (County referral hospital) of the health system. At national level, the MoH directs the overall policy direction and the overarching goals for which the County governments align their strategies and plans.

Table 6.12-33 provides a summary of the health infrastructure. An estimated half of the facilities are public (government owned), 38% private-for-profit, 10% FBOs and 3% owned by NGOs, Ministry of Health (2018). According to official County documents, the average distance to a heath facility is 35 km in Turkana County, and 25 km in West Pokot.

Table 6.12-33: Health Infrastructure in the AoI, 2018

Health facility	Turkana	West Pokot	Kenya (for reference)
By type			
Tertiary Hospital (Level 6)	0	0	4
Secondary Hospital (Level 5)	1	1	28
Primary Hospital (Level 4)	5	4	712
Health Centre (Level 3)	27	11	1715
Dispensary (Level 2)	169	104	4,507
Medical Clinic (Level 2)	22	15	3,351
Other	1	0	217
By ownership			
Government	166	101	5,167
FBO	36	17	1,110
NGO	4	1	321
Private for profit	19	16	4,036
Total	**225**	**135**	**10,534**

Source: Kenya Health Facility Master List (Webpage as of December 2018). Findings corroborated by findings from official County documents and primary baseline data from KIIs

Table 6.12-34 provides a summary of the health system challenges and contributing factors in the Project AoI, according to findings from primary participatory data collected in the field. Key challenges include inadequate health infrastructure, inadequate human resources for health, chronic food insecurity, poor health seeking behaviour, poor access to water and sanitation, and high burden of communicable and infectious diseases.

Table 6.12-34: Health System Challenges in the AoI

County	Challenges	Contributing factors
Turkana	■ Inadequate health infrastructure (35 km average distance to a health facility); ■ Inadequate human resources for health coupled with low capacity/skills of healthcare workers; ■ Food insecurity and high rates of malnutrition; ■ High demand for health services; ■ High burden of communicable and infectious diseases (HIV, TB, respiratory infections, etc.); and ■ Frequent outbreaks of epidemic diseases (cholera, typhoid fever, malaria).	■ Arid and semi-arid climate predisposes to risks of food insecurity; ■ Historical marginalisation of local population; ■ Vast and remote geographical area coupled with sparse population makes health service delivery challenging; ■ Population influx in urban and peri-urban areas; ■ Vulnerabilities associated with the borders of South Sudan/Ugandan and Ethiopia; ■ Large refugee population; and ■ Low literacy levels.

County	Challenges	Contributing factors
	■ Poor health seeking behaviour and health practices in the community; ■ Poor access to safe drinking water and sanitation; ■ Insecurity in certain areas; ■ Population mobility/nomadic lifestyle; ■ Emerging burden of non-communicable diseases; and ■ Referral system challenges .	■ Negative cultural practices (such as use of traditional medicines); ■ Ethnic conflicts; and ■ Changing lifestyles and urbanisation are contributing to the emergence of non-communicable diseases.
West Pokot	■ No primary data.	■ No primary data.

6.12.2.8.1 Environmental Health Areas

The following section describes the baseline health status in relation to the proposed Project with reference to the EHA framework. This is based on secondary data that was identified during desktop review and primary data that was gathered during field work. The list below summarises the EHA as a reference (WBG, 2009).

- **EHA#1: Communicable diseases linked to the living environment** – Transmission of communicable disease (e.g. acute respiratory infections (ARI), pneumonia, tuberculosis (TB), meningitis, plague, leprosy, etc.) that can be linked to inadequate housing design, overcrowding and housing inflation. It also considers indoor air pollution related to use of biomass fuels.
- **EHA#2: Vector-related diseases** – Mosquito, fly, tick and lice-related disease (e.g. malaria, dengue, yellow fever, lymphatic filariasis, rift valley fever, human African trypanosomiasis, onchocerciasis)
- **EHA#3: Soil-, water- and waste-related diseases** – Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g. diarrheal diseases, schistosomiasis, hepatitis A and E, poliomyelitis, soil-transmitted helminthiases)
- **EHA#4: Sexually-transmitted infections, including HIV/AIDS** – Sexually-transmitted infections such as syphilis, gonorrhoea, chlamydia, hepatitis B and, most importantly, HIV/AIDS. TB will be discussed where relevant under HIV, but often linked to EHA#1.
- **EHA#5: Food-and nutrition-related issues** – Adverse health effects such as malnutrition, anaemia or micronutrient deficiencies due to e.g. changes in agricultural and subsistence practices, or food inflation, gastroenteritis, food-borne trematodiases, etc. This will also consider feeding behaviours and practices. Access to land plays a major role in developing subsistence farming contexts.
- **EHA#6: Non-communicable diseases** – e.g. Cardiovascular diseases, cancer, diabetes, obesity.
- **EHA#7: Accidents/injuries** – Road traffic or work-related accidents and injuries (home and project related); drowning.
- **EHA#8: Veterinary medicine and zoonotic disease** – Disease affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies, brucellosis, Rift Valley fever, Lassa fever, leptospirosis).

- **EHA#9: Exposure to potentially hazardous material, noise and malodours** – This considers the environmental health determinant linked to the Project and related activities. Noise, water and air pollution (indoor and outdoor) as well as visual impact will be considered in this biophysical category. It can also include exposure to heavy metals and hazardous chemical substances and other compounds, solvent or spills and releases from road traffic and exposure to mal-odours. There is a significant overlap in the environmental impact assessment in this section. Ionizing radiation also falls into this category.
- **EHA#10: Social determinants of health** – including psychosocial stress (due to e.g. resettlement, overcrowding, political or economic crisis), mental health, depression, gender issues, gender base domestic violence, suicide, ethnic conflicts, security concerns, substance misuse (drug, alcohol, smoking), family planning. There is a significant overlap in the social impact assessment in this section.
- **EHA#11: Health seeking behaviours and cultural health practices** – Role of traditional medical providers, indigenous medicines, and unique cultural health practices.
- **EHA#12: Health system issues** – Physical health infrastructure (e.g. capacity, equipment staffing level and competencies, future development plans); program management delivery systems (e.g. malaria, TB, HIV/AIDS-initiatives, maternal and child health).

6.12.2.8.1.1 EHA#1: Communicable Diseases Linked to Housing Design

Communicable diseases (e.g. ARI, pneumonia, tuberculosis, meningitis, plague and leprosy) are spread from one infected person to another, from animal to human, or from some inanimate objects to an individual. Therefore, they are directly linked to housing design, overcrowding and the general living circumstances in a community.

Secondary Data

Rural housing in both Turkana and West Pokot is predominantly made of traditional material, with temporary or makeshift structures evident in areas linked to the nomadic lifestyle of some inhabitants. Households in Turkana (6.9 persons per household) and West Pokot (5.5 persons per household) are generally larger than the national average of 3.9 (KNBS, 2012; Turkana County Government, 2013; County Government of West Pokot, 2013). Most of these households (>90%) use solid fuels (wood, charcoal, dung, etc.) for cooking. The use of solid fuels for cooking is a major source of indoor air pollution and an important contributory factor for ARI and chronic airways disease. Access to electricity remains very low.

Tuberculosis is endemic nationally, with a prevalence of 558 cases per 100,000 people, according to a national survey conducted in 2016 (Ministry of Health, 2018). The National TB, Leprosy and Lung Disease (NTLD) Programme provides annual statistics on TB with reporting at national and County level based on programmatic data. The disease is also a burden in the AoI, with Table 6.12-35 summarising TB indicators in Turkana and West Pokot Counties compared to national level, based on latest findings from the 2017 NTLD annual report. The number of bacteriologically confirmed cases of TB shows an upward trend in both Counties (Figure 6.12-37) (NLTD, 2018).

Table 6.12-35: Tuberculosis Indicators in the AoI, 2017

Indicator	Turkana	West Pokot	Kenya
Bacteriologically confirmed (no.)	1,182	834	44,365
TB case notification rate (per 100,000 population)	200	235	172
GeneXpert sites (no.)	2	3	32

Indicator	Turkana	West Pokot	Kenya
GeneXpert utilisation rate (%)	36	31	49
Diagnostic sites, smear microscopy (no.)	27	28	537
TB treatment sites (no.)	49	46	3,618
Drug resistance (no. all forms)	21	15	577
Treatment success rate (% confirmed cases)	79	82	81
Death rate (% new confirmed cases)	2	4	6
TB-HIV co-infection rate (%)	22	10	28
TB cases that are children (<15 years) (%)	19	17	9

Source: NTLD Programme Annual Report 2017

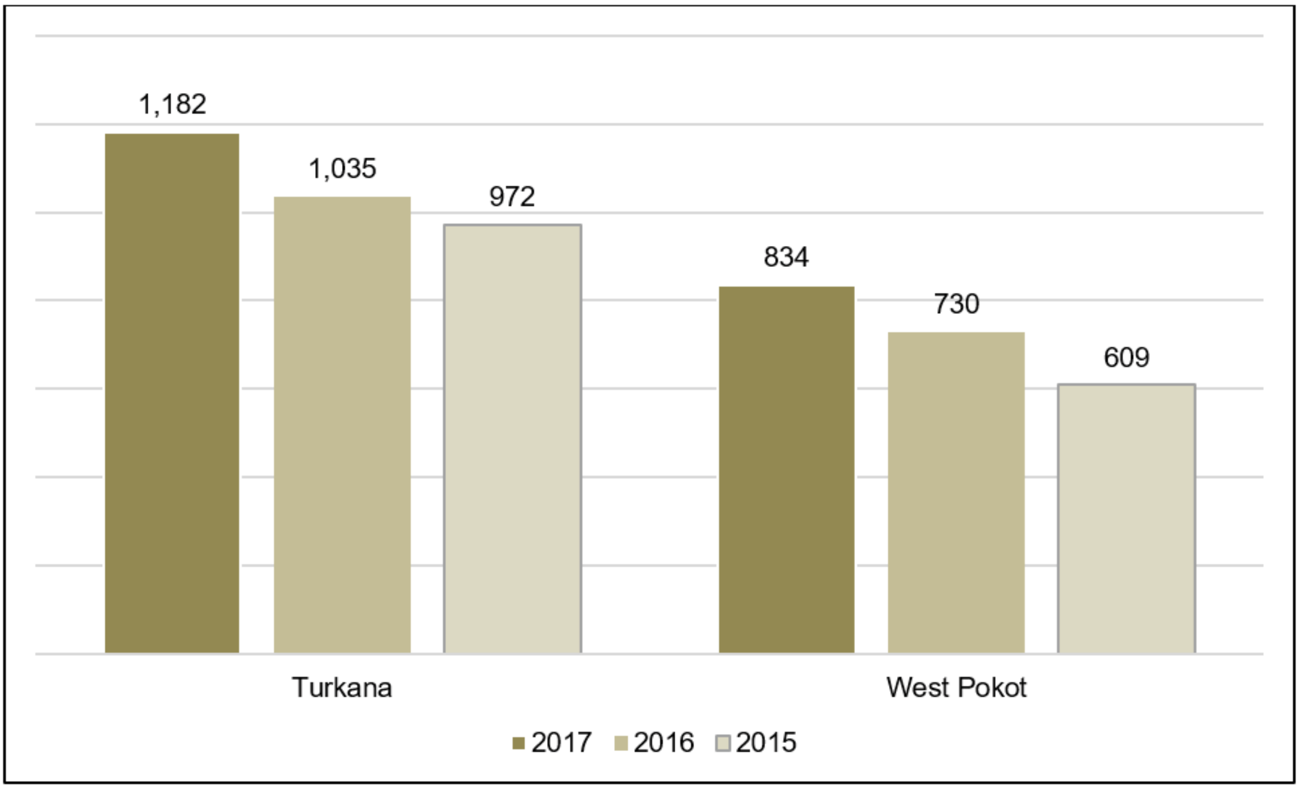

Figure 6.12-37: Trend in Tuberculosis Cases (Bacteriologically Confirmed) in the AoI, 2015-2017

Source: NTLD Programme Annual Report 2017

Acute respiratory infections (ARIs) such as pneumonia, upper and lower respiratory tract infections are a leading cause of disease burden in Kenya (UNDP, 2018; Ministry of Health 2018). According to facility-based data, ARIs account for at least one-third of health consultations in public facilities (34% in 2017, 39% in 2016 and 40% in 2015). The burden of ARI is particularly high among children under-five years of age, where it accounts for 18% of deaths. ARIs are prevalent in the entire AoI, with 2018 routine HMIS data showing that the incidence of pneumonia is above national average (8.5%) in both Counties, with a high of 13.6% in Turkana South Sub-county (Figure 6.12-38) (Ministry of Health, 2019).

Measles remains an important disease of public health concern in Kenya with sporadic outbreaks that are often immediately contained (Obare 2012). Both Turkana and West Pokot Counties are prone to measles outbreaks owing to prevailing sub-optimal vaccine coverage occasioned by nomadic lifestyle and the significant movement of people. The risk in Turkana County is further compounded by its border location and the presence of a large refugee population. A 2017 measles outbreak resulted in 232 cases in Turkana County with the South Sub-County most affected (175 cases), and with West Pokot recording 17 cases. The Project AoI recorded a significant decrease in measles cases in 2018 (Turkana 35 cases, and 15 cases in West Pokot).

Meningococcal Meningitis is an outbreak risk as the north-western tip of Kenya lies within the African meningitis belt (WHO, 1998). Outbreaks of meningitis in the belt are generally associated with seasonality linked to semi-arid areas (dust a predisposing factor). Turkana County is vulnerable to meningitis outbreaks owing to its border location and presence of refugee populations. The risk is generally low in West Pokot. No outbreaks of the disease have been recorded or reported in the AoI in recent past.

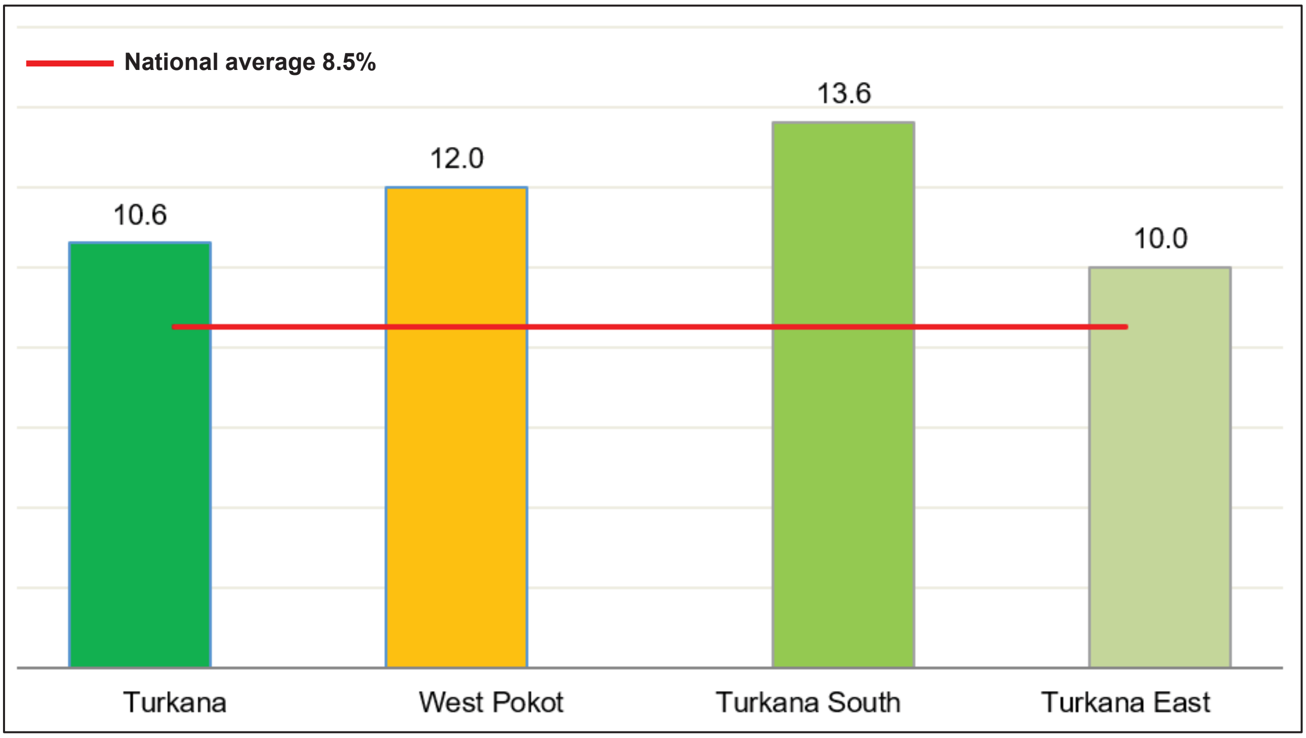

Figure 6.12-38: Incidence of Pneumonia (%) in the Project area, 2018

Source: HMIS 2018

Primary Data

Housing is a major challenge in most parts of Turkana County. Most of the population in rural areas live in *manyattas,* which are makeshift structures, built of rudimentary materials. Poor housing was linked to widespread poverty and the migratory lifestyle of people. Housing inflation was reported in major urban centres particularly Lodwar town and in Lokichar centre. Influx of people has been witnessed in Lodwar and Lokichar and this was partly linked to devolution of resources to County level and the oil discovery in the area (Focus Group Meeting, 21 November 2018).

Focus group discussion participants characterised their housing as poor and cited lack of money to build adequate housing. Participants in Lokichar urban area reported that the demand for housing has increased leading to increasing rental prices. Mushrooming of guest houses and lodges was also evident in Lokichar urban centre, indicating an increasing demand for temporary accommodation. In the local urban settlements, it was reported that there is an increasing number of permanent and semi-permanent housing structures being erected, while the situation in rural areas remained unchanged.

Respiratory infections emerged among the top five causes of morbidity in Turkana County and the local Project area. Findings from field research show that ARIs constitute at least one third of health facility consultations in Turkana South and East Sub-counties. Facility-based data from Lokichar Health Centre (missionary facility), Lokichar Dispensary, Katilu Hospital and Elelea Hospital all showed ARIs among the top five diagnoses. Key informants identified dusty weather and poor housing as the main predisposing factors. This was consistent with findings from the focus group discussions where participants spontaneously listed cough and pneumonia amongst the commonest ailments affecting young children and adults in their communities.

TB was listed among the top ten health challenges in Turkana County (Focus Group Meeting, 21 November 2018). This was corroborated by findings from local health facilities and focus groups. The County TB programme manager reported an increasing trend of new TB cases and attributed this partly to increasing efforts to detect cases, through active screening and improved diagnostics using the GeneXpert analyser. As of 2018, the County had only three GeneXpert sites (at Kakuma Refugee Camp, Lodwar Hospital, and Katilu in Turkana South). Turkana County records 2,600 to 2,800 new TB cases every year. Informal settlements in Lodwar, Kakuma, Lokichar and Kalokol (around Lake Turkana) were cited as hotspots for new TB infections. Multi-drug resistant TB is an emerging threat especially in Lodwar, Kakuma (12 cases in 2017) and Lokichar (4 cases in 2017). TB-HIV co-infection remains a concern the County, at a rate of 22% in 2017. Diagnostic and treatment services for TB were available in all hospitals and some health centres. There is currently no TB treatment centre in Lokichar which relies on the nearest centre at Katilu Sub-County Hospital or the Lodwar County Referral Hospital (has a dedicated TB *manyatta*). Medications for TB including multi-drug resistant TB treatment were generally available at no cost, with occasional stock outs linked to supply chain inefficiencies.

Measles remains a concern in the entire AoI owing to the prevailing poor immunisation coverage and its outbreak potential. According to KIIds, cases are recorded almost every year. Turkana South and West (Kakuma Refugee Camp) were reported as hotspots for measles outbreaks. Meningococcal meningitis did not emerge as a concern, but the threat of an outbreak was acknowledged.

6.12.2.8.1.2 EHA#2: Vector-Related Disease

The most important disease vectors in the Project area are mosquitoes that may transmit malaria and certain filarial disease; and flies, especially sand-flies that may transmit leishmaniasis.

Secondary Data

Malaria: Turkana falls in the seasonal transmission zone, while West Pokot lies in the highland epidemic-prone zone. Description for each zone are shown in Table 6.12-36.

Table 6.12-36: Malaria Epidemiological Zones in Kenya

Malaria zone	Description	Prevalence	AoI County
Endemic areas	Areas of stable and intense malaria transmission throughout the year with high annual entomological inoculation rates. Includes the Lake Endemic and Coastal Endemic areas which are home to 29% of the country's population.	>20%	None
Highland and epidemic-prone areas	Malaria transmission in the western highlands is seasonal with considerable year-to-year variation. The entire population is vulnerable and case-fatality rates during an	3 to 20%	West Pokot

Malaria zone	Description	Prevalence	AoI County
	epidemic can be greater than in endemic regions. Approximately 20% of Kenyans live in these areas.		
Seasonal transmission areas	This epidemiological zone includes the arid and semi-arid areas of northern and central parts of the country, which experience short periods of intense malaria transmission during the rainy seasons. Although geographically the largest zone, only 17% of the population lives in these areas.	1 to 5%.	Turkana
Low risk areas	This zone covers 10 Counties in the central highlands of Kenya including Nairobi. Approximately 34% of the population lives in this zone.	<1% to none	None

Source: NMCP, 2016

Data from official County documents shows that malaria contributes 41.8% of outpatient morbidity in Turkana County, and 15.2% of outpatient morbidity in West Pokot (Turkana County Government, 2013; County Government of West Pokot, 2018).

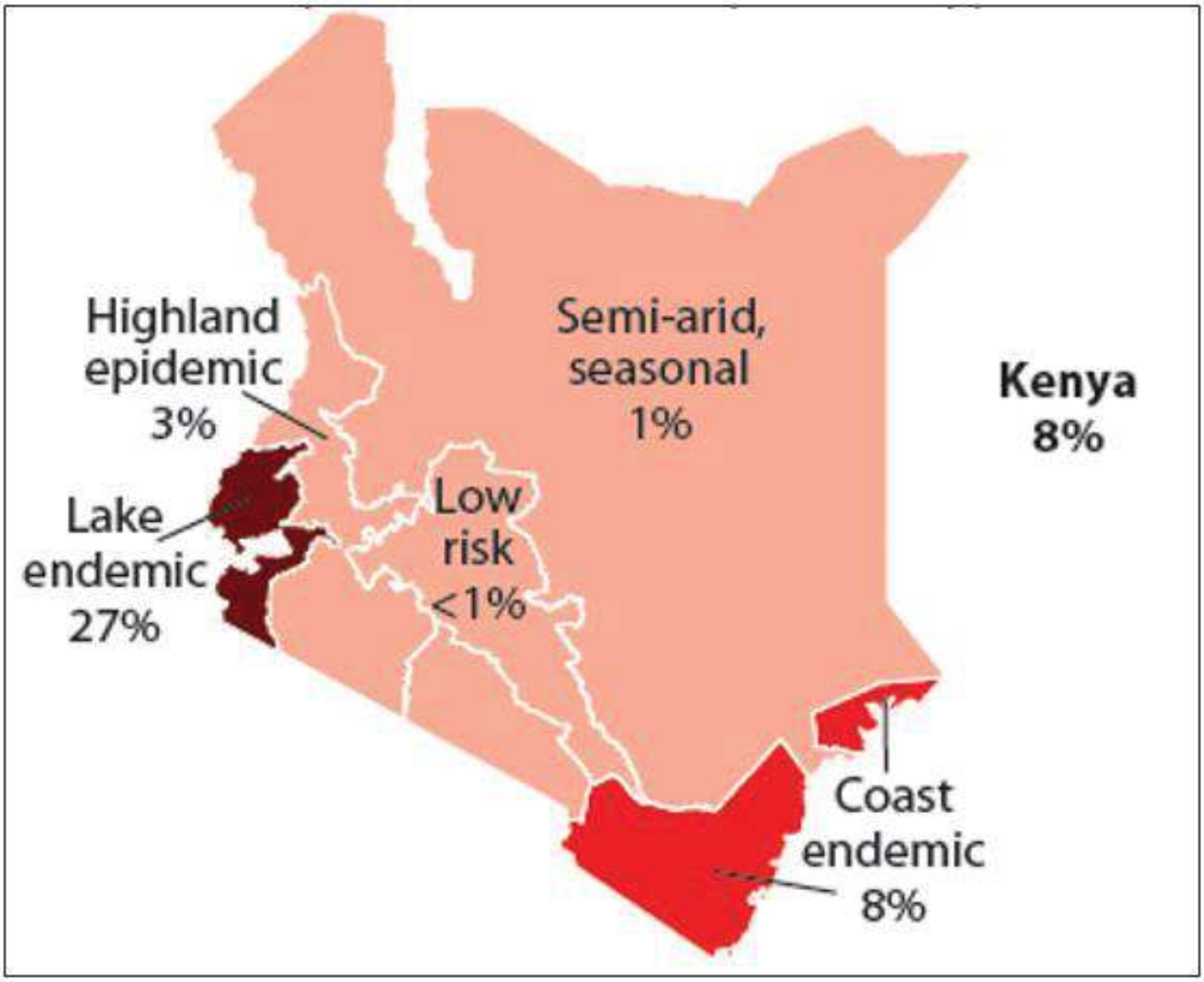

Figure 6.12-39: Prevalence of Malaria in Kenyan Children (Age 6 Months to 14 Years Old) Stratified by Epidemiological Zones, 2015

Source: KMIS 2015

HMIS data for 2018 shows a high malaria positivity rate (proportion of febrile patients that test positive for malaria) in Turkana County (37.4%), compared to 22.2% in West Pokot and 26.6% as the national average. Nearly half (45.2%) of febrile patients in Turkana South and at least a third (36%) in Turkana East tested positive for malaria during 2018 (Figure 6.12-40) (Ministry of Health, 2019). Between 2016 and 2018, the number of confirmed malaria cases in Turkana County increased from 107,977 to 117,003. During the same period confirmed malaria cases in Turkana South increased four-fold from 4,301 to 17,680, while cases in Turkana East increased five-fold from 682 to 3,100. However, West Pokot County registered a modest increase in confirmed malaria cases from 30,762 in 2016, to 34,621 in 2018 (Ministry of Health, 2019). Regarding malaria related deaths, Turkana County recorded 456 in 2018, increasing from 245 in 2017, and 323 in 2016. Nearly half of the malaria deaths in Turkana County in 2018 (231 out of 456) occurred in Turkana South, while Turkana East recorded a few deaths. West Pokot recorded 125 malaria deaths in 2018, representing a fatality rate of 3.6% (Ministry of Health, 2019). It is noted these statistics reflect the patients that were treated in a public health facility and given health seeking behaviour and access challenges, the results may not be consistently accurate.

According to a personal communication with a leading malaria researcher Professor Robert Snow from KEMRI, malaria risks vary tremendously across the vast area of Turkana (Snow, R., 2016). This was largely driven by the presence of *An. Arabiensis* mosquito and often associated with water courses, especially the Turkwel River (Snow, R., 2016). Distribution of malaria cases were also associated with movement of people and weak malaria control programmes. A study completed in Lokichar in 2010 indicated a parasite prevalence of 30%. The risk in the Project area varies between a 5 and 40% (Snow, R., 2016).

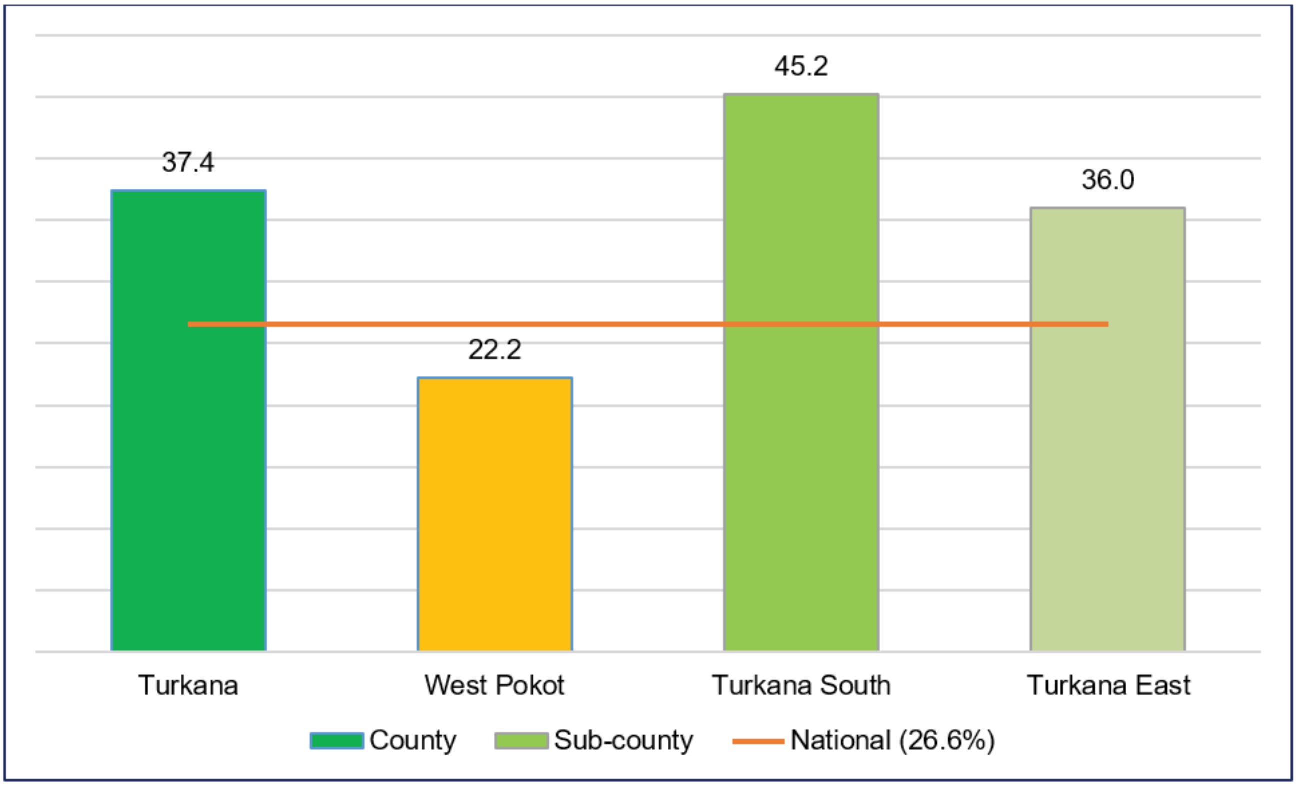

Figure 6.12-40: Malaria Positivity Rate (%) in the Project Area, 2018

Source: HMIS 2018

Arboviral diseases (arthropod borne viruses) are a risk in the Project area. These acute viral fevers (dengue, chikungunya, yellow fever, Rift valley fever) are transmitted by a day-biting mosquito from the *Aedes* genus, which breeds mainly in human-made containers. These diseases are often poorly documented due to limited awareness by health care providers and lack of diagnostic capability. Studies have documented a dengue antibody positivity rate of 12.5% nationally, with clustering around Coastal and North-Eastern regions of the country (Ochieng et al., 2015). Literature indicates a 14% sero-prevalence of yellow fever antibody in northern Kenya, but no confirmed cases or outbreaks have been documented for many years (Sanders et al., 2016).

Rift valley fever is a significant risk in pastoral communities. An outbreak of Rift valley fever was reported in July 2018 from North-Eastern Kenya (Wajir County), which resulted in four human deaths (Daily Nation, 2018). However, but no cases were recorded in either Turkana or West Pokot.

Leishmaniasis, especially the visceral form (Kala-azar), is endemic in parts of Kenya, particularly the Rift Valley, eastern and north-eastern regions (Tonui, 2006). The disease is a risk in both Turkana and West Pokot Counties, which according to HMIS data recorded 272 and 335 cases in 2018, respectively. Turkana South recorded 38 cases Kala-azar in 2018 while Turkana East recorded only 2 cases (Ministry of Health, 2019).

Primary Data

Malaria is an important health concern in Turkana County, with the burden of disease, and therefore risk, considered to be higher than is generally reported on malaria spatial distribution models. According to the County malaria programme coordinator, the disease has localised hot-spots in the County. In Turkana South, the Turkwel and Kerio Rivers were noted as high-risk areas, as are areas in Loima and parts of Turkana East. The increased risk in Turkana South and part of Turkana East was linked to the bordering of endemic areas, especially West Pokot and Baringo, respectively. The risk in Loima was linked to irrigation schemes.

Malaria exhibits a seasonal pattern with an upsurge of cases during the rainy season. The programme officer reported an increase in malaria cases from 125,466 in 2015, to a high of 193,327 in 2017 (including clinically diagnosed and reported malaria cases[18]). Several deaths were also recorded.

According to the national malaria policy, the entire Turkana County is considered low risk for malaria and therefore does not benefit from any mass targeted malaria control programmes. Therefore, there is no mass distribution of LLINs at a community level and no facility-based issuance of LLINs to high-risk groups like children and pregnant women. Some indoor residual spray activity was conducted in the Loima area during November to December 2017, with this in response to an intense transmission period that resulted in a localised epidemic.

A government-led entomological study was conducted in Turkana County in March 2018. The results were not available at the time of writing the report.

Focus group participants consistently listed malaria among common ailments affecting young children, with the disease especially a big challenge during the rainy season. While the majority knew the mode for malaria transmission (through mosquito bites), there were some misconceptions of malaria transmission through drinking dirty water or consumption of dirty food. Ownership of LLINs was generally very low and participants cited lack of a government distribution programme and the lack of means to purchase their own net. Assessment of the local health facilities in Lokichar, Katilu and Lokori revealed that malaria is among the top-five reasons for outpatient consultation. Rapid diagnostic test kits for malaria and treatment were generally available in public health facilities, with these provided to the public at no cost.

Kala-azar was mentioned among neglected tropical diseases occurring in Turkana County and reported to have a focal distribution pattern along river banks. The vector (sand-fly) was associated with and breeds around anthills. Key informants at Lokichar Health Centre and Katilu Hospital reported that tens of cases of Kala-azar are recorded every year. Rapid serological test kits and treatment were generally available at the public

[18]The clinical cases of malaria are generally made on a presumptive basis, either due to the lack of diagnostics or a high index of suspicion.

facilities, but poor recognition of symptoms, confounding diagnosis, and late presentation of cases often led to poor patient outcomes.

No primary data was available on arboviral diseases.

6.12.2.8.1.3 EHA#3: Soil, Water and Waste-related Diseases

The prevalence of soil, water and waste-related diseases highly depend on sanitation facilities and access to safe drinking water, factors that often show strong variations at regional and local levels.

Secondary data

Seven in ten households in Kenya (69%) have access to an improved source of drinking water. This proportion is higher in urban (90%) than rural areas (59%) (KNBS, 2015). For more than a quarter of households, it takes 30 minutes or longer to obtain drinking water (KNBS, 2015). Nationally, only half (53%) of households have access to an improved sanitation facility, including 30% that are shared (KNBS, 2015). Data for 2013 shows that only 44% of households in Turkana County have access to safe drinking water, with a far lower proportion (18%) having access to improved sanitation services (KIRA, 2014).

As of 2018, only 41% of West Pokot's population had access to safe drinking water with the average distance to nearest water point at 5 km. Sanitation also remains a big challenge in West Pokot with only 33% coverage for sanitation services. The majority in both West Pokot (67%) and Turkana (56%) Counties have no sanitation facility and therefore practice open defecation. Both these Counties are implementing a Community Led Total Sanitation (CLTS) strategy, an innovative community led drive for collective behaviour change towards greater ownership and sustainable sanitation in maintaining an open defecation free status. A CLTS monitoring system is in place, with January 2019 data showing that only 51 out of 1,956 villages in Turkana County (3%) and 32 out of 2,311 villages in West Pokot (1%) have been certified as open defecation free. CLTS data also shows that 96% of villages in both Turkana East and South still practice open defecation (CLTS, 2019). According to a 2018 survey, only 10% of Turkana population wash their hands at critical times (Ministry of Health, 2018)).

Diarrhoeal disease (caused by bacteria, virus and parasites), cholera and typhoid fever are some of the most common diseases in this context. Cases are largely attributable to three major environmental causes: poor sanitation, poor hygiene, and contaminated water and food (ACF, 2013). HMIS data for 2018 shows that a third (35%) of children seen in outpatient clinics in Turkana County and 30% in West Pokot presented with diarrhoea. This proportion was even greater in Turkana South at 40.8%Figure 6.12-41) (Ministry of Health, 2019).

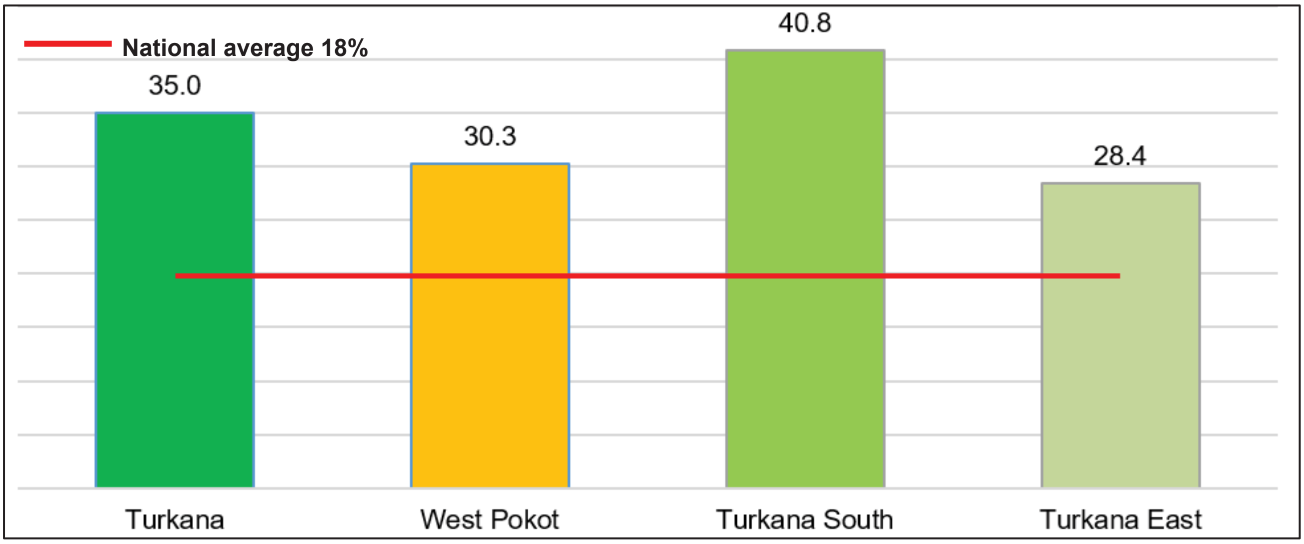

Figure 6.12-41: Proportion of Sick Children (Under 5) Presenting with Diarrhoea in the Outpatient Clinics, 2018

Source: HMIS 2018

Cholera outbreaks occur frequently and remain a significant risk in the Project area, with a 2018 outbreak in Turkana County resulting in a total of 1042 cases and 11 deaths (Turkana County Government, 2018). Turkana Central, North, South and West contributed most of the cases as shown in Table 6.12-37 (Turkana County Government, 2018). Turkana East did not record any cholera cases during the 2018 outbreak. The 2018 outbreak also extended to West Pokot which recorded 352 cases (Ministry of Health, 2019).

Table 6.12-37: Cholera Outbreak in Turkana County, 2018

Sub-county	Total cases (confirmed and suspected)	Deaths	Fatality rate (%)
Turkana Central	516	6	1.2
Turkana West	220	2	0.9
Turkana South	168	2	1.1
Turkana North	123	1	0.8
Loima	15	0	0.0
Turkana East	0	0	0.0
Kibish	0	0	0.0
Total	**1,042**	**11**	**1.1**

Source: Cholera situation report for Turkana County as at 27 July 2018

Helminthiases or intestinal worm infection, mostly roundworms and hookworms are prevalent countrywide. These infections can be caused by ingestion of eggs from contaminated soil (e.g., roundworm, whipworm and *Giardia*) or by active penetration of the skin by larvae in the soil (e.g., hookworm). The high rates of open defecation in the AoI coupled with poor hygiene practices are key predisposing factors to the high burden of intestinal worms reported locally.

Schistosomiasis (bilharzia) is endemic in parts of Kenya especially areas with large pools of fresh stagnant water. Both the uro-genital form (caused by *Schistosoma haematobium*) and the intestinal form (caused by *Schistosoma mansoni*) have been documented (ChartsBin, 2012). Different genus of fresh water snails act as intermediate hosts (Utzinger, 2009). However, survey data shows a low prevalence (<1%) of the disease in Turkana and West Pokot (Brooker, 2009). In 2018, Turkana County recorded 131 cases of bilharzia, of which 4 occurred in Turkana South, and none in Turkana East. West Pokot recorded 53 cases of bilharzia (Ministry of Health, 2019).

Poliomyelitis (polio) is an important consideration in this context. While Kenya achieved polio free status in 2003, recent imports of the virus from neighbouring countries have led to sporadic outbreaks, especially in the northern part. The outbreaks have been linked to ongoing wild poliovirus circulation in Somalia and Southern Sudan, with 14 cases reported in Kenya from the Dadaab (Garissa County) refugee camp in 2013 (WHO, 2016). Turkana, West Pokot and other north-eastern parts of the country are considered hotspots for potential polio outbreaks (IRIN, 2016). During 2016 to 2018, Turkana County notified 9 cases of acute flaccid paralysis while West Pokot recorded 5, but none was confirmed as polio.

Hepatitis A and Hepatitis E virus are endemic in Kenya owing to their transmission via the faecal-oral route through contaminated food or water (WHO, 2015). Even though data is limited, these conditions are a likely risk in the Project area given the underlying environmental and living conditions.

Primary Data

Poor access to safe drinking water and sanitation services were cited among key health challenges in Turkana County. According to the County WaSH coordinator, 46% of households have access to safe drinking water; with the average distance to a water point estimated at 15 to 20 km. Faecal contamination of water as a result of widespread open defecation was a noted challenge. High salinity of ground water was also reported as a concern. Based on results from a 2016 to 2017 nutritional and health survey in the Turkana County, only 16% of the population have toilet/latrine facilities, with a high degree of open defecation. The practice of open defecation was attributed to nomadic lifestyle, culture (not sharing toilets with in-laws), and poverty. The County is implementing the CLTS programme to increase sanitation coverage, but the progress remains very slow.

It emerged from an interview with a Turkana South medical officer that the entire Sub-county is water stressed and there is increasing demand for water in urbanising areas such as Lokichar. Focus group participants also reported that access to safe drinking water was a challenge and the supply was inadequate. Ground water (boreholes) was the most common source but increasing use of surface water was reported during the rainy season, with these sources often shared with animals. Participants in Kapese, Lokichar and Nakukulas settlements reported that TKBV has been active in the provision of safe water sources for the local communities, constructing boreholes and piping or trucking water to storage tanks placed at central locations. Long queues were evident at most of the public water points, and water vending using bowsers was observed in Lokichar, further indicating the high demand for water (Figure 6.12-42).

Figure 6.12-42: Sample of Water Sources in the AoI

Diarrhoeal diseases were reported as a major health concern, with an ongoing risk for cholera, typhoid fever, amoebiasis and dysentery outbreaks. According to the Turkana County WaSH coordinator, cyclical cholera outbreaks occur every 9 to 10 years, with the most recent outbreak reported in January to August 2018, resulting in 1042 cases and 11 deaths (case fatality rate of 1.1%). The outbreak occurred in five Sub-counties: Loima, Turkana Central, South (Lokichar and Katilu), North and West. Lokichar recorded 16 cases. The response to the cholera outbreak involved setting up temporary treatment centres in the affected areas. The outbreak occurred in two waves and lasted 8 months; this partly linked to inadequate and weak outbreak response mechanisms.

Focus group participants also reported diarrhoea among commonest ailments in their community and also cited frequent cholera outbreaks. This was further corroborated by findings from local health facilities where diarrhoea was consistently listed among top-five morbidities.

Intestinal worm infections also occur, with a primary school and child health clinic based deworming programme in place supporting mass drug administration biannually. Bilharzia was reported to be generally uncommon. Polio was not reported.

Waste disposal emerged as a huge challenge. Turkana County does not currently have a sewerage plant and no organised garbage collection system is in place. Most combustible wastes are burnt in the open. Some liquid wastes from septic tanks and slaughter houses are transported for disposal in Kitale, but that was considered unsustainable given the distance. The entire County has only 4 incinerators (1 in Turkana South) for the management of biohazardous waste material.

6.12.2.8.1.4 EHA #4: Sexually-Transmitted Infections, Including HIV/AIDS

Extractive sector and energy projects in developing countries have a legacy of increasing transmission of STIs through a complex network of social and economic determinants.

Secondary Data

HIV/AIDS: The AoI lies within a low to medium HIV prevalence (Figure 6.12-43) with an estimated prevalence of 3.2% in Turkana County and 1.6% in West Pokot (National AIDS Control Council, 2018; Ministry of Health, 2018).

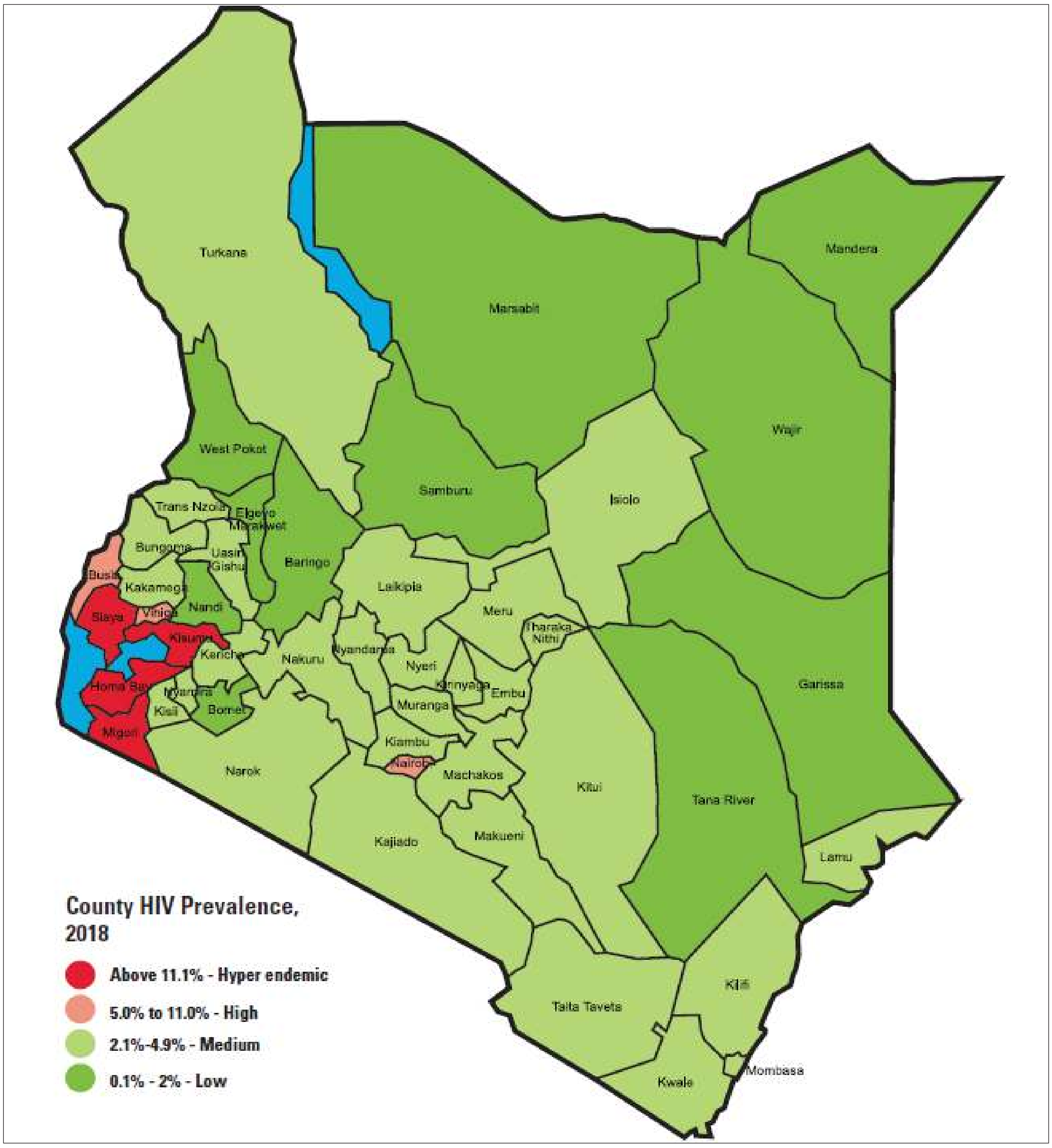

Figure 6.12-43: HIV Prevalence in Kenya by County, 2018

Source: Kenya National AIDS Control Council (NASCOP) AIDS Response Progress Report 2018

The HIV situation in Turkana County is summarised in Table 6.12-38 based on data from an official presentation by the County AIDS programme coordinator in October 2018. The County contributes to 1.6% of the national HIV burden. Together with associated opportunistic infections, the disease accounts for 30 to 40% of adult bed occupancy at Lodwar Hospital. Estimates from data models show that the HIV prevalence in Turkana County has significantly decreased from a high of 7.6% in 2013 to 3.2% in 2018 (NASCOP, 2014; Pulkol, 2018). Between 2013 and 2015, the number of people living with HIV in the County decreased by 50% but increased slightly (by 3%) during 2015 to 2018. HIV-related deaths in the County has declined 77% from 2,537 in 2013, to 588 in 2018 (Pulkol, 2018). Based on survey data presented in the 2014 Kenya Demographic and Health Survey (KDHS), knowledge on HIV was more or less universal in Turkana County, but when questioned on prevention methods knowledge was poor, with 49.2% of women and 2.4% of men reporting that using a condom and limiting sexual contact to one uninfected partner were effective prevention methods [5]. The survey also showed that only 23.9% of women and 1.7% of men (lowest nationally) in the County had comprehensive knowledge about HIV/AIDS. Payment for sex was questioned in the survey with only 0.6% of men in Turkana County reporting that they had ever paid for sex (KNBS, 2014).

Table 6.12-38: Turkana County HIV Estimates, 2018

Indicator	Value
HIV Prevalence	3.2%
Male HIV prevalence	2.7%
Female HIV prevalence	4.5%
HIV Incidence per 1000	0.7%
Adults LWHIV	21,343
Adult new infections	403
Adult HIV related deaths	506
Children LWHIV	1883
Children new HIV infections	152
Children HIV-related deaths	81
Total people living with HIV	23,230
Total new HIV infection	556
Total HIV-related deaths	588
PMTCT need	1117
Mother-to-child transmission rate	18.3%
Adolescents LWHIV (10-19 years)	1,743
Adolescents new HIV infections	84

Indicator	Value
HIV-related deaths among adolescents	42
Young adults LWHIV (15-24 years)	2,582
Young adults new HIV infections	175
HIV related deaths among young adults	51
Adult antiretroviral coverage	23%
Children antiretroviral coverage	38%
PMTCT coverage	48%

Source: Turkana County HIV Situation Presentation by County AIDS Programme Coordinator, October 2018. LWHIV=Living with HIV

The HIV situation in West Pokot shows a better outlook than the national average. The prevalence has decreased from 2.3% in 2014, to the current 1.5%. The County is traversed by the great northern transport corridor with several truck stoppage points which have been identified as hot spots for new HIV infections and commercial sex activity (County Government of West Pokot and NACC, 2016). Gaps and challenges to the HIV response in the County include inadequate funding, negative cultural practices such as female circumcision and wife inheritance, unmet support to orphans and vulnerable children, high stigma and discrimination of HIV affected persons (County Government of West Pokot and NACC, 2016).

Table 6.12-39 (NACC, 2018) shows the trend in new HIV infections in Kenya over the period 2013-2017. Turkana recorded a steady decrease in new HIV infections while West Pokot recorded some increase during 2017.

Table 6.12-39: Trend in New HIV infections, 2013-2017

Increase in HIV infections 2013 to 2017	Decrease in 2015 then increase in 2017	Increase in 2015 then decrease in 2017		Decrease in HIV infections 2013 to 2017	
1 county	8 counties	19 counties		19 counties	
Nairobi	Nakuru	Machakos	Bungoma	Migori	Muranga
	Narok	Makueni	Busia	Homabay	Baringo
	Uasin Gishu	Kiambu	Kwale	Siaya	Samburu
	Kajiado	Meru	Kilifi	Kisumu	Nyeri
	Nandi	Embu	Lamu	Kisii	E. Marakwet
	Lakipia	Tharaka Nithi	Taita Taveta	Turkana	Nyandarua
	West Pokot	Mombasa	Kitui	Bomet	Kirinyaga
	Vihiga	Isiolo	Marsabit	Nyamira	Mandera
		Kakamega	Tana River	Transzoia	Garissa
			Wajir	Kericho	

Source: NASCOP Kenya AIDS Response Progress Report 2018

Sexually transmitted infections such as gonorrhoea, syphilis and chlamydia are an important global health priority because of their devastating impact on women and infants. Moreover, STIs and HIV are linked by biological interactions and can occur in the same population cohorts. Infection with certain STIs can increase the risk of acquiring and transmitting HIV as well as altering the course of HIV progression. STIs are a major health concern in Kenya, with the country recording over 100,000 cases every year (Ministry of Public Health and Sanitation, 2009). HMIS data show that Turkana County and West Pokot recorded 2,224 cases and 2,923 cases of STIs in 2018, respectively. In 2018, Turkana South contributed 20% (452 STI cases) while Turkana East contributed 5% (112 STI cases) (Ministry of Health, 2019).

Hepatitis B virus (HBV) infection is endemic in Kenya and is an important consideration in this context. The virus is 50 to 100 times more infectious than HIV and is transmitted in a similar fashion. Co-infected persons have an increased rate of liver disease, higher HBV and HIV viral loads, and poor response to antiretroviral drugs. According to KEMRI researchers, northern Kenya including West Pokot and Turkana County have shown a high prevalence of HBV, but the actual rate is not known[19] .

Primary Data

HIV/AIDS is among the top health challenges and priorities for Turkana County. According to an interview with the County AIDS and STIs coordinator, HIV prevalence has decreased from 7.6% in 2013, to 4.0% in 2016 and to 3.2% in 2017/18 based on estimates from mathematical models. The most-at-risk populations in the County include female commercial sex workers, adolescent girls, fisher-folk (around Lake Turkana), and the emergence of gay men (Lodwar town). Hotspots for HIV infection in the County include the transport corridor from Kitale-Lodwar-Lokichogio and some urban settlements (including Lodwar and Lokichar). Programmatic data (2016) shows the highest prevalence in Turkana Central (6.7%) followed by Turkana West (3.7%) and Turkana South (3.6%).

Turkana County is currently implementing several interventions against the disease including behaviour change communication, prevention of mother-to-child transmission, free condom distribution, key at risk populations programme, voluntary medical male circumcision and up-scaling of HIV testing, care and treatment services. Challenges include stigma (which remains a problem), limited access to testing and treatment services (<40%), poor treatment adherence (viral suppression rate of 67%, with the target at 90%) and loss to follow-up due to the migratory lifestyle of many inhabitants.

STIs in general were considered a concern, with a prevalence of 2.4% among pregnant women attending antenatal care (ANC) (2017 data). Different causes of STIs are diagnosed including hepatitis B, gonorrhoea and syphilis, and this necessitates tracing and treatment of contacts.

Factors that influence HIV and STIs transmission in the County include trans-generational sex, commercial sex activity, culture of multiple sexual partnerships (polygamy), population mobility and influx in towns, limited awareness and poor uptake of HIV prevention services.

Findings from focus groups show that majority of participants were aware of HIV/AIDS, but the disease was associated with fear and stigma (“*put HIV positive people in an enclosure*” or “*deny them treatment so they all die*”). Many considered the disease a big challenge because of the lack of a cure. The primary modes of HIV transmission were correctly identified by both male and female participants. Condom use was reported to be very low and seen as “*a man’s decision*”. In Lokichar, it emerged that commercial sex activity has increased and some of the sex workers come from outside the area. A bit of commercial sex activity was reported in Lokori urban settlement, but this was subtle and open transactions were not obvious. The rural settlements (Kapese, Nakukulas, Kasuroi and Lochwaangi Kamatak) did not report any evidence of commercial or

[19] Relief Web. *Hepatitis B cases on the rise in Kenya*. 2014 [cited 2016 April]; Available from: http://reliefweb.int/report/kenya/hepatitis-b-cases-rise-kenya

transactional sex activity, however this contradicts primary research related to social maladies and discussed in Section 6.12.2.10.

6.12.2.8.1.5 EHA #5: Food and Nutrition-Related Issues

Nutritional status can provide valuable insights into the health of a community and is a useful indicator to track general well-being.

Secondary Data

More than 75% of Kenya's population, especially living in rural areas, derive their livelihoods from agriculture. The arid and semi-arid areas of the country are extremely vulnerable to food insecurity. The MoH together with partners conduct a Standardised Monitoring Assessment on Relief and Transition (SMART) survey in food stressed areas every year. This includes the Counties of Turkana and West Pokot. Table 6.12-40 gives a summary of the food and nutrition situation in the Project area at the time of this baseline assessment (November 2018).

Table 6.12-40: Food and Nutrition Situation in the Project area

County	Food security and nutrition situation
Turkana	A SMART survey completed in January 2018 showed reduction in levels of acute malnutrition across the County compared to a similar period in 2017. The County was classified in a critical nutrition situation, but there was improvement with the global acute malnutrition score of 16.2% in January 2018, compared to 30.1% in January 2017. Severe acute malnutrition rates decreased to 2.2% in 2018, compared to 5.7% in a similar period in 2017. Global stunting was measured at 20.3% in January 2018 and was highest in Turkana South (23.9%) followed by Turkana Central (20.8%). Food consumption score and dietary diversification remained a challenge. Contributing factors to the chronic food insecurity include high levels of poverty, harsh climate with inadequate rainfall, frequent droughts, diminishing green pastures for livestock and poor road infrastructure that hamper delivery of foodstuffs (Ministry of Health, 2018).
West Pokot	According to a SMART survey conducted in June 2018, the global acute malnutrition rate declined to 11% compared to a similar period in 2017 (20.4%). This classified the County as a serious nutrition status, but this was an improvement from the critical nutrition status classification in 2017. The improvement was attributed to increased access to health and nutrition services/awareness, a cash-transfer programme, and improved household food security due to long rains from March to May of 2018. Stunting, an indicator for chronic food insecurity remains high, but has shown a modest decrease from 46% in 2014, to 40% in 2017 and the current 38% in 2018 (Ministry of Health, 2019). Food consumption score and dietary diversification remains a challenge. Contributing factors to food insecurity include high poverty levels (69%), rampant insecurity, poor road infrastructure, inadequate rainfall worsened by shocks of drought.

Source: SMART Survey for Turkana County (January 2018) and West Pokot (June 2018) (Ministry of Health, 2018)

Malnutrition is a leading contributor to child deaths in less developed settings. Because of its multi-factorial causality (socio-economic, agricultural, climatic, etc.), malnutrition is one of the important indicators for monitoring a given population's health status and gives a reliable snapshot on the burden of disease within a community. Malnutrition is a major concern in both Turkana and West Pokot, owing to the underlying chronic food insecurity (as described above). Anaemia is also common particularly in pregnant women and children (Ministry of Health, 2019).

Primary Data

Food security is a huge challenge in Turkana County. According to the County Nutrition Coordinator, the situation worsens during dry spells and shocks occur throughout the year. This has led to endemic malnutrition in the entire County and over-reliance on food aid. The situation is particularly worse in informal settlements and remote rural areas. In 2017, at least 75,000 children in Turkana County suffered moderate to severe malnutrition, but this decreased to 30,000 in 2018. Nutritional surveillance is performed throughout the year, supported by community health volunteers. According to key informants, factors that contribute to food insecurity and malnutrition in the area include widespread poverty, poor coping mechanisms, changing livelihood patterns, and behaviour related practices. The County is working with the national government and partners such as the World Food Programme to address the situation. These include responding to nutrition emergencies by providing relief food and supporting cash transfers (a safety net) and school feeding programmes. Midterm goals include expanding irrigation (currently being done in Loima and parts of Lokori), women empowerment (voluntary loaning and saving schemes) and livelihood diversification. Health promotion of breastfeeding and proper feeding practices is a continuous and ongoing process.

Findings from focus groups show that households experience chronic food insufficiency which worsens during drought. Malnutrition is a big issue and the situation is dire throughout the year. Most households consume only one meal a day and dietary diversity is limited with meals generally consisting of starch-based foods (maize, millet, rice) and beans with occasional meat (livestock is rarely slaughtered for food), while milk is rarely consumed (available only during rainy season). Most local communities buy food and it was reported that food prices are increasing, and the availability was limited. Participants attributed the price inflation to high demand (reported in Lokichar and Lokori) and poor road infrastructure that hamper food delivery thereby increasing transport costs.

6.12.2.8.1.6 EHA #6: Non-Communicable Diseases

Non-communicable diseases (NCDs) have emerged as the highest cause of disease burden globally. Cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases are responsible for most NCD-related morbidity and deaths. The four major risk factors are: unhealthy diet, physical inactivity, harmful alcohol consumption and tobacco smoking (WHO, 2011). Estimates indicate that NCDs account for 27% of total deaths in Kenya (2014 statistic) (WHO, 2014).

Secondary Data

Hypertension, the most frequent and important risk factor for cardio-vascular disease is a growing concern, with an estimated urban prevalence of 13% among women and 12% among men (van de Vijver et al., 2013). Awareness, treatment, and control are generally poor, and less than a quarter of those on treatment achieving blood pressure control (van de Vijver et al., 2013).

Diabetes is an emerging health concern countrywide. A higher prevalence of 14.7% has been recorded in urban areas compared to 2.7% in rural areas (Njenga, 2009; Maina, 2011).

Cancer burden continues to increase largely because of the aging and growth of the global population alongside behaviours that increase cancer risk, particularly smoking. The estimated proportion of preventable cancer is 40%, with nine leading modifiable risk factors shown in Figure 6.12-44 (Danaei et al., 2005). The burden of cancers in Kenya is increasing at a high rate with close to 37,000 new cancer cases and 28,000 cancer-rated deaths recorded every year (a high death rate of 76%) (Macharia et al., 2018). The leading cancers among Kenyan women are breast-, cervix- and oesophageal cancers. The most common among men are cancers of the oesophagus and prostate as well as Kaposi sarcoma (associated with HIV) (Macharia et al., 2018).

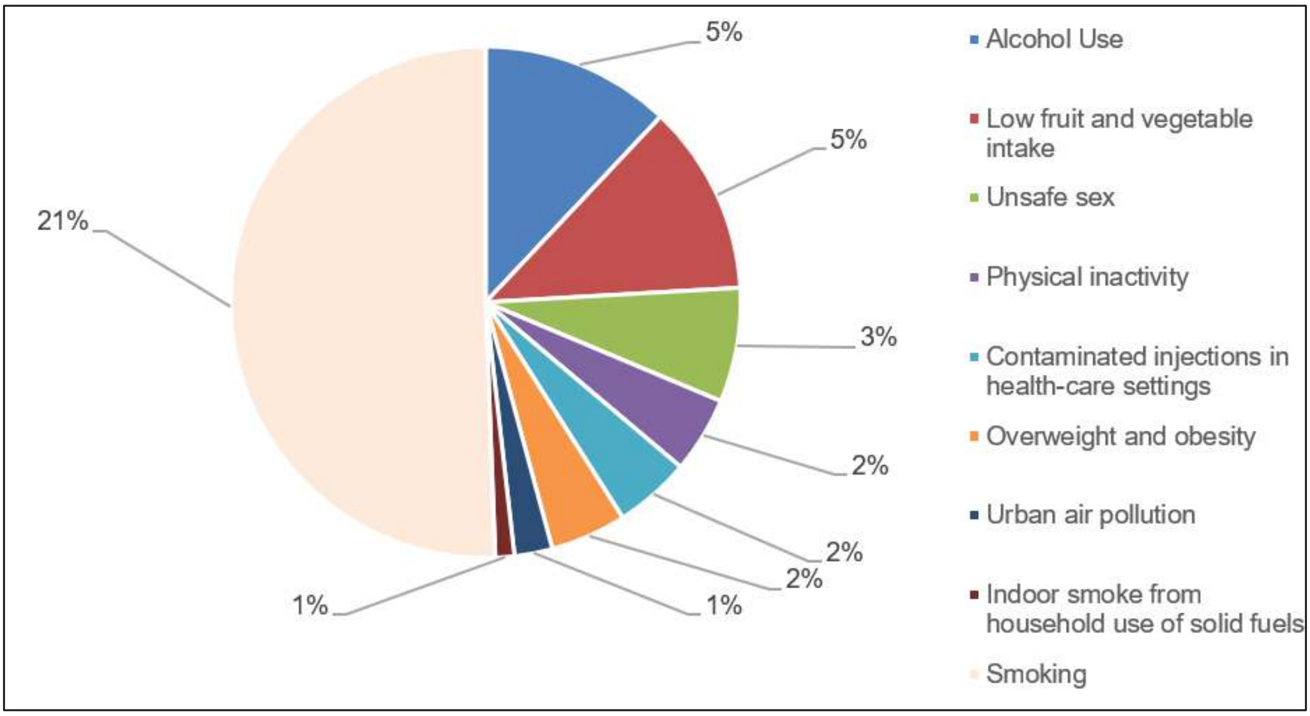

Figure 6.12-44: Modifiable Risk Factors for Cancer Prevention

Chronic respiratory diseases including chronic obstructive pulmonary disease and asthma are an important consideration with risk factors including tobacco smoking, indoor and outdoor air pollution, allergens and occupational exposure (asbestos, silica, certain gasses). The principal use of solid fuels for cooking and heating is a documented source of indoor air pollution, which increases the risk for both acute and chronic respiratory infections and disease. Tobacco smoking is more common in men, with an estimated prevalence of 17% who smoke nationally (KNBS, 2015).

Primary Data

According to the Turkana County public health officer, NCDs particularly hypertension, diabetes and cancers are an emerging health concern in the County. These were linked to changing lifestyles and urbanisation. Cancers of the breast, cervix, and prostate were listed as the most common in women and men, respectively. Sniffing of tobacco products is also common in Turkana, with this linked to throat cancer. It was also mentioned that chronic airways disease and asthma (linked to dusty and cold weather) occur but primary data on these conditions was lacking. To support this growing trend the County is implementing a strategy to address NCDs and the associated risks factors. These include preventive measures (awareness, advocacy, and education) and early diagnosis (screening programmes) and treatment.

Challenges in managing the conditions include; i) late presentation as many of these conditions are not symptomatic until complications are evident, with chronic and severe complications becoming more common; and ii) inadequate diagnostic and treatment services including lack of appropriate and adequate range of medication.

At Lodwar Hospital, at least 100 cases of hypertension and 60 cases of diabetes were being followed up as of November 2018. Findings from local health facilities (Lokichar, Katilu and Elelea) showed that cases of hypertension and diabetes were generally rare with these conditions not a major concern. However, poor health seeking behaviour and lack of skills in the facilities may aid in these low detection rates.

The local health facilities lacked capacity to diagnose or manage cancers and therefore referred all suspected cases to Lodwar Hospital. However, cases from Lodwar are generally referred to MTRH in Eldoret for specialised care. Between 2015 and 2017, Lodwar Hospital referred at total of 551 cancer patients with the numbers increasing as follows: 2015 (142 cases), 2016 (201 cases) and 2017 (208 cases).

6.12.2.8.1.7 EHA #7: Accidents and Injuries

Road traffic accidents contribute a significant portion of the burden of disease in Kenya and have enormous impact on the social and economic well-being of individuals, their families, and society.

Secondary Data

Road traffic accidents and domestic or other forms of violence are relevant with data from Kenya's National Transport and Safety Authority reporting that at least 3,000 people die on the country's roads every year and nearly a third of road accidents are directly fatal (Dossa, 2013). The upsurge of traffic accidents has been attributed to increased use of motorised transport, poorly regulated public transport, driving while intoxicated, over-speeding and poor utilisation of safety equipment such as seat belts and helmets (Bachani et al., 2012). HMIS data for 2018 shows that road traffic injuries contributed 7.6% of all injuries in Turkana County, with the disaggregated to 7.9% in Turkana South, 3.9% in Turkana East and 4.9% in West Pokot. The data is presented in Table 6.12-34 (Ministry of Health, 2019).

Violence of any kind has a serious impact on the economy of a country. Gender-based violence (GBV), usually defined as any physical, sexual, or psychological violence that occurs within the family or general community, is reported to occur commonly in Kenya. Statistics from the KDHS 2014 show that almost half (45%) of Kenyan women have ever experienced physical violence at some point in their lifetime, an increase from 39% in 2008 (KNBS, 2015). Inter-ethnic conflict has been an ongoing concern in the semi-arid north, especially between the Turkana, Samburu and Pokot communities. The main sources of conflicts are land, grazing areas for livestock, boundary disputes, and cattle rustling. The situation is worsened by the illegal availability of firearms in the communities (UNOCHA and Relief Web International, 2013). Table 6.12-41 shows records of injuries in the Project area in 2018 with violence-related injuries making up 8.8% of injuries in Turkana County and 8.0% in West Pokot, and when disaggregated to the sub-County level this is reported at 10.2% in Turkana South and 8.8% in Turkana East. Cases of sexual violence were also recorded (Ministry of Health, 2019).

Table 6.12-41: Records of Injuries in the Project area, 2018

Indicator	Turkana County	West Pokot County	Turkana South (Sub-county)	Turkana East (Sub-county)
Road traffic injuries	2,781	1,686	516	141
Other injuries	12,874	23,307	2,352	1,422
Sexual violence	439	477	96	30
Violence related injuries	3,193	2,763	666	313
Burns	3,553	3,269	636	334
Snake bites	1,661	369	236	83
Dog bites	1,685	1,034	369	141
Other bites	10,302	1,442	1,680	1,110
Total	**36,488**	**34,347**	**6,551**	**3,574**

Source: HMIS 2018

Baseline conditions related to security and conflict are considered in more detail in section 6.12.2.11.1.

Primary Data

Trauma related injuries remain a concern in the entire Turkana County. Gunshot wounds contribute significantly to trauma cases and the numbers are reportedly increasing. Lodwar Hospital registers several gunshot cases every month, the majority being referrals from rural and peripheral areas of the County as the hospital has a theatre and orthopaedic capability. Illegal gun ownership remains a concern and related incidents of violence are often associated with tribal factionalism and cattle theft.

Lodwar Hospital has improved its capability to deal with trauma cases but still lacks capacity to manage severe trauma given the lack of intensive care unit (under construction) and neurosurgical specialists.

Road traffic accidents are also becoming increasing common, especially accidents involving motorcycles as ownership of these vehicles has increased in the past few years. Head safety gear and seatbelts are not commonly worn, with attendant risk of severe injuries. During the period 2015 to 2018, Turkana County recorded 33 cases of severe head injuries and majority were referred to MTRH. Poor road conditions were regarded as a contributing factor, but this may limit severe injuries, as over-speeding was not possible on the poor roads. Emergency response has significantly improved, and the number of ambulances increased from 2 in 2013 to 13 in 2018, but these were still inadequate to serve the needs of the County. There was no effective pre-hospital ambulance system that responds to the scene of accidents.

Physical and sexual assault of women and sometimes children was increasingly reported. This has prompted Lodwar Hospital to set up a dedicated unit (‘wellness centre’) to manage cases of GBV and child abuse, with support from an NGO, International Rescue Committee. Most victims come from Lodwar town, but there are also referrals from peripheral facilities. Substance abuse and influx of people (especially in Lodwar town) of different cultural norms and behaviours were seen as contributing factors.

Key informants in Lokichar, Katilu and Lokori reported increasing cases of road accidents, the majority associated with motorcycles. Ethnic conflict, premeditated by cattle theft contributed significantly to assault injuries in the area, which included gunshot wounds (actual statistics not available). Katilu Hospital reported at least one case of GBV (physical or sexual assault) per month. Domestic violence is largely tolerated, and many cases go unreported.

Animal bites particularly snake bites were reported as a concern, the majority are venomous and require immediate treatment. Polyvalent snake anti-venom was available in most hospitals but rarely at health centres or dispensaries.

6.12.2.8.1.8 EHA #8: Veterinary Medicine and Zoonotic Diseases

Zoonotic diseases are caused by infectious agents transmitted between animals and humans. Environmental changes, human and animal demography, pathogen changes and changes in farming practices as well as social and cultural factors such as food habits and religious beliefs may play a role in the emergence of these diseases. This group of diseases include influenza, rabies, and viral haemorrhagic fevers.

Secondary Data

Influenza virus infection is an important consideration as there has been global concern related to spread of highly pathogenic influenza viruses that have mutated to pose transmission risk to humans from animal hosts, with the potential to cause pandemics. These include SARS, H5N1 and H1N1 viruses. Kenya recorded cases of avian pandemic influenza (H5N1) in 2006 and over 600 cases of pandemic influenza A (H1N1) in 2009 (Matheka et al., 2013). Seasonal influenza outbreaks are common. The prevailing poor environmental health conditions and changing weather patterns promote influenza outbreaks. Pandemic influenza remains a general risk in this setting the risk emanating from increasing population mobility and mixing.

Brucellosis is common among pastoral communities. In 2018, West Pokot and Turkana Counties recorded 5,144 cases and 2,620 cases of brucellosis, respectively. Cases were also recorded in Turkana South and East (Figure 6.12-45). Rapid serological tests are the mainstay of diagnosis with good availability in most local health facilities at the time of this report.

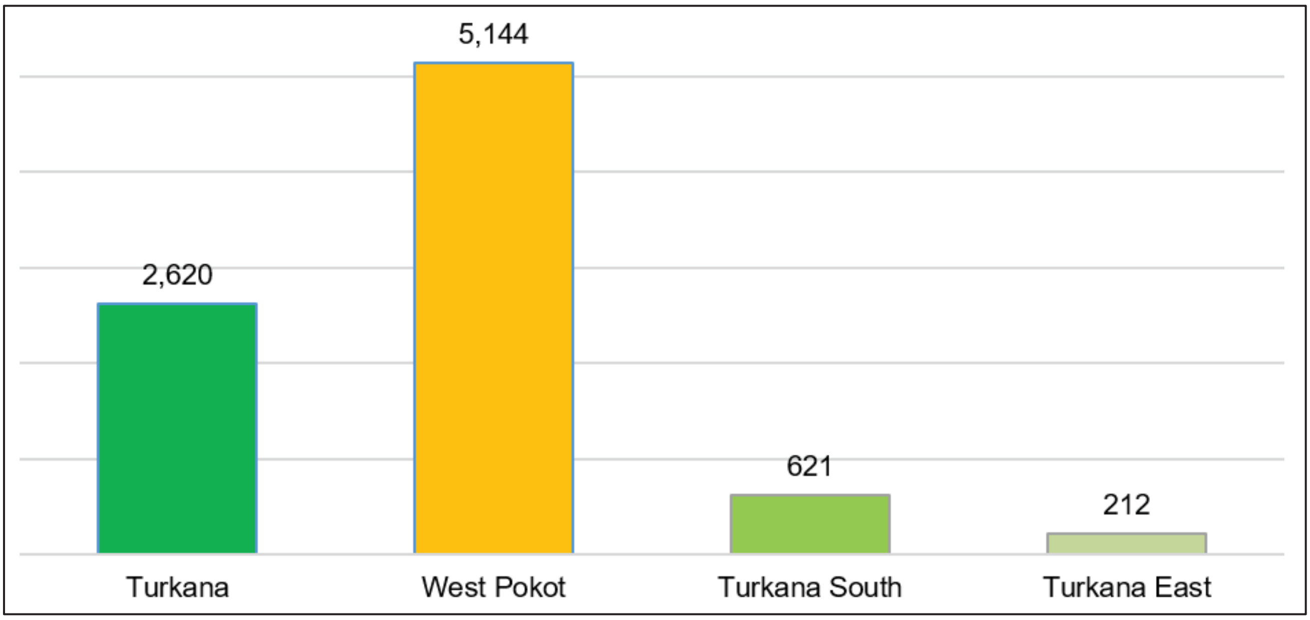

Figure 6.12-45: Brucellosis Cases in the Project area, 2018

Source: HMIS 2018

Rabies is endemic nationally, and the most common mode of transmission is through the bite or saliva of an infected animal. Unvaccinated domestic dogs are the most commont source of infection in this setting (WHO, 2017). Despite being vaccine-preventable, rabies still poses a significant public health problem in the developing world and in the absence of timely post-exposure prophylaxis, the infection is always fatal. No cases of rabies were recorded in the Project area during 2016 to 2018, but the disease remains a considerable risk as evidence from secondary data shows many cases of dog bites (Ministry of Health, 2019).

Viral haemorrhagic fever is a general term for a severe illness, sometimes associated with bleeding and multi-organ failure, but with high mortality rates. These are caused by various viruses, including Ebola, Marburg and Crimean-Congo viruses. No case of viral haemorrhagic fever has been registered in Kenya. However, the risk remains linked to global movement of populations as witnessed with the recent (2014 to 2016) Ebola outbreak in West Africa and the current outbreak in the North-Eastern Democratic Republic of Congo.

Primary Data

According to the Turkana County epidemiologist, a suspected case of viral haemorrhagic fever was registered in the County in 2016, but this was not confirmed. Brucellosis and echinococcosis (dog tape worm infection) are the most common zoonotic diseases in the Project area. Rabies is also a significant risk. Several cases of bites by stray dogs are recorded but post-exposure prophylaxis is routinely administered to avert rabies disease. The vaccine was available in local health facilities but the minimum cost of US$100 for the complete course was considered prohibitive.

Rift Valley fever was also considered a risk given the pastoral nature of the communities, but no cases have been recorded in recent past.

Seasonal influenza is common, but these were broadly categorised as respiratory infections and not separately classified.

Collaboration between the County health and veterinary departments is done through what is referred to as "*one-health concept*". However, regulation of veterinary services has not been devolved to the County level as yet and still managed nationally.

6.12.2.8.1.9 EHA #9: Potentially Hazardous Materials, Noise and Malodours

These may also be listed as environmental health determinants and include items such as pollution of air, soil and water as well as possible exposure to organic or inorganic pollutants, noise and malodours. The pathway to human exposure to pollutants can be complex and can occur from a variety of sources such as ambient air, drinking water, soil and food. The specific environmental health determinants will be discussed in the relevant specialist studies and the baseline conditions for water quality (ground and surface), air quality, visual intrusion, noise/vibration and hazardous chemical substances will be described under these reports, with health elements discussed as required in the impact assessment.

In separate meetings with County health managers and Sub-county health officers, participants voiced their concern on issues of environmental impacts that may be harmful to health of people and were particularly interested in how the Project will manage its waste and minimise environmental degradation.

6.12.2.8.1.10 EHA #10: Social Determinants of Health

Social determinants of health are the conditions in which people are born, grow, live, work and age, including the health system. These circumstances are shaped by the distribution of money, power and resources (see sections 6.12.2.3, 6.12.2.4, 6.12.2.5)

Secondary Data

Mental and behavioural disorders are an often neglected public health problem. It is estimated that up to 25% of outpatients and 40% of in-patients in Kenya suffer from mental health conditions (Ministry of Health, 2015). The most frequent diagnosis is depression, substance abuse, stress and anxiety disorders. Suicide and homicide rates are generally low. The Mathare Psychiatric Hospital located in Nairobi (with a bed capacity of 700) is the only specialised psychiatric hospital in the country. Figure 6.12-46 shows the number of psychiatric disorders in the AoI in 2018. Neuropsychiatric conditions such epilepsy also occur (data not shown).

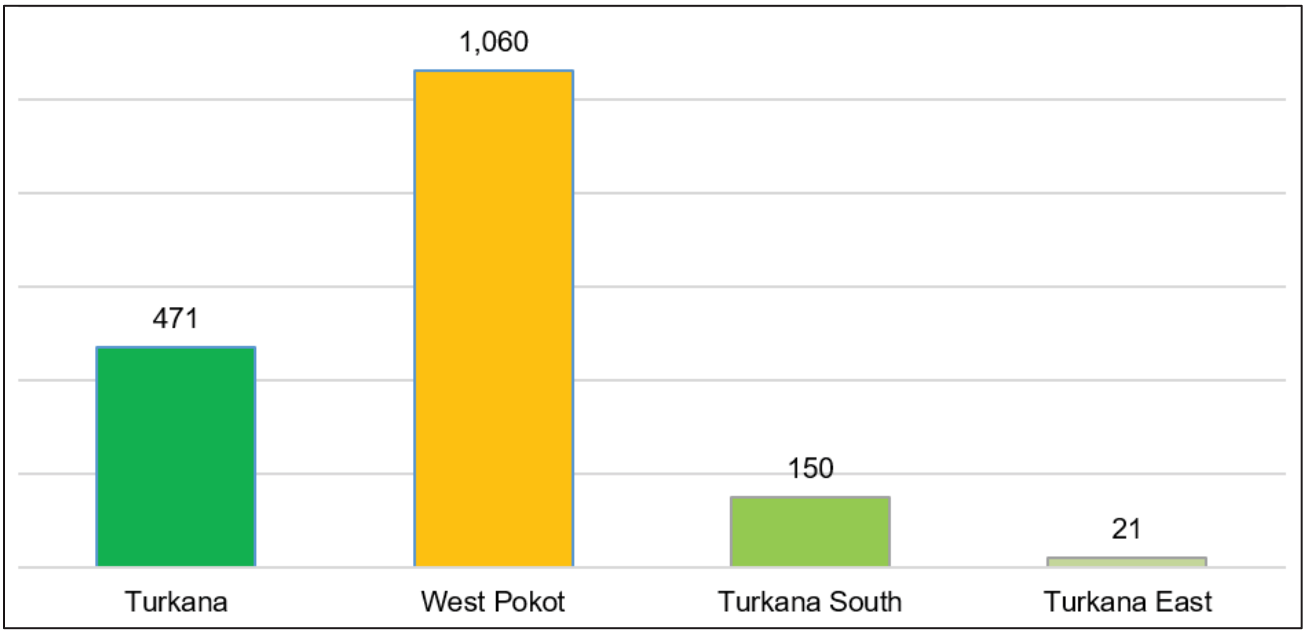

Figure 6.12-46: Psychiatric Disorder Cases in the Project area, 2018

Source: HMIS 2018

Substance abuse such as alcohol, tobacco or other drugs is a growing public health concern nationally. Abuse is often associated with crime, prostitution and domestic violence. A 2012 national survey found that 13% of Kenyan adults use alcohol, 9% use tobacco and 4% consume khat *(miraa),* 1% use cannabis and 0.1% use heroin. Overall, cannabis/marijuana is the most easily available illicit drug at 49% (NACADA, 2012). Secondary data on substance abuse in the AoI were not available.

Education is a key determinant to support and uplift the health status and wellbeing of an individual in a society, and indeed entire communities. Employment and earnings are more likely to empower women if they are in control of their own income. Wage earners constitute only 5% of the West Pokot and 6% of the Turkana population (Turkana County Government, 2013, County Government of West Pokot, 2018). Literacy levels in both Counties are amongst the lowest nationally, with nearly two-thirds of women (64%) and over a third of men (35%) in Turkana County having no formal education (KNBS, 2015). Free primary education and subsidised secondary education have had a positive impact on school enrolment and completion rate over the past 15 years, but this has also exerted pressure on existing education facilities. Baseline conditions related to education are considered in more detail in section 6.12.2.9.

It is generally recognised that women are primarily impacted by domestic GBV, which creates both a health and psychological burden. It also recognised that in many societies, women are socialised to accept, tolerate and even rationalise the practice.

Teenage pregnancies and early marriages are an important consideration. Children born to women aged 15 to 19 are more likely to die in infancy and early childhood. Women who start having children in this age group, often do not complete school, limiting their future economic possibilities and other life prospects. Survey data show that the prevalence of teenage pregnancies in West Pokot (29%) and Turkana (20%) Counties are above the national average of 18% (KNBS, 2015).

Polygamy is an acceptable cultural way of life in the region, with survey data (2018) reporting a high prevalence of polygamy among pastoralist communities in Kenya, with West Pokot (25%) and Turkana County (20%) reporting the second and third highest rates nationally (Kinuthia, 2018).

Primary Data

Mental health disorders have demonstrated an upward trend in the AoI. Psychosocial stressors (economic strife, poverty and other social challenges) and substance abuse were identified as contributing factors.

Substance abuse particularly alcoholism, teenage pregnancy and commercial sex activity were reported as emerging health challenges in Turkana County. The trend is increasing particularly in urban areas and peri-urban informal settlements. Findings from focus groups also show that traditional brews are commonly consumed because they are easily available and affordable. Snorting of tobacco is also common among men and women. Use of illicit drugs such as marijuana and other drugs was reported in Lodwar town and Lokichar urban settlement.

Commercial sex activity was reported in urban areas, particularly in Lodwar and Lokichar. This was linked to business boom that came with devolution process at the County level and the discovery of oil. The more rural communities in the Project area did not report any obvious commercial sex activity. Lokori urban settlement reported little commercial sex activity, with this not openly practiced.

Trans-generational sex is common in this setting, in the context of cultural polygamy, with old men marrying very young girls, with the only prerequisite the ability to afford the price for the bride (generally a few cattle). Teenage pregnancies were largely attributed to early marriages, with most girls in the area married at the age of 14 to 17 years. School drop-outs as result of early marriages and early pregnancies were seen as leading contributors to the poor state of women in the society, the majority of whom lacked formal education. Further, high level of illiteracy was seen as a challenge to health education and contributes to poor awareness of health issues. Additionally, women were perceived as marginalised in many aspects including education, employment opportunities and decision-making capabilities.

Violent behaviour was reported as common in general society, with this reflected in the high rates of violence-related injuries as well gender based domestic and sexual violence. Ethnic animosity and substance abuse were reported as contributing factors.

6.12.2.8.1.11 EHA #11: Health Seeking Behaviour and Cultural Health Practices

Health seeking behaviour is the manner in which people choose which health provider to consult, and when to consult them, depends on a variety of factors, often related to supply (availability of healthcare, cost, equipment, etc.) and demand (affordability, accessibility, prioritisation, etc.). It is essential to understand these factors and identify the community practices to support an understanding of entry into the healthcare system, and how to target any interventions.

Secondary Data

Survey findings (KDHS 2014) show that nearly half of Kenyan women (46%) face at least one-barrier in accessing health care for themselves or their child. These range from getting permission to go for treatment, getting money for treatment, distance to a health facility, and not wanting to go alone. At a national level, care seeking towards a formal health provider has increased from 49% in 2008, to 63% in 2014 (KNBS, 2015). The same survey showed that 62% and 77% of respondents sought medical care from a health facility or formal provider for Turkana and West Pokot Counties, respectively. Self-medication and use of traditional medicine, however, remain common (KNBS, 2015).

Traditional medicine plays an important role in health seeking behaviour, and for several reasons this is often the primary route of health consultation, especially where access and cost are a major determinant in the ability to utilise modern healthcare. Cultural practices in both rural and urban Kenya support the use of herbal medicine for treatment of certain ailments, even when access to modern medicine is available. This is especially common for chronic conditions including HIV/AIDS, hypertension, infertility, cancer and diabetes (Kigen et al., 2013). Use of traditional medicine is a common practice among the Turkana and most adults, especially women, have a wide knowledge of herbal plants that they use for medication (Harragin, 1994). Use of traditional medicine is also common among the Pokot and the County government there has set aside funds to support value addition to natural/medicinal plants for alternative medicine (County Government of West Pokot, 2018).

Female circumcision/ female genital mutilation (FGM) is prevalent among the Pokot (74%) (Ooko, 2019) but less so among the Turkana (1.7%) (KNBS, 2015). The practice is considered a violation of human rights and has been outlawed in Kenya. It is associated with negative health consequences, some of which can be serious. Health education, poverty alleviation and promotion of women's rights are key interventions to reducing this practice.

Primary Data

According to the key informant's health seeking behaviour and the use of traditional medicine is a challenge in Turkana County. However, it was noted that the utilisation of formal health services is increasing, with this likely to be associated with improved access as the number of health facilities in the County had increased with a reduction in the average distance to a health facility to 35 km in 2018, from compared to 50 km in 2013. Late presentation due to poor health seeking behaviour was reported as a key contributor to poor health outcomes. Other factors that influence health-seeking behaviour include poor awareness of health issues, use of traditional medicine, transport challenges, nomadic lifestyle and limited decision making by women.

Findings from focus groups showed that most respondents prefer formal health care but there were instances when they utilise (or prefer) alternative medicine. There are not many traditional healers in the local communities and the use of traditional medicine is decreasing. In general, the participants' reasons for visiting a traditional healer included: distance to a health facility ("if facility is far or closed"), mental disorders, lack of transport, or to seek second opinion if patient fails to improve with conventional treatment. Commonly used herbs are *"ekong"* (aloe vera), "*emus"* (herbal concoction for treatment of fractures and bone disease) and *mwarubaini* (a tree claimed to treat over 40 illnesses including malaria).

6.12.2.8.1.12 EHA #12: Health Systems Issues

A good health system delivers quality services to all people, when and where they need them. This requires a robust financing mechanism, a well-trained and adequate workforce, reliable information on which to base decisions and policies, well maintained facilities and logistics to deliver quality medicines and supplies. Reproductive health, maternal and child health are some of the key measures of a health system.

Secondary Data

Reproductive health statistics show high fertility rates in Turkana (6.9) and West Pokot (7.2) compared to the national average of 3.9. Use of contraceptives is generally very low in the Project area, estimated at 10% in Turkana County and 14% in West Pokot County (NBS, 2015). HMIS data for both Counties show increasing uptake of contraceptives, but at a very slow rate.

Table 6.12-42 gives a summary of reproductive, maternal and child health indicators stratified for Kenya and the two Counties in the Project area, based on survey data from the KDHS 2014 and Kenya Economic Survey 2018 (KNBS, 2015; KNBS 2018).

Table 6.12-42: Reproductive, Maternal and Child Health Indicators in the AoI

Indicator	Year	Turkana County	West Pokot County	Kenya (for reference)
Total fertility rate (number of children per woman)	2014	6.9	7.2	3.9
Current use of any method of family planning (% of currently married women age 15 to 49)	2014	10	14	58
Pregnant women who received antenatal care from a skilled provider (%)	2014	91	85	96
Pregnant women who made 4+ ANC visits (%)	2014	49	18	58
Births assisted by a skilled provider (%)	2014	23	27	62
Births delivered in a health facility (%)	2014	23	26	61
Fully immunised children (% in 2014)	2014	57	31	68
Fully immunised children (% in 2017)	2017	88	39	63

Source: KDHS 2014 and Kenya Economic Survey 2018

Maternal health encompasses the dimensions of health during pregnancy and delivery. Maternal health indicators in the Turkana and West Pokot Counties are much worse than national average (KNBS, 2015). While a majority of pregnant women receives antenatal care, the majority of delivery care (77% in Turkana and 74% in West Pokot) still occurs at home under the care of unskilled attendants. This contributes to high maternal mortality rates in these areas. Figure 6.12-47 shows the number of maternal deaths recorded at health facilities in the Project AoI, during the period 2016 to 2018. Deaths that occur at community level are poorly documented and not captured in the HMIS.

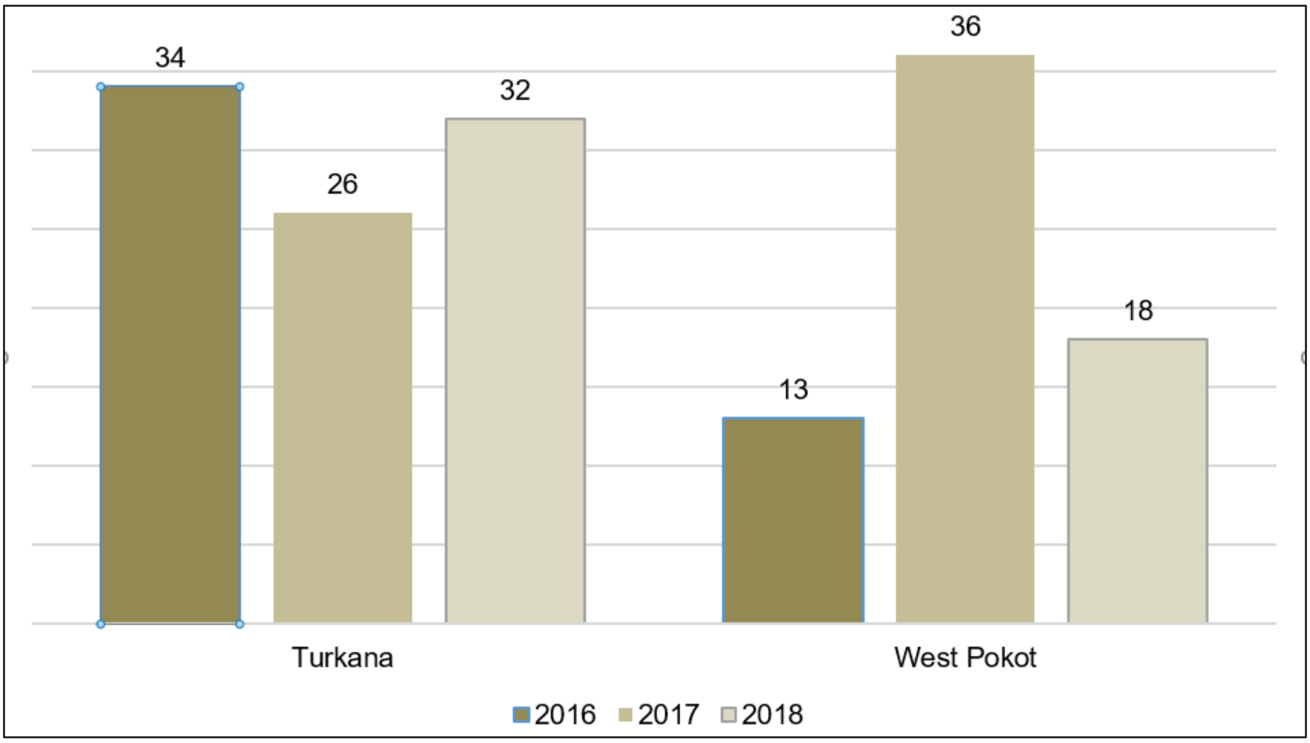

Figure 6.12-47: Maternal Deaths Occurring in Health Facilities in the Project AoI, 2016-2018

Source: HMIS 2018

Child health is a basic indicator of a country's socioeconomic situation and quality of life. Identifying children most at risk helps policymakers and programme planners to allocate resources and target programmes more effectively. HMIS data show that the leading causes of child morbidity in the Project area are ARIs, pneumonia, diarrhoeal diseases, intestinal worms, malnutrition and seasonal malaria (Ministry of Health, 2019). According to official County documents, child mortality rates in the Project area are higher than the national average, but the mortality data from HMIS remains inconclusive because deaths occurring at community level are not adequately documented.

Immunisation of children against common ailments is an important factor that supports disease control and proper child growth and development, with implications into adulthood. Survey data show that full immunisation coverage at national level decreased from 68% in 2014, to 63% in 2017. Immunisation coverage in the Project area is lowest in West Pokot (31% in 2014 and 39% in 2017) (KNBS, 2015; KNBS, 2018). Turkana County has recorded a significant increase in full immunisation coverage from 57% in 2014, to 88% in 2017. Except for measles vaccine (at coverage of 72%) all the other vaccines administered to children in Turkana County reached the minimum recommended coverage of 80% required for herd immunity (KNBS, 2015; KNBS, 2018). However, HMIS data shows that Turkana East and South both recorded low immunisation coverage in 2018, with the coverage of most vaccines not reaching the minimum threshold of 80% (Table 6.12-43).

West Pokot reported coverage below the minimum threshold for all vaccines including measles (58%) and polio (61%) (KNBS, 2015; KNBS, 2018).

Table 6.12-43: Vaccine Coverage in the AoI, 2018

Vaccine/indicator	Turkana County	West Pokot County	Turkana South	Turkana East	Kenya
BCG (Bacille Calmette-Guerin)	>100[(a)]	81.3	90.0	71.8	78.4
Diptheria- tetanus- pertussis (DPT)/Haemophilus influenzae type B third dose (Hep+HiB)	>100*	75.4	75.3	69.5	81.4
Oral polio vaccine	91.0	67.5	61.6	68.1	80.3
Pneumococcal	99.0	73.5	72.7	69.6	81.3
Measles and Rubella	94.8	55.4	61.7	75.7	79.0
Fully immunised children	**84.2**	**52.7**	**59.8**	**70.1**	**76.8**

Source: HMIS 2018

(a) Coverage >100% indicates incorrect population estimates and gaps in data recording system

Primary Data

Health system issues emerged as a major concern, with the broad challenges and contributing factors presented in Table 6.12-27. Health care services in Sub-county hospitals, health centres and dispensaries in Turkana County are offered free of charge. At Lodwar Hospital only certain services (immunisation, maternity, HIV/AIDS, TB, and GBV treatment) are offered free.

High demand for health services was evident at Lodwar Hospital where the bed capacity has been overstretched beyond 150% with patients sharing beds or sleeping on floors and in corridors. This was attributed to population growth and inefficiencies of the referral system compounded by the limited capacity of peripheral facilities. The County lacks certain specialised services (neurological, neuro-surgery, psychiatric, cardiology) and an intensive care unit for critical care. This often necessitates long distance referrals (400 km) to MTRH in Eldoret.

A high demand for services was also evident in Lokichar. The medical officer in-charge of Turkana South indicated that there is need for at least a primary hospital in Lokichar given the ongoing population growth and long distance to Lodwar Hospital. The health centre in Katilu has recently been upgraded to a Sub-county hospital, but the range of services remains limited. Elelea Hospital located in Lokori is the referral centre for entire Turkana East, but the facility is not centrally located and the range of services is similarly limited. Baseline findings show that the local health facilities (including Elelea and Katilu Hospital) are not adequately equipped for emergency obstetric care and both lack surgical, or theatre services. Emergency response also remained a challenge with only one functional government ambulance for Turkana South and a broken (non-functional) ambulance for Turkana East. The cost of hailing the ambulance from Lokichar Health Centre (missionary facility) was considered unaffordable (US$ 100) and therefore inaccessible.

Focus group participants reported challenges in accessing formal healthcare services, with challenges related to the distance from a health facility, inadequate staffing or skills of staff, shortage of medications and inadequate services. When faced with emergency situations, it was mentioned that the public ambulance was rarely available, and generally private transport options would be the only choice, with this rarely available and costly. Motorcycles are sometimes used in emergencies, but not ideal for non-ambulatory patients. Public transport vehicles were almost non-existent.

Maternal health emerged as a concern, especially high maternal mortality linked to poor access to emergency obstetric care and the high rate of home deliveries. For instance, none of the health facilities in Turkana South and East offered surgical services, so it was not possible to perform caesarean sections as a basic and vital emergency procedure. To perform this requires referral to Lodwar Hospital with costs and delays affecting the ability to access timely care.

Poor uptake of family planning services was reported, despite easy availability, because most respondents preferred to have many children. Child health services were generally available and accessible, with these supported by outreach services in remote areas and temporary settlements. Figure 6.12-48 shows a picture plate from health facility assessments. The Service Availability and Readiness Assessment is available as a separate document.

Figure 6.12-48: Picture Plate from Health Facility Assessments

6.12.2.9 Education

Educational services in Turkana and West Pokot County, like other parts of the country, are provided by the Government and other NGOs. However, the development of educational facilities is unevenly distributed, and some areas have better facilities than others.

In total, there are only 315 primary schools and 32 secondary schools in all of Turkana County. There are polytechnic institutes in Kakuma and Lodwar; two colleges, one focussed on health and the second on teacher training. The only campus university sites are in Lodwar and Lokichoggio, and a Technical Training Institute is being built in Lodwar (Turkana County Government, 2013). Specific data on school infrastructure in the nearest Sub-locations was not available.

In the Kositei Location, West Pokot Sub-County, there are five primary schools, one each in Turkwel, Kudungole, Chepokachim, Riting and Reres villages. There is only one secondary school at Turkwel (KII, 30 January 2019). There are nine ECD centres, each in Riting, Reres, Karon, Turkwel camp, Wyapit, Kudungole, Chepokachim, Samum and Kamurio villages. There are neighbouring learning centres in Korpu Location in Pokot North and these are in Sukut, Sirwach, Lonyangalem, Takaywa, Kour, Songkok and Ombolion villages (Focus Group Discussion, 02 February 2019).

The low literacy levels of 22.2% in Turkana County can be attributed to many causes that include extreme poverty, understaffing in schools and cultural practices such as early marriages. Other calamities such as drought and inter boundary conflicts also inhibit the provision of proper education resulting in low literacy and education standards (Turkana County Government, 2013).

The literacy level in the West Pokot County stands at approximately 40% but this varies in the Sub-counties and Pokot West Sub-county has a high illiteracy rate of around 67%. Key informants also indicated that the West Pokot County has a high dropout rate from schools. These factors are similar to those influencing high illiteracy rates. The West Pokot County Education Department attributed this to:

- Pastoralist’s children who migrate with animals and don’t go to school and there are no mobile schools in the region. There is a trend of older children practicing pastoralism while the younger ones go to school;
- Cultural practices also impacting literacy levels. For example, the culture of early marriage detracts women from an education;
- Education is expensive for many people who live a subsistence-based livelihood;
- Security issues surrounding conflict and violent raids; and
- The distance from schools.

Gold mining in Sekerr and Ortom is also noted as a factor keeping children from school. For example, Ortom Secondary School used to produce graduates but now no one has graduated recently (KII, 31 January 2019).

Kositei Location in West Pokot Sub-county has a literacy level which stands at approximately 20% (KII, 31 January 2019). In Chepokachim Sub-location, the literacy level is 2% while it is 1% in Kasitei Sub-location (KII, 02 February 2019).

The Turkana Ministry of Education, Culture and Sports says that the pastoralist lifestyle has contributed to previously low enrolment, but that there has been a 200% increase generated by new education facilities, especially the ECD centres providing free primary education (KII, 29 June 2016). This new emphasis on ECD has also been attributed to increased awareness among parents to make sure they take their children to school. While this is a generally positive trend, it has created shortages of infrastructure (KII, 22 June 2016).

Other challenges cited in improving education include long distances to schools and teacher shortages, particularly as many teachers leave education to seek better paying jobs in the newly developed County Administration (KII, 29 June 2016). School fees in secondary school were also noted as being prohibitively expensive (Focus Group Discussion, 05 February 2019).

In West Pokot County, there is a need to address negative cultural practices in order to improve school attendance and literacy rates. These challenges include, FGM, early marriages and cattle rustling and changing nomadic lifestyle of the community to permanent settlement through provision of water and pastures for animals and development of more adult education centres.

In a response to poor literacy rates and high dropout rates or poor school enrolment due to the pastoralist lifestyle, the County Government recruited 300 adult education tutors to teach the pastoralists. There are no specific classrooms, but the tutors move with the pastoral population wherever they migrate to. The county government has also constructed and fully equipped 3 border schools to promote school enrolment from the border population who are mainly those who practice pastoralism as a source of livelihood. These border schools are located in Akulo, Kanyerus (Kenya and Uganda Border) and Katikomor villages. These schools will also serve the neighbouring counties so as to cultivate values of harmony and peaceful coexistence among the school going children (KII, 1 February 2019).

There are six vocational training facilities in the West Pokot Sub-county which offer carpentry, masonry, brick laying, sewing, baking etc. These are funded jointly by government and private investors. The challenges to the attendance of these facilities is that it is hard to market these courses. Another challenge is that vocational training offers the person an education in a technical trade but once the person graduates, they cannot afford the tools for that trade. The county government offers grants to assist with this situation, but people prefer white collar jobs, so the vocational training is not popular (KII, 31 January 2019).

6.12.2.10 Social Maladies

Social maladies include aspects of alcohol or drug use, crime, commercial sex work, child and forced labour and other work/occupational inequities. While limited data from local administrative units has been received on these topics, social maladies have been investigated through KIIs and focus groups.

According to numerous key informants interviewed in Turkana, alcoholism has increased and greatly influences youth, in some cases causing them to lose jobs. Due to peer groups, youth are drawn into smoking cannabis (*bhang*) and chewing khat (*miraa*), which it is linked to individuals becoming homeless. In Kainuk, focus group participants report new types of drugs and alcohol being consumed, in some cases incapacitating people for up to three days. They also report the use of drugs to spike drinks and cause vulnerable women to become disoriented and vulnerable to assault (Focus Group Discussion, 01 July 2016). It has been reported that women are susceptible to alcoholism and being at risk given their current consumption (Focus Group Discussion 4 February 2019).

Youth from the Lokichar Sub-location also suggest that drug abuse has increased with alcoholism. They state that young people in schools are most susceptible to these problems with girls being most vulnerable to be abused by those with “deep pockets”, men who seek to pay for sex. The outputs reveal a more visible display of prostitution, that commercial sex work attracts women from other parts of Kenya (Focus Group Discussion, Youth of Lokichar, 29 June 2016). Similar trends were noticed by the Sub-county Administrator from Turkana Central. In addition to the increase in substance abuse, he reports that the dynamic is especially harmful in the overcrowded and growing settlements around Lodwar. These areas have suffered incidents of fire, stealing and an increase in STIs (KII, 28 June 2016). In Kaputir, officials confirm they too observe a rise in drug use, which they also notice becoming introduced to rural settlements. This has had an impact on children in relation to their drug usage, as well as other indirect affect like child pregnancy, which has been observed in girls as young as 11 (KII, 31 January 2019).

Influx was also cited as a source of new social maladies in the Kochodin Location where the Project is located. The Location Chief links influx to post-election violence in 2007, when ethnic Turkana from other parts of Kenya were displaced and came to the area. This change coincided with substance abuse, as well as a rise in domestic violence (KII, 4 July 2016).

One NGO worker in Lodwar attributes the rise in drinking and other social maladies with pressure to acquire material things and wealth, which is linked to the availability of more amenities. He specifically highlighted the dynamic in a place like Lokichoggio, the settlement in Turkana West that previously hosted a large number of United Nations organisations. The employment had provided people with new amenities and when the agencies left, it became a town with limited opportunities (KII, 25 June 2016). Teachers in one school said that pastoralist children, particularly girls, can be influenced by the pressure to acquire amenities which leads to anti-social behaviour such as crime or, in extreme cases, commercial sex work (KII, 5 February 2019).

Another NGO in Lodwar links social maladies, particularly the rise in HIV/AIDS with the recent infrastructure development. New accommodation facilities and transport stops for truckers have attracted commercial sex workers (KII, 27 June 2016). This scenario is also reported in Kainuk Settlement. The Lobokat Ward Administrator, which oversees Kainuk Settlement confirmed that the truck drivers are generating an increase in commercial sex work, but suggest it is not only women from other counties who are involved. He added that school children are also affected. Pressure on them to earn money leads them to commercial sex work, dropping out of school and early pregnancies, which are said to be more common (KII, 1 July 2016).

While the overall trend is an increase in commercial sex work, the problem has not gone unaddressed. One peer educator in Lokichar said some NGOs have tried to address the issue. Her work includes reaching out to women who have been pulled into the trade, offering counselling and testing services and demonstration of condom use. She reported that some people have been able to get out of the trade (KII, 04 February 2019).

Social Maladies in West Pokot County are similar to those in Turkana. Child Labour is prominent due to livelihoods which entail young boys to herd livestock and young girls who are employed as house girls. The County Government is addressing these issues through the following aspects:

- Enforcement of the National Government Chiefs Act which states that all children have to go to school;
- Provision of bursaries to students; and
- County government give directive to all school head teachers not to send students out of schools for lack of school fees (KII, 1 February 2019).

World Vision is also addressing FGM issues in West Pokot County through their child protection and education program. FGM contributes to high illiteracy levels due to girl’s non-attendance of school. This initiative was implemented through sensitisation and awareness programs to reduce occurrences of FGM, early marriages and teen pregnancies (KII, 4 February 2019).

6.12.2.10.1 Discrimination in Employment

With salaried employment being relatively limited among the predominantly pastoralist communities of Turkana, discrimination in employment, whether real or perceived, is a commonly cited problem. Frequent work interruptions in Turkana are related to accusations of unfair hiring or firing. Such protests are sometimes linked to a misunderstanding of a job’s terms and conditions, however, there are other inter-ethnic issues as well. Both Turkana and Pokot communities believe that they should be given employment opportunities. For example, *kraal* elders in Turkana South describe how they have been left out of all employment opportunities at the Kenya Electricity Generating Company (KenGen) plant located in West Pokot County, but only a few kilometres from settlements in the Kaputir Location in Turkana County (Focus Group Discussion, 31 July 2016). While such local complaints are not as relevant now from the West Pokot side of the County border, key informants in other parts of West Pokot County commonly voice their expectation for employment from TKBV and other infrastructure projects in Turkana.

Another country-wide problem is related to discrimination based on HIV status. The national HIV and AIDS Tribunal issued a statement on findings in December 2016 that found HIV-positive individuals are likely to experience discrimination in the workplace due to their status. Such discrimination has included individuals being tested for the virus without their consent and in some cases a person’s status has been disclosed to a third party without consent, breaching confidentiality and privacy (Daily Nation, 2016).

6.12.2.11 Social Capital, Security and Conflict

6.12.2.11.1 Overview of Security Trends

Turkana and neighbouring pastoralist Counties in Kenya have well-known histories of conflict and violence, often associated with cattle raiding. This section will characterise some of the historical issues and provide a context for the changing environment. It will cover aspects of interethnic conflict, especially as it relates to West Pokot and Turkana herders, tension between traditional community governance structures and elected leaders and banditry that has relatively less to do with ethnic differences, but rather relates to crime along roads and transportation routes.

During Golder's initial field work in July 2016, there were indications of relative calm in comparison to previous years. During a period from March to October 2016 security monitoring registered few violence incidents. From November 2016, there was an increased in violent incidents.

Control Risks conducts a monthly monitoring report of security incidents in the Project area. A total number of 106 security incidents have been registered in Turkana and West Pokot during the reporting period August 2018 to July 2019. These are differentiated as banditry, cattle raids, civil disorder and intercommunal violence incidents. Turkana accounts for 85.8% of the total number of incidents. Figure 6.12-49 suggests that banditry and cattle incidents are predominant in Turkana. West Pokot reports a less substantial number of cattle raids and banditry incidents with respect to Turkana during the same reporting period.

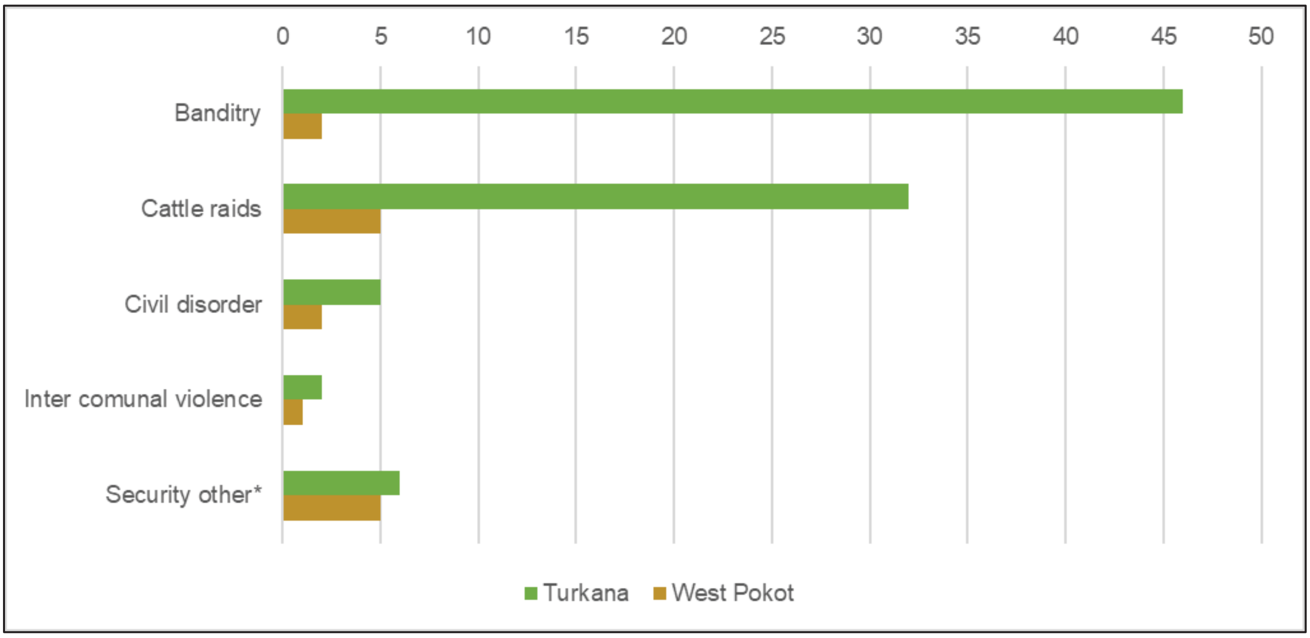

Figure 6.12-49: Incidents per County from August 2018 to July 2019

Source: Control Risks 2018 to 2019 monthly monitoring

**Note: the item "security other" refers to gunshot, arrest of suspect and murder incidents.*

The security reports reveal that the number of incidents related to cattle raiding have increased during the first quarter of 2019. Other security incidents (e.g. civil disorder, gunshot) have been reported with less frequency during the same reporting period (Figure 6.12-50).

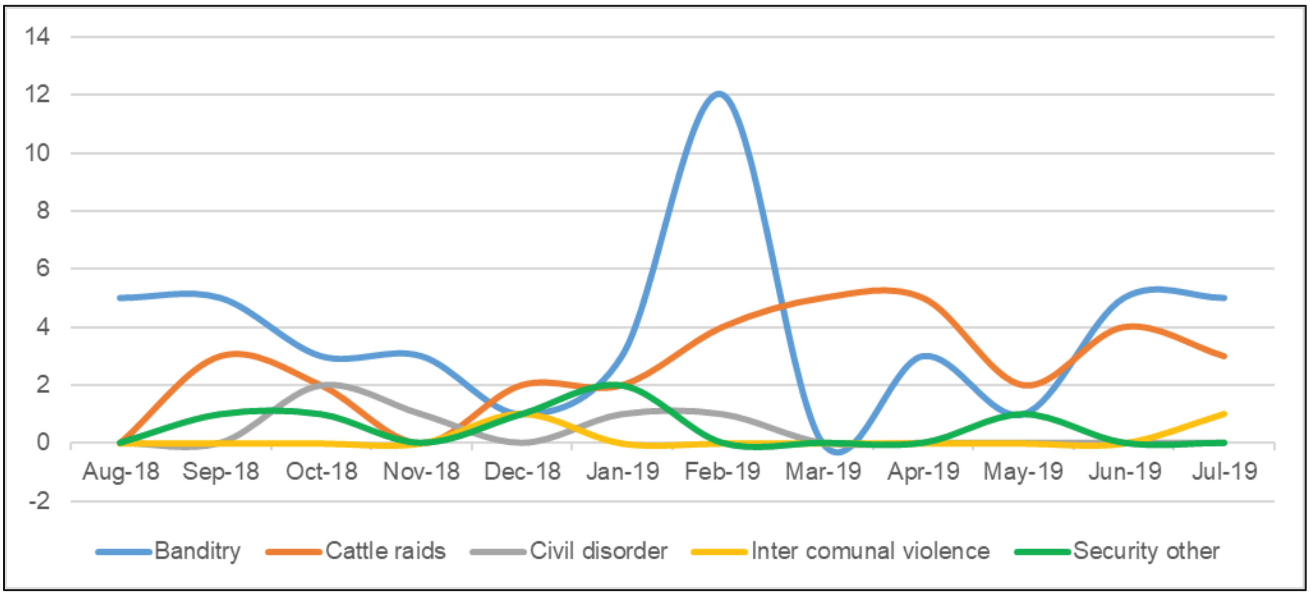

Figure 6.12-50: Incidents Reported in Turkana from August 2018 to July 2019

Source: Control Risks 2018 to 2019 monthy monitoring

West Pokot has fewer reported incidents over the same reporting period with two cattle raids registered during October 2018 and June 2019 (Figure 6.12-51).

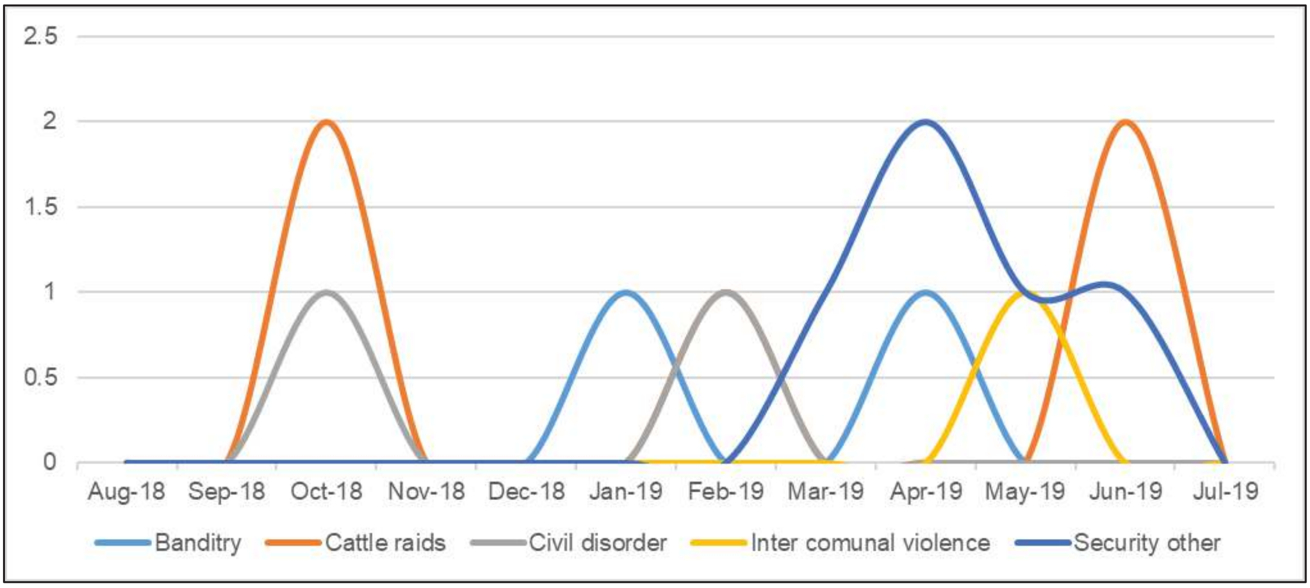

Figure 6.12-51: Incidents Reported in West Pokot from August 2018 to July 2019

Source: Control Risks 2018 to 2019 monthy monitoring

Golder's fieldwork related to security has been conducted by the same team who previously work for TKBV and completed a 2015 study led by the NGO Small Arms Survey. This work sought to understand community perceptions of conflict in Turkana and West Pokot at a time of heightened violence. The Small Arms Survey report indicates shifts and intensification of armed conflict.

Over the past 10 years, a gradual shift has occurred in patterns of livestock raiding and attacks. While cattle raids still occur, the commercialisation of livestock theftin which individuals, and not communities, benefit from raiding has emerged. Politicians, businessmen and other elites are alleged to be supporting and profiting from commercialised raiding, something that is believed to be eroding elders' authority (Mkutu, 2010; Kaimba, 2011; Griener, 2013; Triche, 2014). The majority of Golder's research findings support this overall general trend, but also suggest that has been a gradual slowing of cattle raiding. Research shows that the current violence is more often linked to disputes over natural resources. A shift from cattle raiding to conflict over natural resources is related to more frequent and longer droughts in the country's dryland areas and the problem is exacerbated by easier access to guns, making battles more deadly. The increase in arms is attributed in part to the regions' proximity to South Sudan, an area with an ongoing civil war, and the porous borders with Kenya. Aid efforts are aiming to improve access to natural resources, in particular access to water, to decrease the likelihood of different ethnic groups crossing boundaries. (Thomson Reuters Foundation News, 2016).

By late 2016, the specific violence between Turkana and Pokot had largely subsided, which was marked by a celebration in September 2016 to acknowledge 18 months without killings from cattle raids between the two groups (Finn Church Aid, 2016). However, tension between Turkana and West Pokot remains, as well as other neighbouring counties of Baringo, Laikipia and Samburu. Despite relative calm and the Kenyan government efforts to reduce arms, the deputy president of Kenya estimates there are still 500,000 illegal firearms in the country and most owned by pastoralists (Al Jazeera, 2016). The relative calm and improvement between pastoralist tribes is still at risk due to the number of weapons and challenge of maintaining a balanced use of natural resources.

During Golder research, one key informant explained that security among different ethnic groups began to improve in December 2015 during a key event that brought together the County governments of Baringo, West Pokot, Turkana, Elgeyo-Marakwet and Samburu. This was said to be the beginning of a strong commitment by the County leadership to end interethnic conflict in the region (KII, 4 August 2016). This meeting led to an idea among the political leaders gathered to initiate a "*peace caravan*" after talks with the President and Deputy President on how to end killings in the pastoral communities. A group of leaders comprised the peace caravan in mid-2015 and they travelled through critical areas urging communities to move beyond the cultural practices of raiding that undermine development in the pastoral communities (Citizen Digital, 2015).

Prior to this initiative, the Peace Coordinator of West Pokot described a volatile situation, particularly between West Pokot and Turkana pastoralists. The low point of this period was between January and May 2015. During this time, the conflict worsened from only cattle rustling to the killing of children. This targeting of people, regardless of the potential to steal animals, prompted the government to intervene and the notable change was an ownership of the problem by regional leaders (KII, 4 August 2016). The low point of this phase of violence is exemplified by a particularly violent period that left 300 people dead in the settlement of Kailoseget in the Kainuk Division of Turkana (Daily Nation, 2015). A protest in March 2015 by many of the widows left destitute from the violence was critical in moving leaders to act. Women in a focus group confirm that this was a difficult period, explaining that they recall it to be like a war zone with times when they were attending funerals every day (Focus Group Discussion, 01 July 2016). The Assistant Chief from the Kainuk Sub-location said certain areas were simply no-go zones prior to May 2015, including the Turkana side of the A1 from Kainuk to Kakongu and similarly to the Sub-location of Sarmach in West Pokot.

The no-go zones also included key grazing areas, such as locations as far east as around the Kalemngorok Settlement in Turkana South (KII, 31 July 2016). The Kakongu Sub-location Assistant Chief recalls conflict escalating from 2012, when the frequency and intensity of raids increased. At that time, Pokot groups claimed areas from a large part of Turkana County territory from Kainuk settlement on the border to area of the Kochodin Location near the Project (KII, 01 July 2016). It was at this time that adakar elders from the same Sub-location explain that they and their enemies decided to cease cattle rustling. They cite recent evidence of the change being two examples where some animals were stolen, but they intervened to ensure that the animals were returned to the rightful owner before any retaliation could take place (Focus Group Discussion, 31 July 2016). Such intervention suggests that the threat of theft may remain, but numerous leaders in the area are diligent to make sure isolated instances of raiding or theft do not cause greater problems and a return to the type of violence witnessed in 2015.

The overwhelming majority of key informants and focus group participants describe an improved situation between Turkana and Pokot herders, which was confirmed again in Golder's most recent research in early 2019 in both Turkana and West Pokot Sub-counties. In 2016, researchers themselves who were familiar with the border area during the worst period of violence noticed obvious differences of improved security in settlements and communities they had visited only a year before in 2015. Many people confirm that the peace caravan marked the turning point in the raiding violence. Numerous interviewees explain that Turkana and West Pokot are grazing animals with each other, trade and business happens regularly between the two groups and West Pokot adakars are often residing in Turkana County. At that time, even areas to the south such as the Kapedo Location in Turkana East report that Pokot pastoralists regularly and freely move within the Kapedo settlement. The research team observed that people were walking along the road connecting Kapedo settlement to Chemolingot (in Baringo County). This 30 km journey had previously been impossible and there had not been any vehicles on the road a year ago (Focus Group Discussion, 2 August 2016). With the return to peace, there are still affects from the violent period that are visible in Turkana. The Sub-county Administrator for Loima Sub-county reports that some residents from Turkana East Sub-county have remained in his area under the assumption that it is relatively safer in Loima Sub-county, under the assumption that conflict may return to Turkana East (KII, 24 June 2016).

This does not mean that there are no exceptions and that some tensions remain even if the active violence has greatly decreased from 2015. During Golder research in January 2019, research activities were interrupted due to a raid that took place in the Lokori Location.

In the Sub-location of Lochwaangi Kamatak in Turkana South, the Assistant Chief have reported a trend in overuse of natural resources, which is causing disagreements among stationary and migratory pastoralists. Specifically, people compete for pasture and plants used for animal consumption. In some situations, this has led to gun violence. The second problem noted in this Sub-location is the shortage of Kenyan Police Reserve (KPR) officers. Their role is to provide security in the local area, but several have been engaged in the oil and gas work in the County and this has left the Sub-location with one or two KPR officers at any one time, which is not considered enough to maintain law and order (KII, 29 June 2016).

Areas of the Lochakula Location in Turkana East have also reported tensions over natural resources such as watering points. Even though there is a general agreement to share water between the Turkana and Pokot herders, there is tension in trying to encourage Turkana who had previously fled violence to come back to an area that is relatively worse than other migration corridors along the Turkana and Pokot border (Focus Group Discussion, 28 July 2016). While some Turkana have not returned, Pokot pastoralists use the area. Additional issues have arisen from Pokot herders occupying infrastructure, in particular a primary school located in Lochakula Settlement (KII, 29 July 2016).

Another example of the volatility in security is in the Katilu Location of Turkana South. There some adakar elders state that the Pokot no longer migrate to the same areas as in the past and that this causes disruptions. They also expressed disappointment that there has not been a re-opening of the Narwamoru Settlement (Focus Group Discussion, 29 July 2016). Narwamoru Settlement is located in the Kaputir Location in Turkana South. It borders the Kapokot hills and was previously a gold mining area and an important place for commerce between the two groups. It closed in 1996 after an attack by Pokot on miners in an attempt to scare away Turkana. The dispute over the area was said to have less to do with cattle rustling, but more to do with land acquisition.

Research highlights that while raiding may have subsided from its peak in 2015, there is a persistent problem with violence and robbery along the A1 highway, particularly in areas from Kalemngorok settlement to Kakongu settlement. On this road, the Turkana South Deputy County Commissioner states that robbers harass drivers and passengers, particularly larger trucks. This, he says, is partly to do with individuals who used to participate in cattle raids and refuse or are unable to return to herding and have no other livelihood (KII, 29 July 2016). Other residents near this area suggest that there still may be some involvement of pastoralists who participate in the robberies (Focus Group Discussion, 29 July 2016). Anecdotal accounts explain that pastoralists with phones can sometimes communicate with "*thugs*" or idle warriors. They observe vehicle movements and call ahead to hit vehicles farther along the road. Adakar elders in the Kakongu Sub-location consider the bandit in two categories. The first category are simply common criminals, but the second category includes some people who were left destitute by losing their animals in previous violence. With no animals, but still having access to their weapons, poverty induces them to crime. The elders themselves increasingly see little difference between the two groups and believe that even those who lost animals can survive in aid if they need it (Focus Group Discussion, 31 July 2016).

One of the most dangerous implications of robbery on the road is the possibility that it could lead to accusations across ethnic lines. One Turkana key informant in Lodwar has received information that Turkana youth have carried out some robberies and then sought to blame ethnic Pokot. He also said there are reports of collusion with police (KII, 8 August 2016).

In the Kositei Location in West Pokot Sub-county, the Assistant Chiefs indicated that there has been conflict over the natural resources (grazing areas and livestock) in the area. It was escalated during the construction of the Turkwel dam but then there was peace. They reported that insecurity is high in the Kasitei Sub-location but there have been no incidences of insecurity in Chepokachim Sub-location (KII, 2 February 2019).

The Pokot West Sub-county, Endugh Ward and Kositei Location leadership, in collaboration with external partners, cite the following activities as having created progress in recent years:

- Peace committee, which consists of 60 people (30 Pokot and 30 Turkana) was formed with the sole role of following up and returning any stolen animals from either side;
- Insecurity is addressed through inter-border exchange visits, meetings with adakar/kraal leaders, admission of Turkana students in Turkwel Secondary school and regular communication between the administrative organs in the two counties;
- The churches (religion) changed peoples mind set through awareness of the consequences of violence and death;
- 70% cattle rustlers became Reformed Warriors (RWs) and their role changed from animal theft to ambassadors of peace. RWs is a group of former militia gangs (Ngoroko). They were given motorcycles to do public transport as an alternative livelihood. Some of them were also casually employed in the NRT conservancy;
- Political leaders from both counties accepted, supported and campaigned for peaceful coexistence;
- Women played a key role by talking to their sons to end killing each other. They campaigned on radio stations (Kalya FM and North Rift) for peace among Pokot and Turkana and participated in the peace caravan; and
- Elders have performed traditional rituals cursing (*muma*) cattle rustlers, inciters and highway banditry. These functions were carried out in Lami Nyeusi (Pokot side) and Kalemngorok (Turkana side) (Focus Group, 2 February 2019).

6.13 Cultural Heritage

6.13.1 Introduction

The purpose of the cultural heritage baseline study was to collect objective, scientifically defendable data of sufficient breadth and quality to allow the characterisation of the baseline cultural heritage conditions in the potential AoI.

Cultural heritage, in both tangible and intangible forms, is a unique and non-renewable resource. Tangible cultural heritage is defined as moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic and religious values; or unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls (IFC, 2012a).

Archaeology is considered in this study to comprise all the material remains of past human occupation, land-use and associated activities, as well as any resultant environmental remains and it covers all periods, from prehistory (before written records) to the modern period (20th century).

Cultural heritage assets[20] that are not archaeological are described in this study as ‘living cultural heritage’. This includes intangible cultural heritage, which is described as elements of culture such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles (IFC, 2012a).

The archaeological time periods referred to in this baseline report, their approximate date ranges and how they relate to known geological periods[21] are outlined in Annex I.

A combination of desk-based study, archaeological field survey and KIIs were undertaken to establish the baseline cultural heritage conditions in the AoI.

Baseline cultural heritage data has been collected over an extended period of time (2016 to 2019), with each field survey guided by the likely design of the Project as it stood at that time. As such, baseline cultural heritage data has been collected across an extensive area of the South Lokichar Basin, as well as along the route to the Turkwel Dam. All baseline data that has been collected is included in this baseline study as it allows individual cultural heritage assets to be interpreted in the context of the wider dataset.

6.13.2 Secondary Data

Secondary data was collected through desk-based study, including an appraisal of the following:

- Existing national datasets collated and maintained by the NMK;
- Results of previous archaeological surveys, conducted by NMK specialists in 2014, in advance of seismic surveys across Licence Blocks 10BB and 13T; and
- Specific Site Assessments (SSAs) completed for each wellpad during E&A, which included an archaeological survey.

A review of the available literature was also completed to identify other sites in the area and to provide regional context in which to interpret the established baseline conditions. The Lake Turkana basin, internationally-recognised archaeological and palaeontological significance, has attracted a wealth of academic research, which is used to inform the NMK dataset.

[20] The term ‘asset’ is used in this context as a generic term applied to a variety of cultural heritage site types, which range in size, nature and significance. An individual asset might, for example, be an archaeological findspot of a single isolated pottery sherd/scatter of pottery sherds or, equally, it might refer to a burial or monument.

[21] An overview of the archaeological chronology for Kenya, as defined by the NMK, is presented here https://www.museums.or.ke/archaeology-section/

The NMK archives were the main source of secondary information for sites and monuments of historic or cultural value (including any statutory protections afforded to them). They also record sites of significant national/international archaeological interest.

The data captured by NMK during seismic survey activities in 2014 provided a higher resolution to the archaeological dataset, with sites recorded of relatively lesser significance, such as individual findspots. The SSAs did not record any archaeological sites.

The desk-based study was completed by a member of NMK staff and sought to identify previously recorded cultural heritage sites of all types, including:

- Archaeological;
- Palaeoenvironmental;
- Sites containing hominid remains;
- Palaeontological;
- Historic; and
- Other culturally relevant sites (e.g. religious buildings and places, burials, sacred sites).

6.13.3 Primary Data

6.13.3.1 Methods

This methodology was developed in accordance with Kenyan legislation and guidance pertaining to cultural heritage protection in particular the EMCA 1999 and the National Museums and Heritage Act 2006. It also aligns with the guidance provided in IFC PS 8: Cultural Heritage and IFC GN 8: Cultural Heritage.

6.13.3.1.1 Archaeological Field Survey

Archaeological field survey, which involved walking over a representative sample of the proposed Project footprint looking for evidence of past human and paleoenvironmental activity and recording the locations of identified cultural heritage assets, was completed in four phases. The first two were undertaken in April and July 2016 (the combination referred to as ‘the 2016 Survey’), with the third completed in February 2019 (‘the 2019 Survey’), and a further supplementary phase of survey completed in June 2019 (‘the Turkwel Survey’). Due to the evolution of the Project design in the periods between each phase of survey, the methodology for the archaeological field survey was also evolved for each phase, as described below.

For the first three phases of survey, the fieldwork was completed by NMK specialist staff under the supervision of a Golder cultural heritage specialist and was undertaken in those areas considered likely to be directly affected by the Project (e.g. by ground disturbance). The Turkwel Survey was completed unsupervised, with remote support by a Golder cultural heritage specialist. On each occasion, the survey team completed the walkover survey systematically, covering the area by walking regularly spaced transects. The rationale of the archaeological field survey was not to survey the Project footprint in its entirety, but rather to survey a representative sample to provide a robust dataset that could be used to characterise the baseline conditions over the wider area. Although the archaeological field survey was limited to remains visible at the surface, for the purposes of baseline data collection, this is considered appropriate.

2016 Survey

The 2016 Survey focused on the areas of Amosing, Ngamia and Etom, with the aim of undertaking an approximate 15% survey coverage. To achieve this, each survey area was divided into a series of 500 m x 500 m grid squares, with a 15% sample of these grid squares randomly surveyed.

The second phase of survey also utilised this approach to achieve a 15% survey coverage of the areas of Twiga, Agete and Ekales. Some additional areas in the vicinity of Amosing and Ngamia were also targeted, based on potential Project infrastructure locations.

2019 Survey

The 2019 Survey was focused on the TAN areas and the area between the A1 and the Turkwel Dam. All potential locations at Twiga and Amosing were surveyed and 74% of those at Ngamia were covered. Approximately 19% of the potential water pipeline route between Ngamia and the A1 was surveyed, and 16% of the route between the A1 and the Malmalte River. Survey coverage of potential Project components is presented in Drawing 6.13-1.

Primary data gathering through archaeological field survey was limited to those areas that were safely accessible and amenable to survey. Consequently, heavily vegetated areas, such as those adjacent to the Malmalte River, either could not be surveyed (as they could not physically be accessed) or were discounted for survey as the vegetation cover prevented artefacts from being visible on the surface. Equally, areas that had already been developed during E&A or were located along the existing C46 and A1 roads were also discounted for survey. Physical walkover survey could not be undertaken west of the Malmalte River at that time due to security concerns in that area. The locations of several graves, recorded by TKBV's SPT, were also acquired following this survey.

Turkwel Survey

The Turkwel Survey was undertaken adjacent to the Turkwel River upstream of its confluence with the Malmalte River, as part of a multi-disciplinary field expedition to the area, which was previously inaccessible due to safety concerns. The survey focused on areas where water pipeline infrastructure was proposed to be located. As with previous surveys, archaeological field survey was limited by the heavy vegetation, but walkover survey of a representative proportion of the proposed development area was achieved.

Recording and Finds Processing

The location of each identified asset was recorded using a handheld GPS. A short, written account of the asset was also made (including information such as description, dimensions, setting and associated finds) and accompanied by digital photographs, where appropriate. Where finds were collected, these were placed in sample bags and marked using indelible ink with the finds' location and date of discovery. These finds were washed and processed, with a photographic record made of each. These collected finds are not a comprehensive catalogue of all materials discovered during the survey, rather, they are a representative sample. The finds are stored in NMK's offices in Nairobi.

6.13.3.1.2 Key Informant Interviews

KIIs were undertaken with community members in 20 settlements across the South Lokichar Basin during the 2016 Survey, in order to achieve the following objectives:

- To identify sites of cultural significance (e.g. religious, sacred or ritual sites, cemeteries or burial areas), record their locations and extents and understand how they are used/accessed;
- To record the oral history of the settlement and land use in the area; and
- To document an understanding of local traditions and practices (e.g. belief systems) that are important to the communities (intangible cultural heritage).

The 20 settlements in which KIIs were conducted in 2016, the locations of which are depicted in Drawing 6.13-2, were:

- Akibuket;

- Amoruakwan;
- Asikiim;
- Dapar;
- Kaikol;
- Kaloucholem;
- Kapese;
- Kapetatuk;
- Kaaroge;
- Kasuroi;
- Lochwaa;
- Lokicheda;
- Lokook;
- Lomokamar;
- Lopuroto;
- Lotimaan;
- Lowoidapal;
- Nakukulas;
- Nawoyalim; and
- Nayanae-engol.

KIIs were completed in partnership with an NMK specialist and assisted by TKBV's SPT. The KIIs were conducted primarily in Swahili and were digitally recorded with the consent of the participants. Where interview participants did not speak Swahili, a member of the SPT translated from Swahili into the local language (Turkana). A translated summary was provided in English by the NMK specialist leading the interview.

Initial contact with community members was made by the SPT, which was followed up by an introductory meeting with the Golder cultural heritage survey team. During this introductory meeting, arrangements were made to conduct the KII and an explanation provided of the objective of the interview. To maximise the data gathered from members of the community, interviews were held with different groups, including chiefs, seers, elders, women and youth. A catalogue detailing where and when KIIs were held, as well as who was in attendance, is provided in Annex I. Summary reports detailing the KIIs are also provided in Annex I.

Subsequent to KII, identified cultural sites were visited to capture precise coordinate information (using handheld GPS) and to record details of each asset to allow the scale, form, function, date and relative importance of each to be ascertained.

An additional series of KIIs with community leaders from settlements located between the A1 and the Turkwel Dam was undertaken in Kapenguria in January 2019. Further supplementary KIIs were also completed during the Turkwel Survey. During these KIIs, information relating to the cultural heritage of those communities was gathered, although locations of specific assets were not mapped during baseline data gathering.

6.13.3.1.3 Data Management and Spatial Analysis

Due to the volume and coverage of data collected from secondary sources, primarily as a result of the extensive seismic survey work that has been undertaken, and the relative lack of detail associated with each record from the seismic survey, two separate datasets have been established; one from secondary data and one from primary data.

Cultural heritage assets identified during the primary data gathering activities were compiled, with each asset given a unique identifier (Golder ID). The secondary data dataset, which includes in excess of 1,500 assets, has not been ascribed unique identifiers, but has been classified on a broader basis, based upon the materials recorded. Both datasets have been analysed spatially using GIS software in order to establish their locations in relation to the Project.

The unique Golder ID for each asset includes a two-letter prefix, which defines whether it is an archaeological or living cultural heritage asset, followed by a sequential numbering system. The two letter prefixes used are:

- AR – Archaeology; and
- CH – Living Cultural Heritage.

6.13.4 Results

The results are presented in two sections, addressing the secondary and primary datasets, respectively. The combined primary dataset (the 'Cultural Heritage Gazetteer') is presented in Annex I and encompasses 548 cultural heritage assets.

The secondary data dataset, which covers a large swathe of Turkana county, includes a total of 1575 cultural heritage assets. A summary of the secondary dataset can be provided upon request. The locations of all identified cultural heritage assets from the primary and secondary datasets are shown in Drawings 6.13-3 to 6.13-24.

There are six sites in Kenya designated by UNESC as a WHS, comprising three cultural sites and three natural sites and listed in Table 6.13-1.

Table 6.13-1: UNESCO World Heritage Sites in Kenya

Site Name and Location in Kenya	Year of Inscription; Type
Fort Jesus, Mombasa	2011; Cultural
Kenya Lake System in the Great Rift Valley	2011; Natural
Mijikenda Kaya Sacred Forests	2008; Cultural
Lamu Old Town	2001; Cultural
Lake Turkana National Parks	1997; Natural
Mount Kenya National Park and Natural Forest	1997; Natural

None of these six sites lie in proximity to the Project. The nearest WHS to the Project, the Lake Turkana National Parks (natural; WHS Ref – 801bis), is over 100 km to the east.

6.13.4.1 Secondary Data

A total of 1,575 cultural heritage assets have been identified from secondary sources, the location and distribution of which are shown in Drawings 6.13-3 to 6.13-7. The majority of these assets were recorded during previous archaeological surveys undertaken in advance of the seismic survey, which was carried out over an extensive area between Lodwar and Amosing. It is understood that no sampling of materials was undertaken during these surveys. The materials recorded at each asset have been categorised into eight broad categories, comprising:

- Burial (Living Cultural Heritage);
- Monument/Sacred Site (Living Cultural Heritage);
- Faunal (Archaeology);
- Grindstone (Archaeology);
- Jewellery (Archaeology);
- Lithic (Archaeology);
- Palaeontological[22] (Archaeology); and
- Pottery (Archaeology).

Some assets, which contain multiple materials, fall into more than one category. All burials identified from secondary sources are assumed to be modern burials, based upon the limited information available[23].

A summary of materials recorded across the 1,575 assets is presented in Table 6.13. As shown, the most prevalent materials recorded were pottery and lithic remains, with 61% and 36% of assets containing them respectively. A total of 251 burials were recorded, comprising 16% of cultural heritage assets identified from secondary sources. Faunal, palaeontological and other archaeological remains (jewellery and grindstones) were recorded at far fewer cultural heritage assets.

Table 6.13-2: Materials Recorded at Cultural Heritage Assets (Secondary Data)

Material	Number of assets where material was recorded	Percentage of assets where material was recorded
Burial	251	16%
Monument/Sacred Site	7	<1%
Faunal	64	4%
Grindstone	1	<1%
Jewellery	3	<1%
Lithic	571	36%
Palaeontological	37	2%
Pottery	958	61%

[22] There is only limited information available from secondary sources regarding the majority of palaeontological materials. A proportion are recorded with associated material culture, although there are a number that contain only zoological remains, with no human aspect. In light of the limited information available, and for ease of interpretation, all palaeontological finds are presented as being 'archaeological' for the purposes of this baseline study.

[23] It is not possible to verify the date of these burials from the information recorded in secondary sources, and so there is a possibility that a proportion of these may be historic burials. They have all been assumed to be modern burials as it is considered that this represents the 'worst-case' – i.e. it is assumed that there are human remains and potential living relatives to be considered.

Burial

Burials were recorded throughout the region, although there are notably fewer burials recorded between Lokichar and Ngamia (as shown on Drawing 6.13-4). The densest concentration of burials is observed around Lokichar and extending to the north. In particular, burials appear to be clustered to the western side of the survey coverage, in the area adjacent to the A1 road. A similarly dense distribution of burials is observed south of Ngamia, around Amosing.

Monument/Sacred Site

Seven assets have been identified as 'monuments'. Based upon the limited information available from secondary sources, these are best interpreted as sacred sites used by the community and include three 'shrines' used for feasting and three small mounds topped with cairns. One asset is simply described as a monument.

Faunal

Faunal remains, comprising non-fossilised animal bone and tooth fragments, as well as ostrich egg-shell, were recorded at relatively few locations in the region (4% of identified cultural heritage assets). These are distributed throughout the region, although a large proportion of these faunal remains are recorded north of Lokichar. There is also an apparent absence of materials between Ngamia and Lokichar.

Grindstone

A single grindstone was recorded, adjacent to the A1, north of Lokichar. Grindstones are used for food processing, such as grinding grain.

Jewellery

Examples of jewellery, comprising various beads and including one ostrich egg-shell bead, were recorded at three of the identified cultural heritage assets.

Lithic

Lithic remains were recorded at 36% of the identified cultural heritage assets, making them the second most prevalent archaeological material observed. These comprised a variety of stone tools, including flakes and cores from a range of different materials. As shown in Drawing 6.13-5, lithic remains are recorded throughout the region, although there is a particularly dense cluster around the areas of Etom and Agete. South of Agete, as far as Amosing, the distribution of lithic remains is relatively sparse, with a denser concentration south of Amosing.

Palaeontological

Palaeontological remains, comprising a range of fossilised bones and teeth from a variety of species, were recorded at 37 (2%) of the identified cultural heritage assets identified from secondary sources. As such, they are relatively uncommon in the area compared to other materials identified. Isolated examples are recorded throughout the region, but the densest concentrations are noted near Amosing and to the east of the Etom area. Based upon the information available, none of these palaeontological remains are hominid fossils.

Pottery

Pottery remains were the most commonly recorded material, with pottery present at 61% of the identified cultural heritage assets. As shown in Drawing 6.13-6, these are distributed throughout the region, with no discernible clustering of material. Unlike the other materials recorded, pottery appears to be the only consistently recorded material between Lokichar and Amosing.

6.13.4.2 Primary Data

A total of 548 cultural heritage assets were recorded during primary data gathering, the location and distribution of which are shown in Drawings 6.13-8 to 6.13-24. These comprise 441 archaeological assets (AR-001 to AR-441) and 107 living cultural heritage assets (CH-001 to CH107). The details of each asset are presented in the Cultural Heritage Gazetteer in Annex I.

Archaeology

Consistent with the results of the desk-based study, archaeological remains were observed throughout the landscape during field survey. Archaeological remains were limited to lithics and pottery at all but two assets; AR-142, where a cowrie shell bead was recorded, and AR-425 (near the Amosing area), where a potential fossil was recorded. A summary of the materials recorded at archaeological assets is presented in Table 6.13-3

Table 6.13-3: Materials Recorded at Archaeological Assets (Primary Data)

Material	Number of assets where material was recorded	Percentage of assets where material was recorded
Pottery	118	27%
Lithics	358	81%
Jewellery	1	<1%
Palaeontological	1	<1%

The vast majority of pottery was undecorated (recorded at 112 assets), with decorated pottery recorded at just eight assets. Examples of undecorated and decorated pottery are presented inn Figure 6.13-1 and Figure 6.13-2, respectively. Rim and neck sherds were also recorded at 15 assets. Thick-walled, undecorated pottery is generally associated with the Iron Age in Kenya, dating to between 2,500 and 500 years before present (BP). It is typically younger in age than decorated pottery recorded in the area. Pottery occurs in the archaeological record of the Lake Turkana region from approximately 4,500 years BP. Its earliest occurrence is recorded at a site to the east of Lake Turkana, and its appearance is associated with the presence of domesticated livestock. This early pottery type is known as 'Nderit ware' and is decorated with incised wavy lines. Another form of decorated pottery with incised lines, known as 'Ileret ware', is also present in the region around this time, but is characteristic of later pastoralists who occupied the region. Nderit and Ileret wares disappear from the archaeological record circa 3,000 years BP.

Figure 6.13-1: Undecorated Pottery (AR-217)

Figure 6.13-2: Decorated Pottery (AR-317)

There was greater diversity of lithic objects recorded, comprising a variety of flakes, cores and debitage (chunks and other waste material). There was also a variety of different materials identified, with stone tools manufactured from quartz, chert, obsidian and rhyolite recorded, as well as several tools manufactured from poorer quality materials like basalt. Figure 6.13-3 shows a lithic assemblage with examples of rhyolite, quartz, obsidian and chert tools. A summary of the prevalence of different lithic remains is presented in Table 6.13-4. Overall, quartz and rhyolite tools were the most prevalent, recorded at 43% and 37% of archaeological assets, respectively. Chert and obsidian were recorded at 22% and 16% of archaeological assets, respectively.

Table 6.13-4: Lithic Remains – Materials Recorded

Material	Number of assets where material was recorded	Percentage of assets where material was recorded
Quartz	191	43%
Chert	98	22%
Obsidian	71	16%
Rhyolite	165	37%
Other (e.g. Basalt, Chalcedony)	75	17%

Figure 6.13-3: Lithic Assemblage (AR-251). Stone Tools Ranging from Large Rhyolite Flakes to Worked Quartz to Smaller Obsidian and Chert Flakes (Including Some Microliths).

The presence of quartz tools within the survey area is explained by the relative abundance of source material in the local environment. The mountains to the west of the region are the likely origin of this material, but nodules of quartz are ubiquitous in the numerous luggas that traverse the landscape where they have been transported and deposited by ephemeral surface water flow.

Chert and obsidian, however, do not occur in the surrounding landscape. The nearest known source of obsidian lies 100 km to the north-east, on the Central Island of Lake Turkana, although the exact provenance of the recorded finds is not currently known.

It is considered that, in the absence of definitive stratigraphic evidence, stone tools of different materials that were found in the same context should be deemed contemporaneous in date.

Samples of archaeological materials were taken during survey, although it was not feasible to collect every artefact recorded. A detailed breakdown of the quantity of each find type across the survey area is, therefore, not possible. The sample assemblage totals approximately 2,070 individual artefacts. Photographs of a representative sample of the collected materials are presented in Annex I.

Living Cultural Heritage

A total of 107 living cultural heritage assets were identified during primary data gathering, the locations of which are shown in Drawings 6.13-17 to 6.13-24. A summary of these living cultural heritage assets is provided in Table 6.13-5.

Table 6.13-5: Types of Living Cultural Heritage Assets Recorded (Primary Data)

Asset Type	Number of asset type recorded	Percentage of all assets
Burial/Grave	42	39%
Meeting Tree	39	36%
Fire Pit	10	9%
Religious Building	3	3%
Other	13	12%

Generally, living cultural heritage sites in the region are found in close proximity to the settlements with which they are associated. Away from these settlements, living cultural heritage sites are limited to individual, isolated burials. Burials are typically demarcated by a small pile of rocks and can be found scattered throughout the landscape. More formal graves were also recorded, specifically those of eminent elders and group leaders. In Turkana culture, an individual’s social standing within a community determines the type of burial they receive, the location and size and scale of any grave markings. The graves of respected leaders and elders are typically marked with a recognisable memorial (e.g. headstone, cross) and are located near the settlement. A more detailed description of Turkana burial practice is provided in Annex I. A total of 42 burials/graves were identified during survey or from KIIs.

Another frequently recorded asset was specific ‘meeting’ trees, which are culturally significant to different members of the community within Turkana. Some meeting trees are reserved for groups of elders, whilst others are reserved for the youth of the community. Each *ere*[24] has a specific tree, or several trees, where men meet, known as *ekitoe a ng’ikiliok*[25]. Community meeting trees are used by all members of the settlement, and are used as the location for ceremonies, community events and group discussions (regarding issues of concern, like drought). Trees are also significant locations in terms of conducting weddings, initiations and other religious

[24] *Ere (pl: ng’ereria)* describes the ancestral domain of a family. An ere may be described by the current household (including grand-parents, siblings and children) as the location from where the family derives and, to a variable extent, may live (seasonally or more permanently for the old, women and children) and graze their livestock. Borders of the ere are usually delineated by features such as a luggas, ridgelines, livestock tracks (for moving stock long distances), roads and occasionally certain species of trees. These borders are generally known by everyone living in the vicinity.

[25] Alternatively known as *Ekitoe a Ngikileok*

functions. A total of 39 meeting trees were recorded. Associated with the meeting trees are fire pits and roasting pits, which are used during feasts held at these locations. Ten such pits were recorded during data gathering.

Often the graves of eminent leaders are in close proximity to meeting trees, and there are occasional instances of fire pits associated with the graves of eminent elders, where feasts associated with consulting the deceased ancestor have been held.

Two churches and one mosque were recorded in Lokichar (CH-050, CH-051 and CH-049, respectively). A total of 13 'other' living cultural heritage assets were also identified. These include a charcoal making site (CH-104; recorded by the Malmalte River), two grazing fields (CH-010 and CH-013) and an irrigation dam/channel (CH-054- 056). These 'other' living cultural heritage assets also include several ceremonial meeting places where the feasting tradition of *akiriket*[26] takes place (CH-041, CH-063, CH-065, CH-070, CH-083, and CH-094), as well a place where a game, known as *Nikales*, is played on a 'board' drawn into the sand (CH-093).

Whilst it was not possible to physically record the locations of specific living cultural heritage assets in West Pokot, it is understood from the KIIs completed in 2019 that similar assets, especially specific meeting trees, are also important in West Pokot culture.

Intangible Cultural Heritage - Turkana

The KIIs provided a perspective on the typical practices and beliefs carried out in the surrounding areas.

A widespread and distinct 'Turkana culture' is evident throughout the region, comprising several related practices and beliefs. Widely observed practices include a nomadic pastoralist way of life and use of the local environment for subsistence. The latter includes grazing, hunting and the collection of medicinal plants, although the more general use of different tree species (such as *Ewoi, Edome* and *Ekadeli*) for a variety of functional and spiritual purposes was also recorded (further detail is provided in the ecosystem services baseline; Section 6.10). Associated with this is a social structure and belief system which permeates all aspects of life and is ingrained in the culture of the local people. In addition, the local population have sincerely held religious beliefs, spanning multiple denominations of Christianity, Islam and local polytheist/animist religions, with the significance of 'seers' also recorded during the KIIs.

Turkana culture is widespread, and practices such as nomadic pastoralism and the use of the landscape for subsistence are carried out over large geographical ranges. A brief overview of the recorded 'Turkana culture', with supplementary information from Herlocker et al., (1994), is presented here, although this should not be considered a comprehensive or definitive description.

Turkana History, Society and Belief System

Turkana culture and identity are closely associated with the history of the people and the region. This history is primarily recorded and transferred between generations through the recounting of oral histories, and these histories inform how Turkana society is structured and how the relationships between the Turkana people manifest themselves.

Fundamental to Turkana social structure are the concepts of 'sections'[27] and 'clans'[28]. Sections are geographical areas of varying size, some of which overlap, which cover the entirety of the Turkana region and define different territorial boundaries. Sections provide a social identity and a sense of protection as they define limits of ownership and accessibility to resources. There are 15 sections (and 4 sub-sections) in Turkana,

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[26] Akiriket is where both groups cut two pieces of meat (*apol*) from the hind-quarters of the carcass, comprising a bigger piece (with the kidney attached) and a smaller piece. The *Ngicuro* cut the small *apol* from the left side of the carcass and the big *apol* from the right, whilst the *Ngimonia* do the reverse. The *Ngicuro* also remove the kidney prior to roasting, whilst the *Ngimonia* only remove it once the meat is roasted.

[27] Section - *ekitela* (single), ng'itela (plural)

[28] Clan - *emacar* (single), *ngimacarin* (plural)

separated into two groups – *Ngicuro*[29] ('those of the waterfalls') and *Ngimonia*[30] ('those of the dense forest'). These comprise:

- ***Ngicuro*** – Ngikamatak; Ngilukumong; Ngiwoyakwara; Ngibilae; Ngikebootok; and
- ***Ngimonia*** – Ngikwatela; Ngijie (lu Akorumwa Anarengan); Ngisiger; Ngisir; Ngiyapakuno; Ngimonia a Anyangataok; Ngiboceros; Ngikajik; Ngisonyoka; Ngiesetou.

This distinction represents two separate phases of migration into Turkana, with five sections in the earlier *Ngicuro* group (believed to have settled in Turkana in the early 16th century) and ten in the later *Ngimonia* group (believed to have settled in Turkana in the 18th century). The *Ngicuro* sections occupy the western and southern areas of Turkana, whilst the later *Ngimonia* sections are located in the central, northern and eastern areas, described in 1994 as being bounded to the north by Lothagam Hill, on the west by the Turkwel River and on the east and south-east by the Kerio River. The distinguishing feature between the two groups, as documented by Müller-Dempf (1994), is the way in which they slaughter, prepare and roast an animal for *'akiriket'*. The potential AoI is located within the *Ngisonyoka* and *Ngikebootok* sections (*Ngimonia* and *Ngicuro* group, respectively).

Clans are based on kinship, defined as groups of people 'related through their animals' (Herlocker et al.; 1994), and can be identified and distinguished from each other by slight variations in dress, customs and livestock brands. There are 29 clans in Turkana, which can be separated into three rough categories:

- Those found primarily within the *Ngicuro* sections (15 clans);
- Those found primarily within the *Ngimonia* sections (6 clans); and
- Those found throughout both *Ngicuro* and *Ngimonia* sections (8 clans).

Despite these groupings, clans are not bound to a fixed territory and so different clans can be found in any section. Clans act as units of cooperation and members ensure proper distribution of property and livestock amongst family members. This kinship system also links individuals throughout the Turkana region and when a group of individuals move to a new territory, they would customarily approach their clansmen in that new area for support and guidance. Men and women of the same clan are not permitted to marry; when a woman marries a man, she joins her husband's clan. Clan affiliation is hereditary through the male line, with the elders of each clan the custodians of their clan's unique customs.

Elders of a clan or family (both male and female) are grouped into two alternating age-sets; the senior age set (*Ngirisae*) and the junior age set (*Ngimor*). Customarily the *Ngirisae* wear gold jewellery (such as rings or earrings) and the *Ngimor* wear silver jewellery (KII, 7 April 2016). The designation of senior or junior alternates each generation, so the children of *Ngirisae* are *Ngimor* and the children of *Ngimor* are *Ngirisae*. During *akiriket*, where the group sits in an arc, the most senior of each age set sit at the centre, with the *Ngirisae* seated on the right side of the arc and the *Ngimor* on the left. Seers are not actively involved in decision making but do advise both age sets.

Clan affiliation and the section from which an individual is from can be used to identify and differentiate them from other individuals. If an individual travels and settles in a new section, they still identify themselves as being from their original section. Importantly, this links an individual back to their heritage and the history of the Turkana people, which in turn entrenches the significance and strength of Turkana culture within society. An individual's surname, derived from the grandfather's forename, also provides an insight back into their heritage and allows them to trace their lineage, reaffirming their Turkana identity.

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[29] Also commonly referred to as *Ngikamataka* ('those of the Apol Nakamatanit')

[30] Also commonly referred to as *Ngisir* ('those of Apol Nasirit')

Other features of Turkana culture include their own calendar, special initiations, distinct burial practices and marriage customs (including 'official' and 'unofficial' marriages) and perceptions of the landscape. There are also established concepts of land ownership and wealth, which are founded on principles of communal ownership and communal obligations. As such, they do not necessarily conform to 'Western' concepts of land ownership.

Nomadic Pastoralism

A significant element of Turkana culture is nomadic pastoralism, which is practised by a large proportion of the population of Turkana. This way of life, determined by seasonal fluctuations in the availability of water and grazing, has been practised for generations and is integral to Turkana culture and values. Its influence over the landscape in terms of settlement, land use and tangible cultural heritage is profound. Indeed, the Turkana pastoralists have developed robust strategies to cope with the risks inherent to survival in their arid and semi-arid environment. These include:

- Splitting livestock in smaller herds and distributing them over a wider area to reduce grazing pressure;
- Being highly mobile to exploit and react to the changing conditions of the landscape;
- Following a seasonal grazing pattern;
- Reserving specific areas of grazing land for the dry season;
- Exploiting a wide range of natural resources to overcome food scarcity and also pragmatically selling livestock to access the produce of agriculturalists; and
- Effective distribution of roles and responsibilities.

A key feature of nomadic pastoralism in Turkana is the distinct social structure and settlement pattern it has engendered. At the smallest scale communities are based on an extended family unit. This is headed by the male leader of the household (*elope*), and would include his wives and children, as well as, potentially, any younger brothers and their families. Each wife and her children would typically have their own individual home[31] which would be clustered together, along with pens for livestock, within a homestead[32]. The *elope* (and any other men within the homestead) would typically sleep outside to protect the animals.

During the wet season, the homestead is established in the family's '*ere*'. It is during this period, typically, that social activities such as marriages take place. Multiple homesteads may be established within an *ere* by different family members. Each *ere* is different in terms of size and shape, and typically there is overlap between neighbouring *eres*. The process for establishing a new *ere* is overseen and organised by clan and family elders.

During the dry season, when grazing and water at the *ere* becomes sparse, households must move their herds to other areas to find sufficient food and water. During this time, the elderly (potentially including the *elope*) and the very young may stay at the *ere* with a small number of livestock, whilst the remainder of the household move to other areas. Those who remain at the *ere* are referred to as the '*eegos*', literally meaning 'baggage'. Throughout this time the household lives more transiently in the landscape, moving from location to location in search of grazing. During this transient period, households may establish temporary homesteads[33] within the *ere* of another family, with some households following an established route, developed over multiple years, through several different *eres*. In this sense *ere* boundaries are widely acknowledged and understood but they are permeable – it is accepted by the Turkana people that others may temporarily settle and use an area, but

[31] Home/shelter – *ekol* (singular), *ng'ikolia* (plural)

[32] Homestead – *awi* (singular), *ng'awiyei* (plural)

[33] Temporary homestead – *abor* (singular), *ng'aborin* (plural)

this is done so in consultation with each other so as to avoid conflict. The ultimate ownership of an *ere* by a specific family is recognised by all Turkana people.

Multiple homesteads from the same area will often come together to form a larger mobile unit, known as an adakar[34], when moving herds to new grazing. When travelling long distances, several adakar will often merge to form a larger group known as an *arumrum*[35]. This is for the purpose of security (KII, 9 May 2017).

Environmental Subsistence

As a traditional practice, environmental subsistence is an element of intangible cultural heritage and is recognised as such. Details of the specific materials gathered (plant and animal species and soil and mineral types), where they are collected and how they are used by the local people is provided in the ecosystem services baseline (Section 6.10). This practice is carried out throughout the region and is not specific to any single settlement or location.

Intangible Cultural Heritage - West Pokot

The KIIs completed in 2019 provided an insight into social structure and traditional beliefs within West Pokot. A brief overview of the recorded 'West Pokot culture' is presented here but this should not be considered a comprehensive or definitive description.

The Pokot migrated to West Pokot as a result of conflict in surrounding regions and, as a traditional society, are structured based on 'clans'. There are 36 clans, which are each divided into several 'sub-clans'. There are 330 sub-clans, in total. Pokot society is patriarchal, with decisions predominantly made by men. However, powers and positions of authority that are inherited through an individual's clan lineage are considered to be divine rights (i.e. bestowed by their deity) and are not gender specific.

Groups within the traditional Pokot society structure include:

- *Kirwook* (Judges) – a group of powerful and influential individuals who have ultimate authority within the traditional leadership structure. Individuals come from various clans and they are believed to have been gifted with wisdom, a sense of justice and the ability to solve problems. Clans associated with *Kirwook* are *Siwotoy* (buffalo), *Sotot* (sun), *Ngisurot* (rain), *Kasera* (dove), *Pkomor* (wild pig) and *Soko* (lion);
- *Karoyok* (Intestine Readers) – these individuals are believed to have the ability to read prophecies from animal intestines following animal sacrifice.
- *Werkoy* or *Laibon* (Seers) – these are individuals that are believed to be gifted with spiritual insight. Due to security concerns, KII participants indicated that seers prefer to keep their identity secret. Seers are believed to derive their ability from their clan lineage and only specific clans are known to produce seers (*Siwotoy* (buffalo), *Sotot* (sun), *Solyongot* (thunder rain), and *Talai* (crow/lion)). *Werkoy* are not common and can be women, depending upon their gifts.
- *Kokwo* (Tree of Men – Elders gathering) – considered to be the Pokot 'Parliament', where decisions are deliberated on by *Kirwook*. The size and representation of the gathering depends on the magnitude of the issue to be deliberated. Nearby *Kirwook* (typically one or two individuals) and representatives from affected collections of homesteads, known as M*ongot*[36]*,* will convene at *Kokwo*. These *Mongot* representatives are selected by members of the homestead based on their effective communication, good judgement,

[34] ng'adakarin - plural

[35] ng'arumrumio - plural

[36] Manyatta – singular homestead, Mongot – multiple homesteads; consists of group of households with familial ties, for example grandfather, children, their spouses and grandchildren, as well as more distant relations (e.g. cousins). A 'kau' is a household with father, mother and children. A large household could also consist of one man with many wives and children.

intelligence and quick thinking. *Kokwo* is convened under special trees significant to the area. These are either fig, sycamore or tamarin indica trees.

- *Mpoy* (Women's' gathering) – this is a meeting of women held to disseminate the information and the decisions made at *Kokwo*. This group has no decision-making authority. This group does, however, deal with the discipline of men who abuse women. They are allowed to enact justice for any crime a man commits against women and have the power to arrest, fine or beat men, depending on the crime and irrespective of the man's position in society.
- *Akiko* (Large-scale gathering) – this is a summit that is used to assemble a large group of leaders that covers a larger geographical area, to discuss major issues/decisions of importance to the wider population. *Akiko* are not held frequently, maybe once a year, as it requires a lot of planning and travelling to mobilise all the relevant people. Typically, *Akiko* would be attended by *Kirwook* from different *Mongot*, who come together to discuss major issues affecting the broader community. It is the ultimate decision-making power within Pokot community. Women don't participate in the decision-making process of *Akiko*, but they are present to organise the event. During *Akiko*, between 15 and 20 bulls are slaughtered to feed the people and to bless the proceedings or issue that needs to be resolved.

This traditional society structure has been integrated into Government structure, with *Kirwook* advising government administrators.

Young people in Pokot culture are not involved in decision making, but they are considered to be the 'defenders' of the community (described during KII as the 'military arm' of the community). They are guided by *Kirwook* and *Werkoy*, and act as messengers to disseminate the decisions made by *Kokwo* to those who were unable to attend.

It is understood that nomadic pastoralism and environmental subsistence are also practices that are common within Pokot society.

6.13.5 Discussion

The baseline study has identified a large number of cultural heritage assets across an extensive area. The combined total of both the primary and secondary datasets is 2,123 cultural heritage assets. As discussed below, this provides a useful and robust context within which individual assets can be interpreted and from which assumptions can be made. However, the coverage of baseline data exceeds the potential AoI, and so it is anticipated that only a fraction of these assets will be considered further in the impact assessment.

This section presents the over-arching conclusions regarding the cultural heritage baseline conditions, based upon the data collected and observations made in the field.

6.13.5.1 Archaeology

As shown in Drawing 6.13-3, secondary sources indicate that there are archaeological remains distributed across a very large area. Combined with the results of the archaeological walkover survey, the baseline data indicates a consistent density and distribution of archaeological remains, particularly lithic and pottery remains, across the region. From this, it is inferred that areas within the potential AoI that have not been subject to survey are likely have a similar distribution of artefacts.

The archaeological walkover survey provided an opportunity to ground-truth the observations derived from the secondary data. For example, although the secondary data indicated an apparent clustering of lithic remains to the north (between Etom and Lokichar) and to the south (around Amosing), the results of the archaeological walkover survey indicate that this is inaccurate and that, in fact, lithic remains are present throughout the region, including the area of apparent absence between Lokichar and Amosing. It is considered therefore, that there is potential for archaeological remains to exist throughout the landscape, with very few discernible patterns to distribution at the wider scale.

The archaeological walkover survey also made it possible to make finer scale observations regarding the distribution of artefacts. Whilst there is no apparent spatial pattern to the distribution of artefacts at the wider scale, it was observed in the field that archaeological remains were typically observable at the surface where the overlying sandy soil had been removed – either by aeolian erosion or transported by surface water runoff (sufficient to remove the overlying sediment, but not sufficient to transport larger particles, or artefacts). As such, there are localised concentrations of artefacts within these areas of erosion. The action of surface water runoff to remove sediments means these localised distributions are linked with the location of luggas. Immediately adjacent to luggas. Where surface water flow has greater energy, all materials (including artefacts) appear to be eroded from the surface and transported along lugga channels until they are deposited when the ephemeral water flow recedes. Slightly further from the luggas, particularly on ground that is relatively elevated, surface runoff seemingly has less energy and so removes the overlying sediment but leaves archaeological remains *in situ*.

Very few artefacts were observed in heavily grazed areas, where the vegetation cover and sandy surface obscured any potential surface finds. However, based upon the distribution of archaeological remains throughout the region, the absence of archaeological remains on the surface in these locations should not be considered evidence that no archaeology exists. It is considered likely that remains exist beneath the surface.

Survey between South Lokichar and the Malmalte River was restricted by vegetation coverage and the steeper topography. Although some archaeological remains were observed (specifically lithic artefacts), as well as a grave; based on these observations, and the wider regional dataset, it is assumed that un-surveyed land in this area is likely to contain a similar distribution of cultural heritage assets observed elsewhere.

Although archaeological remains have been observed throughout the landscape, the source of these materials (e.g. settlement sites) remains unknown. No 'monumental' or architectural remains were observed during survey, and very few scatters of artefacts were considered to signify the potential for any significant sites. The potential for undiscovered settlements to exist below the surface is, therefore, considered to be low. On the assumption that use of the land was transient, buildings would have been constructed from organic materials and therefore little evidence for their existence remains. This is consistent with a nomadic pastoralist way of life, which is known to have existed in the region for several thousands of years. Three locations, however, were identified as having higher potential of more significant archaeological remains below the surface:

- to the north-east of the Ngamia area, where a large scatter of particularly old lithic remains was discovered; dating to between 300,000 and 1.76 million years Before Common Era (BCE);
- the vicinity of AR-105, where a dense collection of lithic tools and pottery were discovered; and
- the vicinity of AR-109, where a dense deposit of worked quartz was identified forming a plateau along an elevated ridge.

Other observations made during archaeological survey include:

- The areas with higher numbers of archaeological finds were located relatively close to the major luggas;
- Based on typological evidence and Holocene surface deposits, the majority of the finds date to the Later Stone Age onwards, although the possibility of earlier stone tools within the assemblage cannot be discounted; and

- Surface sediments are interpreted as being Holocene in date with older Pleistocene, Pliocene and Miocene sediments absent or deeply buried. It is within these earlier sediments that significant hominid discoveries have been made previously at Loperot, Lothagam and Nuchukui.

It is considered, that, despite the acknowledged limitations, the approach to representative data gathering provides a robust basis for characterising the baseline cultural heritage conditions and provides a strong evidence base for areas not surveyed.

6.13.5.2 Living Cultural Heritage

A robust understanding of the living cultural heritage assets in the region have been established, with burials and ceremonial meeting locations (e.g. trees, roasting pits, feasting locations) associated with the majority of semi-permanent settlements. It has not been possible to map these assets between South Lokichar and the Malmalte River, although it is assumed that settlements in these areas, including the area in West Pokot, east of the Malmalte River, will have associated graves and meeting places (as indicated by KIIs completed in 2019).

6.13.5.3 Intangible Cultural Heritage

In both Turkana and West Pokot, identifiable traditional cultures have been recorded. Both cultures practice nomadic pastoralism and have commonalities (e.g. meeting trees), but each is distinct in terms of its history, structure and perception of the world. In particular, they have distinct perceptions of each other, and intangible cultural heritage between Turkana and West Pokot may be sensitive to change.

7.0 POTENTIAL IMPACTS AND MITIGATION

7.1 Air Quality

7.1.1 Introduction

The potential impacts on air quality as a result of the Project have been determined using a combination of quantitative and qualitative assessment methodologies. Where potential impacts have been identified, these are considered in turn and mitigation are set out where necessary to ensure that any potential impacts are reduced as far as practicable.

7.1.2 Area of Influence

The Air Quality AoI considers a 500 m corridor (in addition to the 27 m construction RoW, in which construction activities may generate dust) along the water pipeline route, a 250 m zone around the perimeter of all infrastructure fence-lines and an area of approximately 2 km around the emission points of infrastructure associated with wellpad drilling for the construction phase. For operation, an area of around 2 km is considered around the fence-lines of the CFA, wellpads, IWMF and all associated operational infrastructure. This area is encompassed in the Project AoI as defined in Section 3.13.

7.1.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.1-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.1-1: Criteria for Determining Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ Receptor with a high quality and/or rarity on a regional or national scale and limited potential for substitution/replacement. (not applicable to this Chapter)
High	■ Human health of permanent residential or transient PAP; and/ or ■ Receptor with a high quality and/or rarity on a local scale and limited potential for substitution/replacement.
Medium	■ Receptor with a medium quality and/or rarity on an international, national, regional or local scale and limited potential for substitution/replacement; and/or ■ Receptor with a low quality and/or rarity on a regional or national scale and limited potential for substitution/replacement.
Low	■ Human amenity receptor; and/or ■ Receptor with a low quality and/or rarity on a local scale.

7.1.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.1-2.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the Project phases the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period). The CFA/CPF will be constructed within the first 36 months;
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

For Air Quality impacts, the duration is also defined by the averaging periods of the AQS. For example, if a PAP is likely to be present in an area for 24 hours, only the AQS for averaging periods equal to or less than 24 hours will be appropriate.

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project.

Table 7.1-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Change in air emission concentrations or deposited dust predicted to exceed relevant[a] AQS at indicative sensitive receptors with process contribution greater than 25% of AQS.	Large scale or major improvement predicted in Air Quality at resource/receptor.
Medium	Change in air emission concentrations or deposited dust predicted to exceed relevant[a] AQS at indicative sensitive receptors with process contribution less than 25% of AQS; OR Change in air emission concentrations or deposited dust predicted to exceed relevant[a] AQS at non-sensitive receptors, with process contribution greater than 25% of AQS.	Some benefit or improvement predicted in Air Quality at resource/receptor.

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
Low	Change in air emission concentrations or deposited dust predicted to exceed baseline, but not exceed relevant[a] AQS at indicative sensitive receptors; OR Change in air emission concentrations or deposited dust predicted to exceed relevant[a] AQS at non-sensitive receptors, with process contribution less than 25%[b] of AQS.	Minor benefit or improvement predicted in Air Quality at resource/receptor.
Negligible	No expected detectable change in measurable air emission concentrations or deposited dust to ground at sensitive or non-sensitive receptors.	

a Not all AQS will be relevant for each receptor type e.g. transient receptors will not be present in a location for more than one year and therefore the annual AQS will not be applicable.
b In alignment with IFC EHS Guideline: Air Emissions and Ambient Air Quality

7.1.5 Key Guidance and Standards

The Kenyan policy and legislation documents presented in Section 2.2 and the international guidance and standards presented in Section 2.3 are relevant to this assessment. The following are of particular relevance:

- Kenyan Government EMCA, 1999 and Amendments, 2018;
- Kenyan Government, Environmental Management and Co-ordination (Air Quality) Regulations, 2014;
- WHO Air Quality Guidelines Global, 2005;
- IFC PSs, 2012; and
- World Bank Group Environmental, Health, and Safety General Guidelines (WBG EHS Guidelines), 2007.

The Project standards (also in Annex I) are presented in Table 7.1-3. All emissions are calculated and reported at the 100th percentile, except for 24-hour PM_{10}, which is reported at the 99th percentile.

Table 7.1-3: Summary of AQS Adopted for Human Health

Emission	Time weighted average	Concentration ($\mu g/m^3$, unless stated)
SO_2	Annual	50
	24-hour	20[(a)]
	10-minute	500
NO_2	Annual	40
	24-hour	188
	1-hour	200
NO_x	Annual	60
	24-hour	80
PM_{10}	Annual	20

Emission	Time weighted average	Concentration (µg/m^3, unless stated)
	Annual IFC Interim Target 2	50
	24-hour[(a)]	50
	24-hour IFC Interim Target 2	100
$PM_{2.5}$	Annual	10
	Annual IFC Interim Target 2	25
	24-hour	25
	24-hour IFC Interim Target 2	50
Deposited Dust	24-hour	200 mg/m^2/day

Abbreviations: µg/m^3 = micrograms per cubic metre; mg/m^2/day = milligrams per square metre per day; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns; PM_{10} = particulate matter less than or equal to 10 microns; SO_2 = sulphur dioxide
(a) The 24-hour standard is lower than the annual as the annual standard is a Kenyan standard and the 24-hour standard is an IFC standard. The equivalent Kenyan 24-hour standard is higher than the annual Kenyan standard. As detailed in Annex I, the Project standards consider the most conservative of the available standards

There are no specific IFC standards for Air Quality relating to vegetation or ecosystems. There are Kenyan standards for NO_2, SO_2, and PM_{10} in controlled areas, which include National Parks, Reserves and Sanctuaries and Conservation Areas. Due to the minor sources of emissions to air of these pollutants as a result of the Project (i.e. limited to vehicles and combustion), which will predominantly occur away from controlled areas, this has been screened out of the assessment.

Results of the baseline monitoring and how the monitoring results compare to the AQS at each location are presented and discussed in the Section 6.2.

7.1.6 Receptors of Interest and Importance

Air quality receptors within the AoI have been identified and the importance of the receptor has been defined. Higher importance receptors are considered to be areas with rare vegetation species that are susceptible and sensitive to changes in air quality concentrations and any specific locations where people reside or spend periods of time (for example, for the purposes of grazing). Lower importance receptors are areas where there are no sensitive vegetation species identified.

Receptors included in the assessment, where present, are defined in Table 7.1-4 and summarised as follows:

- Homesteads - PAP;
- Transient human receptors/PAP - due to the prevalence of nomadic pastoralism in the region and the associated transience of settlement, all areas where transient receptors could be present have been included in the construction and operational assessment; and
- Ecological receptors - where areas of protected and sensitive ecological receptors are present and screened into the assessment. Due to the location of the ecological receptors, only the effects of dust emissions will be considered, as there are no Project combustion sources (excluding vehicle emissions, which have been screened out of this assessment in Section 7.1.10.1) planned in the vicinity of the protected areas and species.

Table 7.1-4: Receptors and Importance

Receptor	Importance	Comment
Rare or Sensitive Vegetation	Very High	Impact on critical habitat and species that trigger critical habitat, e.g. *Euphorbia turkanensis*.
Homesteads	High	Human health impact on PAP at identified homesteads.
Transient Human Receptors	High	Human health impact on people using areas anywhere outside of the Project fence-line for grazing / livelihoods.
Vegetation located in protected areas	High	Vegetation and biodiversity species located in a protected area, including the Nasolot NR and the South Turkana NR
Human Amenity receptors	Low	Not a human health impact but an impact relating to the loss of amenity and nuisance through dust deposition and soiling.
Other vegetation species	Low	Vegetation species that are not rare and are not sensitive or located in a protected area.

As far as possible, Project infrastructure has been routed and located to minimise the impact to homesteads and sensitive areas of biodiversity and cultural importance. Within the AoI the following permanent receptors are present:

- Colonies of *Euphorbia turkanensis*;
- The Nasolot NR;
- The South Turkana NR;
- The Pellow Conservancy; and
- PAP.

7.1.7 Sources of Impacts

Potential sources of impact of a range of magnitudes will occur throughout the life of the Project are set out below by Project phase.

7.1.7.1 Construction Phase

Based on the Project Description and the understanding of the baseline air quality conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to air quality during the construction phase. The potential sources of impact and routes by which they could impact air quality are as follows:

- Dust generated during construction of Project infrastructure, including the water pipeline, wellpads, infield pipework, the CFA and associated infrastructure, the landfill and upgrades to the airstrip. The airstrip is not under TKBV ownership but currently leased and is therefore an associated facility. It will be included in this assessment and any mitigation measures identified will be included with a commitment on TKBV to exert influence on the current owners to consider inclusion of the identified measures in the upgrade works. Construction activities include, for example, clearance, trenching, backfilling, concreting and concrete batching at the CFA;
- Vehicle emissions during the construction phase;

- Three diesel generators powering well drilling, each located at a separate wellpad; and
- Three ground flares associated with well testing, each located at a separate wellpad.

7.1.7.2 Operational Phase

Based on the Project Description and the understanding of the baseline air quality conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to air quality during the operational phase. All potential sources of emissions to air will not occur simultaneously but at different times throughout the life of the Project. The potential sources of impact and routes by which they could impact air quality are as follows:

- An enclosed ground flare located in the CFA comprising the main flare and the acid gas flare;
- Two SGT-700 GTGs with associated waste heat recovery units located at the CPF/CFA;
- An incinerator located at the IWMF;
- Two heaters located at the CPF/CFA;
- A MS5001 crude fired turbine, including waste heat recovery unit;
- An emergency diesel generator;
- Vehicle emissions during the operational phase; and
- Dust generating during operations from traffic on roads.

7.1.7.3 Climate Change

Climate change predictions with respect to meteorological data can be highly variable. The uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Niño events. Most climate predictions suggest there will be an increase in temperature and rainfall and of extreme weather events (i.e. rainfall intensity and droughts). The following air quality related impacts may be experienced:

- An increase in summer and winter rainfall volume and periods of higher intensity rainfall (storms) could lead to increased dust dampening and suppression. This could result in less dispersion of dust as the increased rainfall would result in particles being less available to be entrained by the air;
- In the summer, higher air temperatures could result in changes to atmospheric chemical reactions; and
- Changes to wind speed could change the dispersion patterns of pollutants.

7.1.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.1.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on air quality:

- All point source emissions to air will operate in compliance with the relevant Kenyan and IFC emission limits;

- Use of an enclosed ground flare provides high efficiency combustion with a high destruction efficiency;
- Point source emission to air will be monitored in accordance with Kenyan and IFC requirements; and
- Construction works will be staggered.

7.1.8.2 Good International Industry Practice

Project activities will consider the measures defined below, to reduce the potential for creating an impact:

- A permanent water supply will be available and dampening down of roads and construction areas will be undertaken if large quantities of resuspended dust are reported or observed;
- Prompt removal of materials that have a potential to produce dust (including spoil), unless being re-used on site;
- No waste burning will be undertaken, outside of the incinerator;
- Where practical, trucks transporting dusty material associated with the Project will be covered to prevent escape of materials during transport, vehicles will be serviced and maintained, idling will be avoided, and speed limits will be adhered to;
- Daily site inspections will be undertaken by the Environmental Clerk of Works (ECoW) when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions and additional wetting will be undertaken if required; and
- Generators will be operated, maintained and tested in accordance with the manufacturer's recommendations and using the appropriate fuel.

7.1.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were identified during the EOPS and LLCOP consultation meetings and should only be use as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations:

- Stakeholders requested information on mitigation measures put in place to reduce impact of gases such as carbon monoxide and carbon dioxide produced by the Project;
- Questions regarding considerations undertaken by the Project proponent to address dust issues during construction;
- Questions regarding monitoring plans in place to address gas emissions;
- Comment on glass flaring and its effects on health; and
- Concern regarding noise and air (gas) pollution and potential risks to communities.

7.1.10 Impact Classification

Taking into account baseline air quality (Section 6.2), the relevant incorporated environmental measures (Section 7.1.8) and the potential sources of impact (Section 7.1.7) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

A separate assessment of Greenhouse Gas Emissions is presented in Annex I.

7.1.10.1 Construction

The impact classification process focuses on the potential impacts to air quality that could result in significant impacts. As such some potential impacts can be "*scoped out*" where there is insufficient linkage between the source of impact and receptors, or the magnitude of this impact would be negligible when taking account of incorporated environmental measures.

The following bullets provide qualitative evaluation of impacts which are not considered for further impact classification:

- Fugitive generation of odour is considered to be **Negligible** as the construction process is not anticipated to generate odours.
- In the absence of any International or Kenyan guidance, the UK Design Manual for Roads and Bridges (DMRB) screening criteria has been used to determine the level of assessment required for public roads based on the projected additional traffic flows associated with the development. The additional traffic flows are assessed against the following assessment screening criteria:
  - Existing road alignment will change by 5 m or more;
  - Daily Light Goods Vehicle (LGV) traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more;
  - Heavy Goods Vehicle (HGV) flows will change by 200 AADT or more;
  - Daily average speed will change by 10 km/hr or more; or
  - Peak hour speed will change by 20 km/hr.

The AADT is the total traffic flow for the year (2-way) divided by 365 and is the industry specific way of comparing or describing traffic flows on roads. If none of the above screening criteria are met, then a detailed assessment is not required.

The estimated maximum number of truck journeys per year in the construction period is approximately 31,000, which equates to an AADT of 85, which is below the screening criteria. The annual number of vehicle trips could be as high as 73,000 before a detailed traffic assessment would be required. No changes are anticipated to the alignment of the public roads and it is not anticipated that there will be any increases to the speed limit on public roads. Therefore, a further detailed assessment is not required and this has been assessed as **Negligible**.

Deposited Dust

Dust typically comprises particles ranging from 1 to 75 micrometres (µm) in aerodynamic diameter, which are formed through a mixture of crushing and abrasive forces on materials. Due to the relatively large particle size of dust, dust particles are airborne for short durations following initial release to the atmosphere. The larger dust particles generally fall out of suspension rapidly and in relatively close proximity to the emission source (usually within 250 m).

Dust particles, therefore, are unlikely to cause long-term or widespread changes to local air quality and have little effect to human health; however, the deposition of dust particles can result in the local soiling of surfaces which may result in complaints due to amenity loss or perceived damage caused and very high levels of dust can result in damage to plants, through reduced photosynthesis. During construction, the potential for dust impacts are likely to be transient and sporadic. During site operations dust impacts may be intermittent at nearby receptors if emissions are not adequately mitigated and managed.

For the purpose of this assessment, potential dust impacts are considered to be significant where sensitive human and ecological receptors are located within 250 m from the Project and international air quality guidelines for dust have been adopted as the working air quality standard (in the absence of a relevant Kenyan standard).

The transport of dust emissions is determined primarily by the following local meteorological conditions surrounding the development Site:

- The wind speed determines the likely entrainment and deposition of dust and the distance of travel from the Site;
- The wind direction controls the area over which the dust particles are carried; and
- Moisture/precipitation influences adhesion (i.e. less likely to be entrained) and deposition (via rainfall) of particles in the air.

In the qualitative assessment of construction impacts, wind data has been considered from an MMIF modelled meteorological station for the Project location (consistent with the Air Dispersion Model (ADM)) and the Ngamia and Kapese monitoring stations. Precipitation will suppress dust and prevent it from becoming airborne, as well as increasing the rate at which dust is deposited onto ground surfaces (i.e. no longer airborne) due to surface wetting. Precipitation levels of in excess of 6 mm/month are considered sufficient to effectively suppress potential airborne dusts for most of the year. According to the 5-year average MMIF dataset and the 2018 Ngamia and Kapese data the greatest amount of rainfall occurs between March and June, with a peak again in November. The driest periods, according to all datasets are between December to February and the Ngamia dataset also shows low rainfall in July to September. For all months, excluding January (all data sets), February (Kapese), July (Kapese), September (Ngamia) and December (Kapese) the monthly average rainfall is above the 6 mm threshold described, acting as a natural dust suppression mechanism.

The wind roses provided in Figure 7.1-1 indicate the prevailing wind direction. There is variation between the sources but they all indicate a similar north-easterly to south south-easterly prevailing wind direction. With a dominant north-easterly to south south-easterly wind direction, it is considered likely that any dust sensitive receptors located to the north-west to south-west of the Project are most likely to be affected by deposited dust emissions associated with the construction and operation of the Site. There are several PAP and biodiversity receptors located downwind of construction activities.

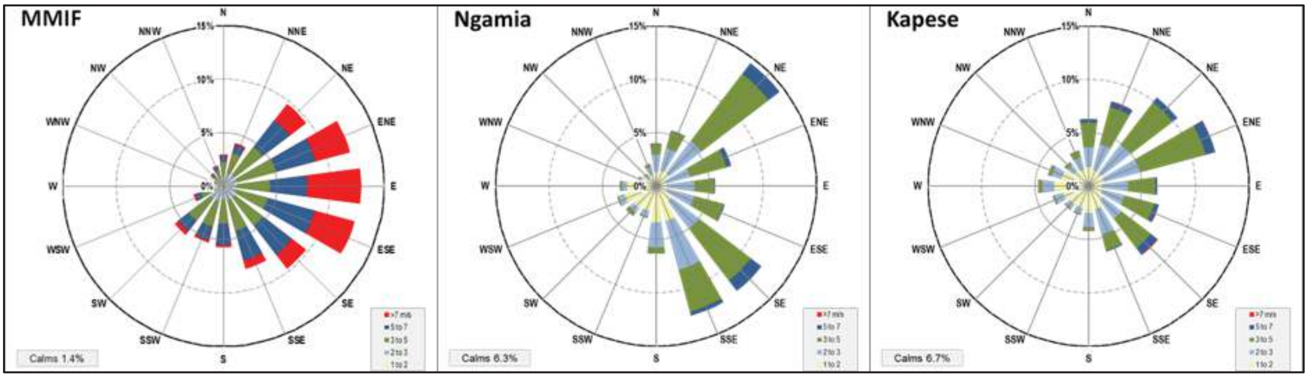

Figure 7.1-1: Windrose for MMIF, Ngamia and Kapese Meteorological Data

Details of specific construction works and timescales are not available at this time although construction of the Project including the water pipeline will be phased and there will not be prolonged construction activities in each location. The potential for impacts from dust emissions to air are likely to be generated predominantly by land clearance activities, trenching and backfilling and on-site transport vehicle movements, construction of wellpads and construction of associated Project infrastructure.

Including incorporated measures, air quality changes will result in a low magnitude impact on *Euphorbia turkanensis* communities to the north and west of the water pipeline, which, due to the very high importance of this receptor, returns a moderate impact significance. To mitigate for this potential impact, TKBV will complete a pre-construction survey to map species distribution along the RoW and within 250 m of water pipeline route by the Biodiversity Clerk of Works (BCoW). Once mapped, vegetation will be monitored by the BCoW to identify if dust deposition is having an adverse impact on plant health. Current understanding of plant distribution, which is primarily along roadsides, indicates it has some tolerance for dusty environments. If, however, an adverse impact is observed during monitoring, suitable mitigation strategies will be proposed. This may include the use of fine netting or may require translocation of potentially affected *Euphorbia turkanensis* communities in accordance with the Biodiversity Management Plan (BMP). After mitigation is implemented, the residual impact significances will be **Minor**.

With the incorporated best practice, air quality changes will result in a negligible impact magnitude on colonies of *Euphorbia turkanensis* that are located to the south to east of the water pipeline. Due to the very high importance of this receptor, a **Minor** impact significance is expected, and no further mitigation is proposed.

Including incorporated measures, air quality changes will result in a low impact magnitude on the areas of the Nasolot NR that are located to the north and west of the water pipeline. Due to the high importance of this receptor, a **Minor** impact significance is predicted. It is proposed that a survey of plant communities within 250 m of the section of the water pipeline RoW that is within the Nasolot NR is undertaken by the BCoW to identify if there are any rare species or those highly sensitive to changes in dust concentrations that could be impacted. Monitoring will be carried out to observe if any adverse impacts are experienced, with proportionate mitigation measures enacted if plant health is considered to be at risk. Potential measures include netting or being relocated under the guidelines of a Biodiversity Management Plan. With the proposed mitigation in place, the residual impact significance will be **Negligible**.

Including incorporated measures, air quality changes will result in a negligible impact magnitude on the areas of the Nasolot NR that are located to the south and east of the water pipeline. Due to the high importance of these receptors, a **Negligible** impact significance is expected.

With the incorporated best practice, air quality changes will result in a low to negligible impact magnitude on permanent or transient receptors located within 250 m of construction of Project related infrastructure. A communication plan will be produced and implemented involving relevant traditional leaders and local administrative leaders to inform local PAP and pastoralists of the Project construction schedule and duration.

Table 7.1-5: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Euphorbia turkanensis communities within a buffer around the water pipeline to be determined as a dust deposition zone during pre-construction surveys, which will include the RoW and a 250 m buffer either side of the water pipeline route RoW (very high)	Dust from the construction of the water pipeline	Low (short term, temporary, direct)	Moderate	A pre-construction survey will be undertaken to further understand and identify species distribution along the RoW and within 250 m of the water pipeline RoW route. Once mapped, suitable mitigation strategies will be proposed, if required. This may include the use of fine netting or may require translocation or propagation of cuttings of potentially affected *Euphorbia turkanensis* communities, by a BCoW, under the guidelines of the BMP.	Negligible (short term, temporary, direct)	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Nasolot NR within a buffer around the water pipeline to be determined as a dust deposition zone during pre-construction surveys, which will include the RoW and a 250 m buffer either side of the water pipeline route RoW (high)	Dust from the construction of the water pipeline	Low (short term, temporary, direct)	Minor	A survey of plant communities within 250 m of the water pipeline RoW that lies within the Nasolot NR will be undertaken, by a BCoW. Any rare species or those highly sensitive to changes in dust concentrations will be monitored and, if required, netting, translocation or propagation of cuttings of specific species may be undertaken by the BCoW, under the guidelines of a BMP.	Negligible (short-term, temporary, direct)	Negligible
PAP located within 250 m either side of construction (high)	Dust from the construction of Project related infrastructure	Low- Negligible (short term, temporary, direct)	Minor-Negligible	Produce and implement a communication plan and protocols involving relevant traditional leaders and local administrative leaders to inform local PAP of the Project construction schedule and duration.	Low- Negligible (short term, temporary, direct)	Minor-Negligible
Transient receptors located within 250 m either side of construction (high)	Dust from the construction of Project related infrastructure	Low- Negligible (short term, temporary, direct)	Minor-Negligible	Produce and implement a communication plan and protocols involving relevant traditional leaders and local administrative leaders to inform local pastoralists of the Project construction schedule and duration	Low- Negligible (short term, temporary, direct)	Minor-Negligible

7.1.10.2 Operational Phase

The impact classification process focuses on the potential impacts to air quality that could result in significant impacts. As such some potential impacts can be "*scoped out*" where there is insufficient linkage between the source of impact and receptors, or the magnitude of this impact would be not significant when taking account of incorporated environmental measures.

The following bullets provide a qualitative evaluation of impacts which are not considered for further impact classification:

- Assuming facilities, in particular waste management facilities are managed in line with the commitments in the Project Description and GIIP for waste facilities, fugitive emissions of odour are considered to be **Negligible** as the operational process is not anticipated to generate high levels of odour.
- There are no operational Project emissions which will impact on areas of known rare or sensitive vegetation and therefore potential impacts on biodiversity are considered to be **Negligible**.
- All PAP which are outside of the $PM_{2.5}$. contour area shown in Figure 7.1-3 (currently excluding identified PAP H19.1, H33.1 and H50.1) will have limited exposure to pollutants, excluding 24-hour $PM_{2.5}$, 24-hour PM_{10} and annual PM_{10} (which is carried forward for further assessment). Therefore, the impact magnitude will be low and the significance of the impact will be **Minor**. There is no mitigation to be applied to these receptors and therefore there will be no further impact classification.
- Transient receptors will have limited exposure to all emissions to air quality pollutants excluding 24-hour $PM_{2.5}$. Therefore, the impact magnitude will be low and the significance of the impact will be **Minor**. There is no mitigation to be applied to these receptors and therefore there will be no further impact classification.

Results for air quality within the Project fence-line is outside the scope of this ESIA and will be considered separately in the context of occupational health and managed through the occupational health management plan (worker health and safety plan).

All PAP within the Project footprint will be relocated prior to construction (Section 7.9). These PAP have therefore not been considered in this section.

Point Source Emissions

For the assessment of operational emissions from the Project infrastructure, a quantitative Air Dispersion Modelling Assessment has been undertaken by Worley Parsons as part of FEED using the Lakes Environmental AERMOD software (version 9.6.5). The model input data is presented in Annex I. Golder has not independently verified the data used in the assessment however Golder has adopted the outputs of the assessment completed by a recognised competent consultancy, with the assumption that Quality Assurance (QA) checks were completed by Worley Parsons. Golder has undertaken a sensitivity analysis to consider a revision to the design-height of some of the buildings included in the model. Where this analysis indicates a wider impacted area or a higher impact and significance, the results of this analysis have been used in this assessment. A comparison of the modelled building heights is provided in Annex I.

Emissions have been considered from the following three scenarios:

1) Scenario 1A: Peak gas scenario (Year 3) plus wellpad operations and IWMF incinerator:
    - 2 x SGT-700 Gas turbines;
    - 2 x gas-fired heaters;
    - Enclosed flare burning fuel gas and acid gas;

- IWMF incinerator; and
- Well test operations at 3 wellpads (including one diesel generator and one flare at each of the wellpads).

2) Peak flare scenario (Year 1) plus wellpad operations and IWMF incinerator:
   - 2 x SGT-700 Gas turbines;
   - 2 x gas-fired heaters;
   - Enclosed flare burning fuel gas and acid gas;
   - IWMF incinerator; and
   - Well test operations at 3 wellpads (including one diesel generator and one flare at each of the well-pads).

3) Peak crude scenario (Year 10) plus IWMF incinerator:
   - 1 x SGT-700 Gas turbines;
   - 1 x gas-fired heater;
   - 1 x MS5001 crude oil fired turbine;
   - Enclosed flare burning fuel gas and acid gas; and
   - IWMF incinerator.

Modelled emissions include:

- nitrogen oxides (NO_x);
- nitrogen dioxide (NO_2);
- sulphur dioxide (SO_2);
- fine particulates (PM_{10} and $PM_{2.5}$) and
- carbon monoxide (CO).

A standard ADM assumption has been adopted in the assessment, which is that 70% of NO_x is converted to NO_2 in the long-term and 35% in the short-term. Meteorological data used in the assessment is MMIF modelled data for the Site and the windrose is presented in Figure 7.1-1. Five years of data is used to account for inter-annual variability in the data. Terrain data has also been incorporated into the assessment. Emission rates used in the assessment are detailed in Annex I.

The ADM uses the emissions source data and the meteorological data to predict the potential effect of emissions on air quality across the modelled domain. A receptor grid has been included, centred on the CFA and TAN fields, from which contour plots of predicted concentrations have been generated. The Three Dimensional (3D) modelled domain is presented in Figure 7.1-2.

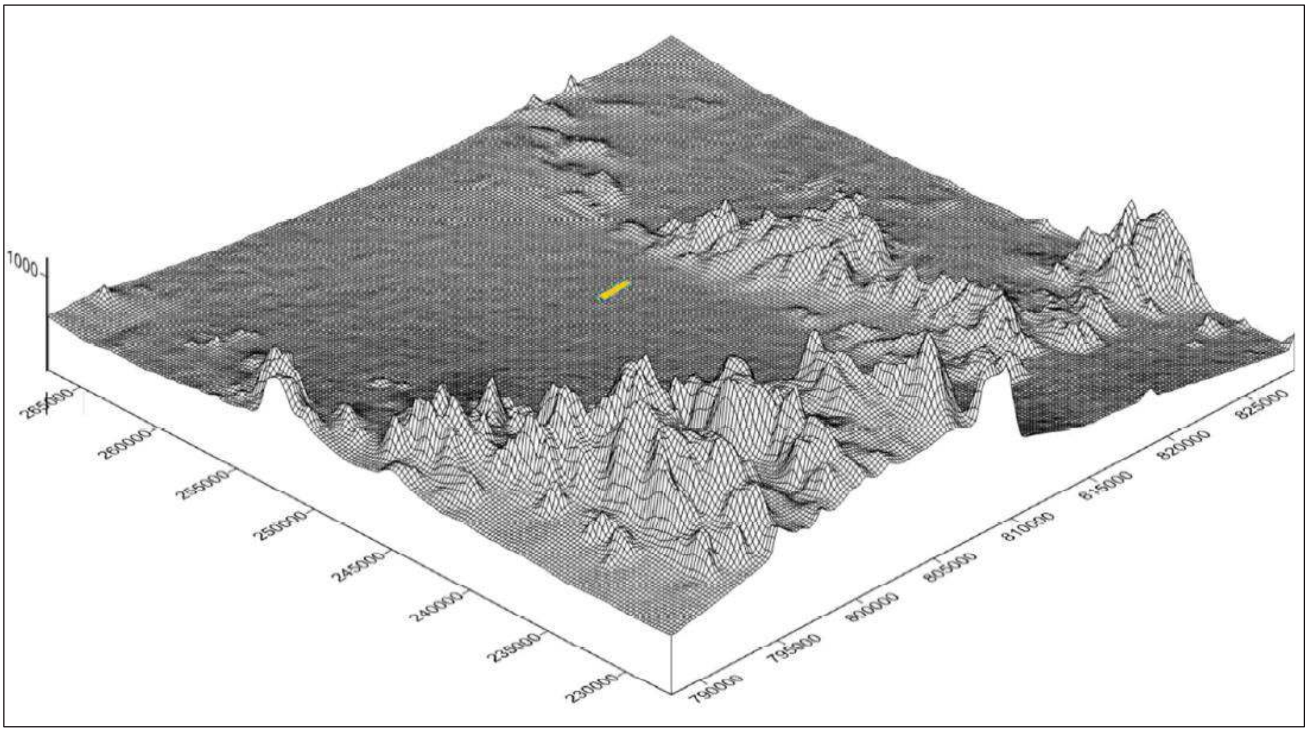

Figure 7.1-2: Model Domain (Source: Worley Parsons)

The ADM predicts the contribution from the site, known as the Process Contribution (PC), to ambient air quality as a ground level concentration attributable to the modelled Project source. For the assessment of each pollutant considered, the PC is added to the existing background concentration (detailed in Section 6.2), to calculate the Predicted Environmental Concentration (PEC), which is the contribution from the site plus the existing air quality environment. The PEC is then compared to the adopted AQS for the Project. The AQS indicates the degree of environmental effect that can be considered acceptable for the pollutant of concern at a receptor.

NO_2, SO_2 and CO PECs for all relevant averaging periods are predicted to be above the existing baseline but below the Project AQS and therefore a low impact magnitude. Therefore, the resulting impact significance on all impacted receptors (permanent PAP transient PAP and vegetation) is **Minor** to **Negligible** (dependent upon receptor importance).

PM_{10} and $PM_{2.5}$ background values for 24-hour and annual averaging periods are greater than the Project AQS resulting in the PEC always exceeding the AQS. As discussed above, the PCs from the facility are only a small proportion of the AQS and therefore the exceedance is considered to be driven by the existing high background levels. Elevated particle concentrations (PM_{10} and $PM_{2.5}$) could relate to specific meteorological events, such as periods of high wind speeds or dry periods. Monitoring was undertaken over 24-hour periods and it may be that these coincided with periods of higher than average particulates. A snapshot of PM_{10} and $PM_{2.5}$ baseline data for 24 hours is to be acquired at the TAN fields prior to commencement of the Project in order to confirm this assertion.

The PM_{10} 24-hour and annual average PEC for each scenario is above the AQS but the PC is below 25% of the AQS. Therefore, this results in a low-medium impact magnitude and **Moderate** to **Minor** impact significance (dependent upon receptor importance). The additional baseline monitoring proposed above will confirm the impact significance level. No further mitigation is proposed as the significance is driven by the existing background data. Elevated concentrations of PM_{10} and $PM_{2.5}$ are common in ASAL; over 80% of Kenya's land area is classified as ASAL.

The $PM_{2.5}$ 24-hour average PC for each scenario is above 25% of the AQS for a small area around the CFA (Figure 7.1-3). This area incorporates three indicative PAP (H19.1, H33.1 and H50.1) outside the infrastructure footprint, according to the 2018 data. Therefore, this results in a high impact magnitude (on a high importance receptor) and **Major** impact significance.

In order to mitigate this impact, receptors should be identified as part of the household surveys to be completed at the cut-off date relating to the Livelihood Restoration Plan and in line with commitments in the Land Acquisition and Resettlement Framework (LARF) and those identified in the Land Impact Assessment (Section 7.9). If these homesteads are still present in the area, or new homestead have been established, these will be relocated outside of the contour area defined in Figure 7.1-3, resulting in a **Minor** residual impact significance. No further mitigation is proposed.

The same area of exceedance is open to transient receptors, resulting in a high impact magnitude and **Major** significance. Implementation of the Influx Management Plan (as detailed in the social impact assessment), as well as putting effective communication plans to engage traditional leaders and local administrative leaders and signage in place prior to operations to inform people of the risks of staying in the area for more than 24 hours will result in a **Minor** residual impact significance. No further mitigation is proposed.

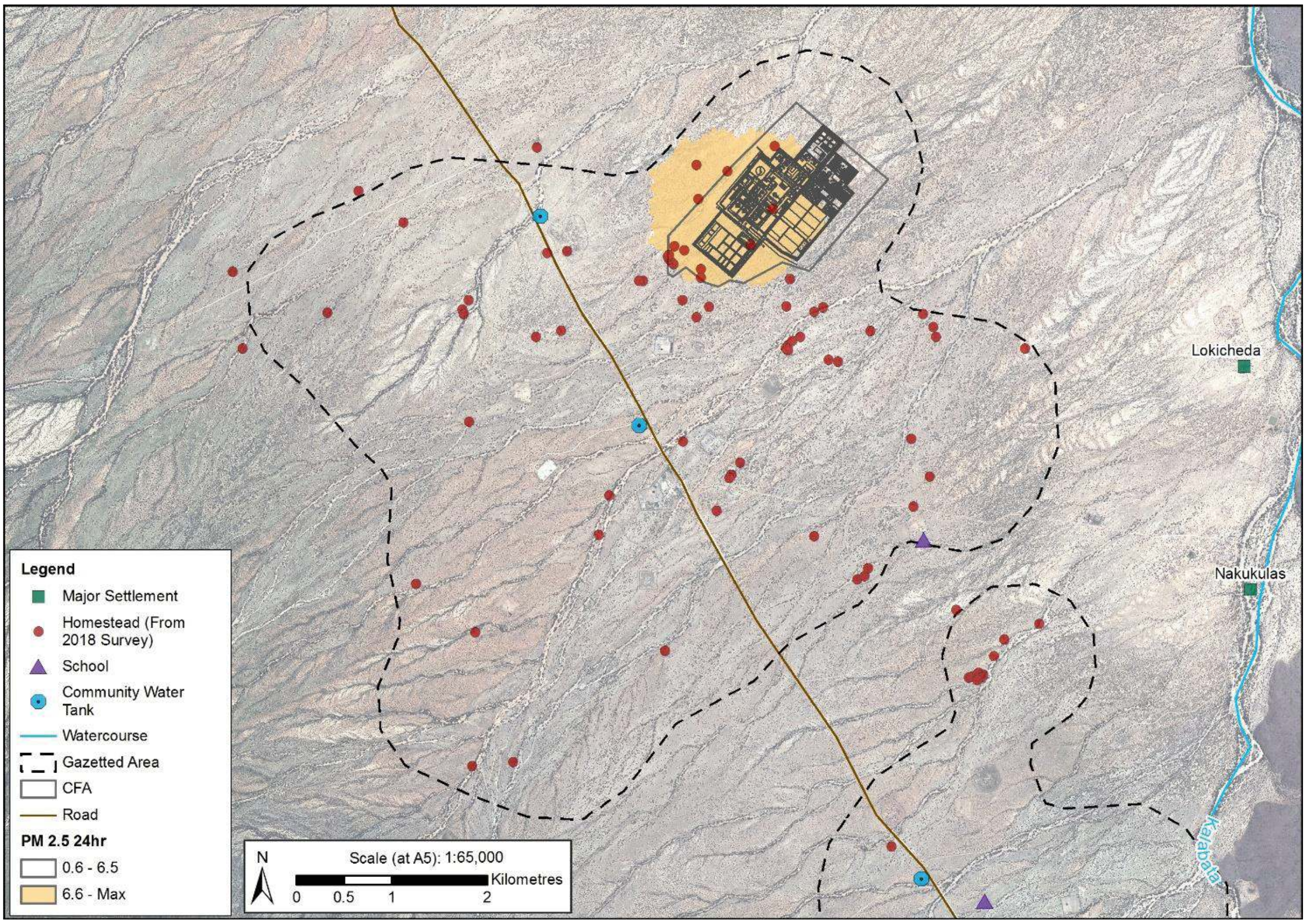

Figure 7.1-3: C1-1-Wi 24-hour $PM_{2.5}$ Area Where PC is Greater Than 25% of the AQS and Indicative Locations of PAP

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Table 7.1-6: Operational Phase Impact Assessment.

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Homesteads H19.1, H33.1 and H50.1 - PAP (high)	Emissions of $PM_{2.5}$ for 24-hour averaging period	High (medium term, temporary, direct)	Major	Identification and resettlement of homesteads that are located within the $PM_{2.5}$ contour area shown in Figure 7.1-3 outside the area of low impact. This will be considered as part of the LARF and LRP. Further details regarding the LARF are provided in the social impact assessment.	Low (medium term, temporary, direct)	Minor
Transient Receptors (high)	Emissions of $PM_{2.5}$ for 24-hour averaging period	High (medium term, temporary, direct)	Major	Implementation of the Influx Management Plan. TKBV will develop communication plans to engage traditional leaders and local administrative leaders and install signage put in place prior to operations to inform people of the risks of staying in the area for more than 24 hours	Low (medium term, temporary, direct)	Minor

7.1.10.3 Decommissioning

The Project has an operational design life of 25 years. At this stage it is not possible to anticipate the situation at that time. However, should any ground disturbance or demolition be required which will result in deposited dust, the mitigation measures implemented during the construction phase (or GIIP) will be applied during decommissioning. No sources of emissions to air are anticipated in addition to those already assessed.

7.1.11 Summary of Mitigation

The following mitigation measures are proposed for the Project:

- Identified homesteads within the area defined in Figure 7.1-3 (Indicative PAP H19.1, H33.1 and H50.1) will be considered as part of the LARF and LRP;
- Implementation of the Influx Management Plan;
- TKBV will develop and implement a communication plan and protocols involving relevant traditional leaders and local administrative leaders to inform local PAP of construction schedule and duration, as well as during operations to inform PAP of the risks of staying in the area defined in Figure 7.1-3 for more than 24 hours. Signage will also be installed prior to operations to inform them of these risks;
- Pre-construction survey of *Euphorbia turkanensis* communities within 250 m of the water pipeline RoW route, by a BCoW, under the guidelines of a BMP. Monitoring of impacts from dust deposition, with erection of netting and relocation potential measures to reduce any impacts observed; and
- Pre-construction survey of rare and dust sensitive plant species within 250 m of the water pipeline route through the Nasolot NR, by a BCoW, under the guidelines of a BMP. Monitoring of impacts from dust deposition, with erection of netting and relocation potential measures to reduce any impacts observed.

7.1.12 Summary of Residual Impacts

The Project has the potential to impact the air environment in the following ways:

- Through the generation of dust and increased deposited dust concentrations relating to the construction phase; and
- By changing the local air quality concentrations through the emissions to air from exhaust emissions of equipment located at the CFA and wellpads.

The residual impact significance that results from the combination of receptor importance and predicted impact magnitude is classified as **Minor**.

7.2 Noise and Vibration

7.2.1 Introduction

This section considers the potential impacts within the noise and vibration AoI arising from noise and vibration sources associated with the Project. Specifically, environmental noise and blasting induced vibration impacts relevant to human receptors are assessed. Where potential impacts have been identified, these are considered in turn and mitigations are set out where necessary to ensure that any potential impacts are reduced as far as practicable.

7.2.2 Area of Influence

The noise and vibration AoI comprise the areas within 3 km of the water pipeline RoW, the CFA, wellpads, IWMF, and all associated infrastructure. This incorporates the areas beyond where it is expected that noise and vibration from Project sources will attenuate to a level below the ambient noise level or below a detectable vibration level. This area is encompassed in the Project AoI as defined in Section 3.

7.2.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.2-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.2-1: Criteria for Determining Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ Noise or vibration sensitive receptors with a high quality and rarity, regional or national scale and limited potential for substitution/replacement. (not applicable to this Chapter)
High	■ Human health of permanent (residential) or transient noise and vibration sensitive receptor; ■ Noise or vibration sensitive receptor with a high quality, local scale and limited potential for substitution/replacement. ■ Noise or vibration sensitive receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement; and/or ■ Essential services/infrastructure susceptible to changes in noise or vibration (i.e., Turkwel Dam).
Medium	■ Noise or vibration sensitive receptor with a medium quality and rarity, local scale and limited potential for substitution/replacement. ■ Noise or vibration sensitive receptor with a low quality and rarity, regional or national scale and limited potential for substitution/replacement; and/or ■ Permanent or transient residential structure.
Low	■ Noise or vibration sensitive receptors of local, limited or no known importance; and/or ■ Noise or vibration sensitive receptor with a low quality and rarity, local scale.

7.2.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.2-2.

The magnitude effects criteria have been developed in accordance with the key guidelines discussed in Section 7.2.5, as well as general guidance provided from various directives for noise and vibration assessments[1]. The following are other criteria considered when assessing the potential overall impact of the Project on noise and vibration.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period). The CFA/CPF will be constructed within the first 36 months;
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project.

Table 7.2-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria [1]	
	Noise	Vibration
High	Project related change in daytime and/or night-time equivalent noise level >10 dB above baseline or exceeds applicable noise limit at permanent sensitive receptors	Project related ground vibration level of > 10.0 mm/s for ground vibration (level of human perception) and air overpressure >150 decibels linear (dBL) at permanent sensitive receptors. May influence related design decisions regardless of any possible mitigation
Medium	Project related change in daytime and/or night-time equivalent noise level >5 dB and ≤10 dB and meets applicable noise limit at permanent sensitive receptors	Project related ground vibration level >5 and ≤10 mm/s and air overpressure >117 and ≤150 dBL at permanent sensitive receptors. Should influence decisions on Project design unless mitigated. An impact or benefit which is sufficiently important to require management

[1] For noise assessment, the 3 dB, 5 dB and 10 dB intervals are informed by Bies and Hansen (2009)

Magnitude of Impact	Description Criteria [1]	
	Noise	**Vibration**
Low	Project related change in daytime and/or night-time equivalent noise level >3 dB and ≤5 dB and meets applicable noise limit at permanent sensitive receptors	Project related ground vibration level >0.5 and ≤5 mm/s and air overpressure >90 and ≤117 dBL at permanent sensitive receptors and meets the Project guidelines. Impacts with little real effect and which should not have an influence on or require modification of the Project design or alternative mitigation
Negligible	Project related change in daytime and/or night-time equivalent noise level ≤3 dB and meets applicable noise limit at permanent sensitive receptors	Project related ground vibration level <0.5 mm/s (level of human perception) and air overpressure <90 dBL at permanent sensitive receptors.

7.2.5 Key Guidance and Standards

Noise

The Kenyan policy and legislation documents presented in Section 2.2 and the international guidance and standards presented in Section 2.3 are relevant to this assessment. The following are of particular relevance:

- Kenyan Government EMCA (1999) and Amendments, 2018;
- *Kenya Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations* dated 2009 (Kenya Noise Regulations);
- IFC PSs, 2012; and
- WBG EHS Guidelines, 2007.

Golder previously carried out a review of the WBG EHS Guidelines and Kenya Noise Regulations, recommending the use of the WBG EHS Guidelines for Project operation (Golder tech memo 1654017.511 provided in Annex I). This was subsequently confirmed with the Kenya NEMA in a minuted meeting that the WBG EHS Guidelines could be used as Project standards for the EOPS Phase II ESIA (Ref. 1654017.718) and they have therefore been adopted for this Project also.

Permanent noise-sensitive receptors identified for the noise impact assessment are best categorised as "*residential; institutional; educational*" under the WBG EHS Guidelines, with noise level limits as presented in Table 7.2-3.

Table 7.2-3: WBG EHS Guidelines Noise Limits for Operation

Receptor Type	Noise Limit (dBA; $L_{Aeq,1hr}$) [a]	Reference Period
Residential; institutional; educational	55	Daytime (07:00 to 22:00)
	45	Nighttime (22:00 to 07:00)

[a] WBG EHS Guidelines allows for either the sound level limits presented here or a maximum increase in background levels of 3 dB at the nearest receptor location off-site.
LAeq = A-weighted, equivalent continuous sound level

The Project standards (also in Annex I) adopt the noise level limits presented in Table 7.2-3 at off-site permanent receptor locations during Project operations and considers these as the applicable noise level limits for the magnitude criteria for the impact assessment presented in Section 7.2.4.

The WBG EHS Guidelines does not explicitly provide construction noise level limits and therefore the construction limits provided in the Kenya Noise Regulations (Table 7.2-4) have been taken to assess the construction phase. *Section 13 (1)*, *Section 14 (1)* and *Second Schedule – Maximum Permissible Noise Levels for Construction Sites* in the Kenya Noise Regulations present the applicable daytime and night-time sound level limits for construction. It is acknowledged that there may be an opportunity to allow Project construction to operate above these limits under specific conditions (i.e., apply for license), in discussion with NEMA. For the purposes of this assessment, these limits have been used as the applicable noise level limits for the magnitude criteria for the impact assessment at permanent receptors presented in Section 7.2.4.

Table 7.2-4: Kenya Noise Regulations Noise Limits for Construction

Receptor Type	Noise Limit [a] (dBA; $L_{Aeq, daytime/nighttime}$)	Reference Period
Health facilities, educational institutions, residential	60	Daytime (06:00 – 18:00)
	35	Nighttime (18:00 – 06:00)

[a] *Section 13 (1), Section 14 (1) and Second Schedule-Maximum Permissible Noise Levels for Construction Sites in the Kenya Noise Regulations present the applicable daytime and night-time sound level limits for construction.*

Note that the definition of daytime and night-time for the construction limits in the Kenya Noise Regulations differs from the daytime and night-time definition in the WBG EHS Guidelines.

There are no noise guidelines applicable to transient human receptors, and therefore the criteria for assessing magnitude of noise impacts at transient human receptors will rely solely on the change from baseline noise level presented in Table 7.2-2.

Vibration

The Kenya Noise Regulations is the relevant document that provides guidance in managing ground vibration levels at specific locations, due to blasting. Peak Particle Velocity (PPV) is considered the best measure of the impact of vibrations on residential structures.

Residential Receptors

The receptors identified for the vibration impact assessment are best categorised as "*residential*". The Kenyan Noise Regulations contain ground and air vibration limits for residential receptors which are adopted in this assessment for off-site permanent receptor locations/homesteads. These limits are presented in Table 7.2-5.

Table 7.2-5: Kenya Vibration Guidelines for Residential Blasting Vibration Limits

Receptor Type	Ground Vibration Limit (mm/s) [(a)]	Air Vibration Limit (dBL)
Residential	5 mm/s [2]	117 [3]

[2] Ground vibration is an elastic effect measured in units of peak particle velocity and is defined as the speed of excitation of particles within the ground resulting from vibratory motion. For the purposes of this assessment, ground vibration is measured in mm/s.

For context, humans perceive vibrations below the levels required to impact residential structures. The level of human perception for impulsive vibration, such as blasting, is 0.5 mm/s.

[3] Air vibration is a pressure wave travelling through the air, produced by the direct action of an explosive on air or the indirect action of a confining material subjected to explosive loading. For the purposes of this assessment, air vibration is expressed in a logarithmic scale as decibels in the Linear or Unweighted mode (dBL).

Air vibrations from surface blasting operations differ from noise in that they consist primarily of acoustic energy below a frequency of 20 Hz, where human hearing is less acute (Siskind et al., 1980). Alternatively, noise consists primarily of acoustic energy within the audible range from 20 to 20000 Hz

[a] *The Kenya Noise Regulations require that vibration levels do not exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.*

Non-Residential Receptors

While the receptors identified are primarily residential, the Turkwel Dam represents a non-residential receptor that may be impacted by the blast-induced ground vibrations from the Project. No other essential services/infrastructure has been identified. The following are typical limits set for non-residential receptors identified for the Turkwel Dam:

- Massive concrete – 130 mm/s (Richards and Moore, 2007); and
- Rigidly mounted switches – 30 mm/s (Richards and Moore, 2007).

As the Turkwel Dam is a critical part of the regional infrastructure and its current condition has not been provided, the vibration limit has been reduced to a conservative 100 mm/s. The proposed ground vibration level limits are presented in Table 7.2-6.

Table 7.2-6: Vibration Guidelines for Turkwel Dam Blasting Vibration Limits

Receptor Type	Ground Vibration Limit (mm/s) [(a)]
Concrete Structure	100
Switches	30 [b]

[a] *Richards and Moore, 2007*
[b] *Switches considered critical to the operation of the Turkwel Dam.*

7.2.6 Receptors of Interest and Importance

Noise and vibration receptors within the AoI have been identified and the importance of the receptor has been defined. Receptors of higher importance are considered to be noise and vibration sensitive locations where people live or spend long periods of time (i.e. permanent) or where people have access (for example, for the purposes of grazing) but do not spend long periods of time (i.e. transient and less than one year).

Receptors for the noise and vibration assessments are presented in Table 7.2-7 and Table 7.2-8 respectively.

Table 7.2-7: Noise Receptors and Importance

Receptor	Importance	Comment
Homesteads which are indicative of PAP	High	Noise impacts on human receptors at permanent noise sensitive receptors/homesteads
Transient Human Receptors	High	Noise impacts on human receptors at non-permanent locations.

Table 7.2-8: Vibration Receptors and Importance

Receptor	Importance	Comment
Turkwel Dam	High	Vibration impacts on the Turkwel Dam. Defined as a receptor of high importance due to the regional relevance as a source of hydro-electric power.
Permanent and Transient Residential Structures	Medium	Vibration impacts on residential structures (i.e., residential homesteads).

7.2.7 Sources of Impacts

Potential sources of impact of a range of magnitudes will occur throughout the life of the Project and are set out below by Project phase.

7.2.7.1 Construction Phase

Noise

Based on the Project Description and the understanding of the baseline noise conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to noise during the construction phase. The potential sources of impact to noise are as follows:

- The use of heavy equipment such as dozers, backhoes, excavators, graders, side boom tractors, cranes, and ancillary equipment such as generators, pumps, air compressors and welders in the construction or upgrades of the CFA, wellpads, infield flowlines, water pipeline and landfill;
- Upgrade works to the existing Kapese airstrip and associated infrastructure. The airstrip is not under TKBV ownership but currently leased and is therefore an associated facility. It will be included in this assessment and any mitigation measures identified will be included with a commitment on Tullow to exert influence on the current owners to consider inclusion of the identified measures in the upgrade works;
- The use of drilling equipment at the wellpads; and
- Truck traffic on the transport route.

Vibration

Continuous vibration (produced by road traffic, construction activities and industrial sources) propagates over comparatively small distances, in the order of tens of metres. Other than at locations immediately adjacent to the roadside, the existing vibration levels in the study area were therefore assumed to be zero.

As blasting operations for grade and ditch excavation during the construction phase will be the source of vibrations beyond those small distances, this assessment will focus on blast-induced vibrations during the construction phase. Vibration, as a potential source of impact, consists of two components: ground vibration and air vibration[4].

7.2.7.2 Operational Phase

Noise

Based on the Project description and the understanding of the baseline noise conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to noise during the operational phase. The potential sources of impact to noise are as follows:

- Routine operation of the CFA, which includes the following sources of noise:
  - CPF (compressors, air coolers, fired heaters, pumps, power generation units, valves and flare);
  - IWMF (incinerator and pumps); and
  - LEF (pumps).

[4] The term “ground vibration” is used in this document to describe vibrations that travel through the ground produced by blasting operations at the Project Site. The term “air vibration” is used in this document to describe the vibrations that travel through the air produced by the blasting operations at the Project Site.

- Operation of the wellpads, which includes sources of noise such as pumps and flow reduction valves/ multi-stage restriction orifices;
- Pumps operating at the Turkwel Dam;
- Project operations at the Kapese airstrip, which includes several flights per week. The airstrip is not under TKBV ownership but currently leased and is therefore an associated facility. It will be included in this assessment and any mitigation measures identified will be included with a commitment on Tullow to influence the current owners to consider inclusion of the identified measures in the upgrade works;
- Delivery and maintenance of waste at the landfill, which includes the use of a vibratory roller and trucks delivering waste from the IWMF; and
- Truck traffic on the transport route.

Vibration

Blasting will cease at the end of the construction phase. No impacts are expected during the operation phase.

7.2.7.3 Climate Change

Climate change is not considered relevant to this section of the ESIA.

7.2.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.2.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on noise and/or vibration:

- The water pipeline and infield flowlines will be buried, therefore mitigating operational noise;
- Construction activities will be sequentially staggered and will not take place concurrently at the same location;
- Use of a ground flare at the CFA rather than an elevated flare;
- Installation of a 6 m tall noise barrier to the west, north, and east of the ground flare during operation;
- Installation of a 10 m tall noise barrier to the west, north, and east of the power generation units during operation; and
- Locating the IWMF close to the western side of the CPF to maximise the distance between the IWMF and permanent noise-sensitive receptors.

7.2.8.2 Good International Industry Practice

Construction Measures

Environmental measures that were considered in the impact assessment of construction were the following:

- Where practical, Project equipment will be selected or designed such that they will not be the source of tonal or impulsive noise;

- Regular schedule of vehicle maintenance to ensure optimal emissions performance, including noise abatement equipment (i.e. mufflers) as provided by the manufacturer or required by the Project;
- Site-specific Scaled Distance (SD) plots will be developed as a blast design tool to predict estimated maximum peak ground vibration levels at specific distances from a blast for various respective explosive loads; and
- Where reasonable and practical, vehicles and equipment will be turned off when not in use, unless weather and/or safety conditions dictate the need for them to remain turned on.

Operation Measures

Environmental measures that were considered in the impact assessment of operation include the following:

- Where practical, Project equipment will be selected or designed such that they will not be the source of tonal or impulsive noise;
- Regular schedule of vehicle and generator maintenance to ensure optimal emissions performance, including noise abatement equipment (i.e. mufflers and silencers); and
- Where reasonable and practical, vehicles and equipment will be turned off when not in use, unless weather and/or safety conditions dictate the need for them to remain turned on.

7.2.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were captured during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- The stakeholders sought clarity on the issue of noise and air which ESIA findings had revealed were within acceptable standards. They argued Turkana was windy thus sound could travel far, and any interference of air could also be spread widely.
- Questions about how sound will be minimised during Project activities.
- Question about noise measures and buffering in place to ensure that noise produced (in decibels) do not pass NEMA limits.

7.2.10 Impact Classification

Taking into account the baseline noise setting (Section 6.3), the potential sources of impact (Section 7.2.7) determined from the Project description, and the relevant incorporated environmental measures (Section 7.2.8), the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each Project phase is presented in the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

For the purposes of the noise assessment, a semi-quantitative noise assessment has been conducted for the Project activities associated with construction of the CFA, wellpads, infield flowlines, water pipeline, Kapese airstrip, and landfill. A quantitative noise assessment has been undertaken for drilling at the wellpads during the construction phase, as well as the operation of the CFA, wellpads, Turkwel Dam, and landfill. A qualitative noise screening and assessment was undertaken (where required) for the operation of the Kapese airstrip and truck traffic on the transport route during construction and operation.

The quantitative noise assessment of drilling at the wellpads during construction and the operation of the CFA, wellpads, and Turkwel Dam was developed based on the results of noise modelling conducted as part of the FEED Worley Parsons Noise Study (Annex I). Golder has not independently verified the data used in the assessment. Where possible, Golder has adopted the outputs of the assessment completed by a recognised competent consultancy, with the assumption QA checks were completed by Worley Parsons. The Noise Study represents the final proposed design of these Project components, including noise mitigation. The modelled equipment is representative of the most significant noise sources relating to the Project.

In addition, semi-quantitative and quantitative noise assessments noise prediction modelling has been undertaken using the FEED Worley Parsons noise model and the Computer Aided Noise Attenuation (CadnaA) noise modelling software applying the modelling algorithms based on *ISO 9613 Acoustics: Attenuation of Sound during Propagation Outdoors (International Organization for Standardization 1993 and 1996)* [ISO 1993 and 1996]. The ISO 9613 prediction method is conservative as it assumes that all receptors are downwind from the noise source or that a moderate ground-based temperature inversion exists. The ground surrounding the different Project components was observed to be generally flat between the noise sources and receptor locations, therefore no localised shielding from topography was considered in the noise prediction modelling.

7.2.10.1 Construction - Noise

Noise levels are expected to increase, on occasion, due to construction activities, but construction noise will be temporary, intermittent, and limited to the vicinity of the construction activities, within the defined AoI. The range in increased noise levels associated with construction activities will depend primarily on the number and type of noise sources and their proximity to receptors (i.e. the Project noise levels in the environment generally decrease as the distance between the receptor and construction activities increases).

The Kenya Noise Regulations set out construction average noise level limits of 60 dBA during the daytime and 35 dBA during the night-time at health facilities, educational institutions, and residential type receptors. Project construction activities will need to meet this noise level limit at homesteads (2018 survey being used as indicative of PAPs) and where transient receptors could be present, unless the EPC contractor or TKBV acquire a NEMA issued licence to allow the limit to be temporarily exceeded (assumed not to be the case for the purposes of this assessment).

The construction phase noise impact assessment is presented in Table 7.2-11.

Truck Traffic on the Transport Route

The estimated maximum number of truck movements per year during the construction period is approximately 31,000, which equates to an AADT volume of 85 with the assumption it is equally distributed across the year. Baseline traffic volumes reported in the EOPS Phase II ESIA (1654017.718) ranged from 319 to 20,362 vehicles per day. With the additional 85 vehicles per day, the increase on the least travelled road results in an expected noise level increase of less than 3 dB. Truck movements during construction have therefore been screened out of the noise impact assessment, due to their expected **not significant** impact on traffic noise levels and therefore will not be considered further for impact classification.

Construction of Project Components - CFA, Wellpads, Infield Flowlines, Water Pipeline, and Landfill.

Detailed construction information, such as a list of planned equipment and schedule, is not yet defined. Therefore, a semi-quantitative assessment based on assumptions has been completed through noise modelling to predict the potential noise levels in the AoI as a result of construction phase emissions. Predictions were undertaken to assess the potential noise levels resulting from the operation of assumed typical construction equipment. The noise prediction modelling was carried out with CadnaA applying the modelling algorithm ISO 9613.

The following key assumptions were applied for construction of the different Project components:

- The sound pressure level considered to represent a single unit of typical construction equipment was 85 dBA at 15 m when operating at full power; this is representative of large off-road equipment such as dozers, excavators, graders, cranes, or generators;
- An acoustical usage factor of 40% was considered. This is representative of equipment operating for 24 minutes per hour at full power with noise levels for the remaining time considered not significant, or acoustically equivalent; and
- No nighttime construction works will be undertaken, except for within the CFA fence-line where night-time construction may occur.

It was assumed that five units of construction equipment would be operating at a location in a given 12-hour period.

The modelling predicts that there will be high and medium magnitude impact zones surrounding infrastructure during construction, which result in a **Major** or **Moderate** impact significance. Some analysis was completed to ascertain if a 5 m noise barrier could reduce the size of the high and medium impact zones.

Table 7.2-9 presents the distances of predicted construction noise contours (with medium and high magnitude) from the source, both with and without mitigation (5 m high noise barrier [5]), and the nearest identified PAP to the source.

[5] N.B such a noise barrier must be located a maximum distance of 10 m from the construction equipment and block the line of site between the construction equipment and the receptor

Table 7.2-9: Predicted Noise Impacts for Construction of Project Components

Project Component	Location	Average Baseline Noise Level (dBA)		Minimum Predicted Construction Noise Level Resulting in a High Magnitude (dBA) (a), (b)		Minimum Predicted Construction Noise Level Resulting in a Medium Magnitude (dBA) (a), (b)		Unmitigated Scenario – Approximate Distance Resulting in a High Magnitude (m)		Mitigated Scenario d – Approximate Distance Resulting in a High Magnitude (m)		Unmitigated Scenario – Approximate Distance Resulting in a Medium Magnitude (m)		Mitigated Scenario d – Approximate Distance Resulting in a Medium Magnitude (m)		Approximate Distance to Closest Receptor (m)
		Day	Night	Day	Night	Day	Night	Day	Night(f)	Day	Night(f)	Day	Night(f)	Day	Night(f)	
CFA	Ngamia	60.5	42.0	60.0	35.0	- (e)	- (f)	210	1,930	100	1,670	- (e)	- (e)	- (e)	- (e)	50
Wellpad/Infield Flowlines	Ngamia	60.5		60.0		- (e)		210		100		- (e)		- (e)		20
	Amosing	44.1		53.6 (c)		47.4 (c)		395		250		710		550		250
	Twiga	36.5		46.0 (c)		39.8 (c)		800		630		1,340		1,130		150
Kapese Airstrip (Associated facility) (g)	Kapese	55.0		60.0		58.3 (c)		210		100		250		130		130
Landfill	Ngamia	60.5		60.0		- (e)		210		100		- (e)		- (e)		110
Water Pipeline(h)	Rest of Pipeline	36.5		46.0 (c)		39.8 (c)		800		630		1,340		1,130		<20

(a) Minimum of Kenya Noise Regulations construction noise limit 60 dBA (daytime) or 35 dBA (night-time) and change in baseline noise level > 10 dB (high magnitude) or > 5 dB (medium magnitude).

(b) Construction scenario in Section 8.2.9 assessed.

(c) Change in baseline noise level (i.e., change >10 dB or >5 dB) influencing predicted construction noise level resulting in a high or medium magnitude, not the Kenya Noise Regulations construction limit.

(d) Implementation of a 5 m high noise barrier within 10 m from the construction equipment and blocking the line of site between the construction equipment and the receptor, or acoustically equivalent. As additional mitigation would still be required and due to the costs and practicalities associated with a noise barrier during construction, the 5 m noise barrier has not been taken forward into the final mitigation.

(e) Due to elevated baseline noise levels, if the predicted noise level is below the Kenya Noise Regulations construction limits, the impact will be negligible (i.e., change from baseline is less than 3 dB).

(f) Night-time working is not anticipated outside of the CFA

(g) The airstrip is not under TKBV ownership but currently leased and is therefore an associated facility. It is included in this assessment so that any mitigation measures identified are included with a commitment by Tullow to influence the current owners to consider inclusion of the identified measures in the upgrade works;

(h) Due to the higher baseline at Ngamia the distance to a high magnitude is 590 m less for the area of the water pipeline in the vicinity of Ngamia. For consistency and conservatism, the larger distance for the remainder of the water pipeline route has been applied.

The colour coding in the mitigated columns of Table 7.2-9 shows whether the 5 m barrier could be effective at reducing the high magnitude at the receptor. Green text implies an improvement that would lead to a reduction in magnitude classification, and red implies no improvement.

Therefore, with the implementation of a 5 m high noise barrier, there are still high magnitude impacts (**Major** significance) predicted for construction during the daytime of the CFA, wellpads in Ngamia and Twiga, and the water pipeline and during the night-time for construction of the CFA. While a 5 m barrier may improve the situation close to the landfill and the Kapese airstrip during the daytime, PAP within the areas subject to high magnitude noise impacts would still need mitigation to manage the impact during construction. As additional mitigation would still be required and due to the costs and practicalities associated with a noise barrier during construction, the 5 m noise barrier has not been taken forward into the final mitigation.

The **Major** significance is triggered by the difference between baseline and the predicted noise levels, rather than any exceedance of the Kenya Noise Regulations construction limit. The absolute unmitigated noise level does not exceed 60 dBA during the day which is the equivalent noise to "*normal speech conversation*" according to the EU 2008. A communication plan involving relevant Traditional Leaders and local administrative leaders will be implemented to inform PAP and local pastoralists of the Project construction schedule and to encourage avoidance or minimal exposure. Successful implementation of such mitigation would result in the significance being reduced to **Minor**. As a minimum the following needs to be communicated:

- Within 0 to 75 m from the perimeter of the following, noise levels may lead to hearing impairment if exposure occurs for a 24-hour period according to the WHO Guidelines for Community Noise, 1999.
  - The TAN wellpads
  - The infield flowlines RoW
  - The CFA
  - The landfill
  - The water pipeline RoW
- In the area directly outside this perimeter, noise will change due to the Project up to that similar to a car driving 100 km/hr on a blacktop road at a distance of 30 m but should not lead to any hearing impairment through sustained exposure.

TKBV will also exert influence to encourage the owners of the airstrip to consider the implementation of a similar communication plan.

Drilling of Wellpads

The quantitative assessment of wellpad drilling during the construction phase once the other equipment at the wellpads is installed has been undertaken using CadnaA.

The assessment considers a maximum of three drill rigs which will be operating concurrently at three separate wellpads at a given time. The locations and sequencing of the drill rigs at the different wellpads in the TAN fields are based on a Project drilling schedule. A single point source with an overall sound power level of 105 dBA is assumed to represent the entire drilling operations at a single wellpad, specifically each drill rig operating continuously, in the centre of each wellpad fence-line.

No two wellpads in Amosing or Twiga are planned to be drilled at the same time. Therefore, a total of 13 potential drilling scenarios are assessed and Figure 7.2-1 to Figure 7.2-13 present the predicted noise levels. Note that for night-time impacts, as shown in Table 7.2-9 above, a high magnitude occurs when noise levels are above 35.0 dBA at any of the wellpad locations, and a medium magnitude impact occurs at Amosing above

32.6 dBA and at Twiga above 31.2 dBA. Note that due to elevated baseline noise levels in Ngamia, if the predicted noise level is below the Kenya Noise Regulations construction limit (i.e., 35 dBA), the impact will be negligible (i.e., change from baseline is less than 3 dB).

Table 7.2-10 summarises the highest predicted noise levels and the resulting magnitude ratings at the closest indicative PAP located near wellpads in the TAN fields.

Table 7.2-10: Predicted Noise Impacts for Wellpad Drilling

Wellpad Location	Average Baseline Noise Level (dBA)		Maximum Predicted Wellpad Drilling Noise Level (dBA) [(a)]	Cumulative Noise Level (Baseline + Project) (dBA)		Change from Baseline Noise Level (dB)		Maximum Magnitude Rating (based on closest homestead identified in 2018 survey)	
	Day	Night		Day	Night	Day	Night	Day	Night
Ngamia	60.5	42.0	46.3	60.7	47.7	0.2	5.7	Negligible	High
Amosing	44.1	29.3	38.5	45.2	39.0	1.1	9.7	Negligible	High
Twiga	36.5	27.9	41.4	42.6	41.6	6.1	13.7	Medium	High

(a) Construction scenario in Section 7.2.9 assessed.

The modelling predicts a negligible magnitude rating during all daytime drilling activities in Ngamia and Amosing. A change from daytime baseline noise level of 6.1 dB was predicted during the daytime drilling of wellpad TW-04 in Twiga, resulting in a medium magnitude rating, although the predicted noise level is below the Kenya Noise Regulations daytime construction noise limit of 60 dBA. The modelling predicts up to a high magnitude rating during night-time drilling activities as the maximum predicted noise levels are above the Kenya Noise Regulations construction noise limit of 35 dBA, which would be a **Major** significance.

In order to mitigate these impacts, a communication plan involving relevant Traditional leaders and local administrative leaders will be implemented to inform PAP and local pastoralists of the Project drilling schedule and to encourage avoidance. Successful implementation would result in the significance being reduced to **Minor**. As a minimum the following needs to be communicated:

- In the area surrounding the wellpad fence-line (during drilling) noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.

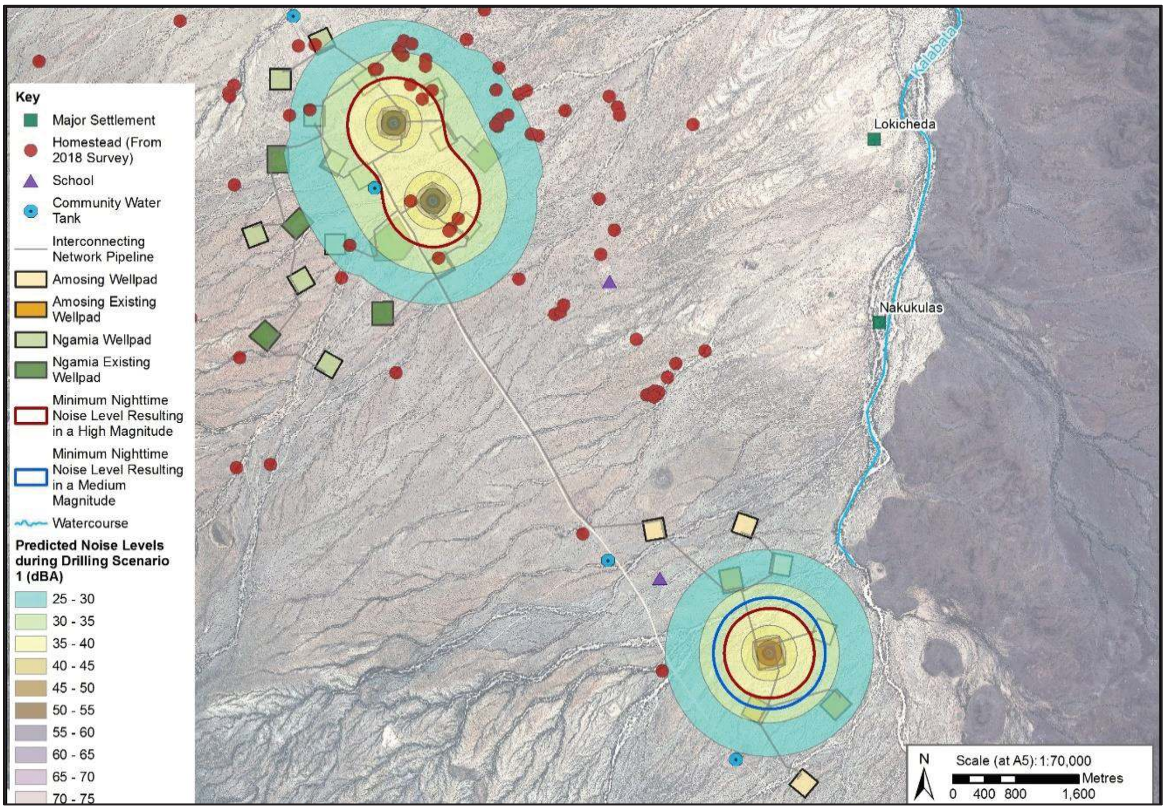

Figure 7.2-1: Predicted Noise Levels During Drilling Scenario 1

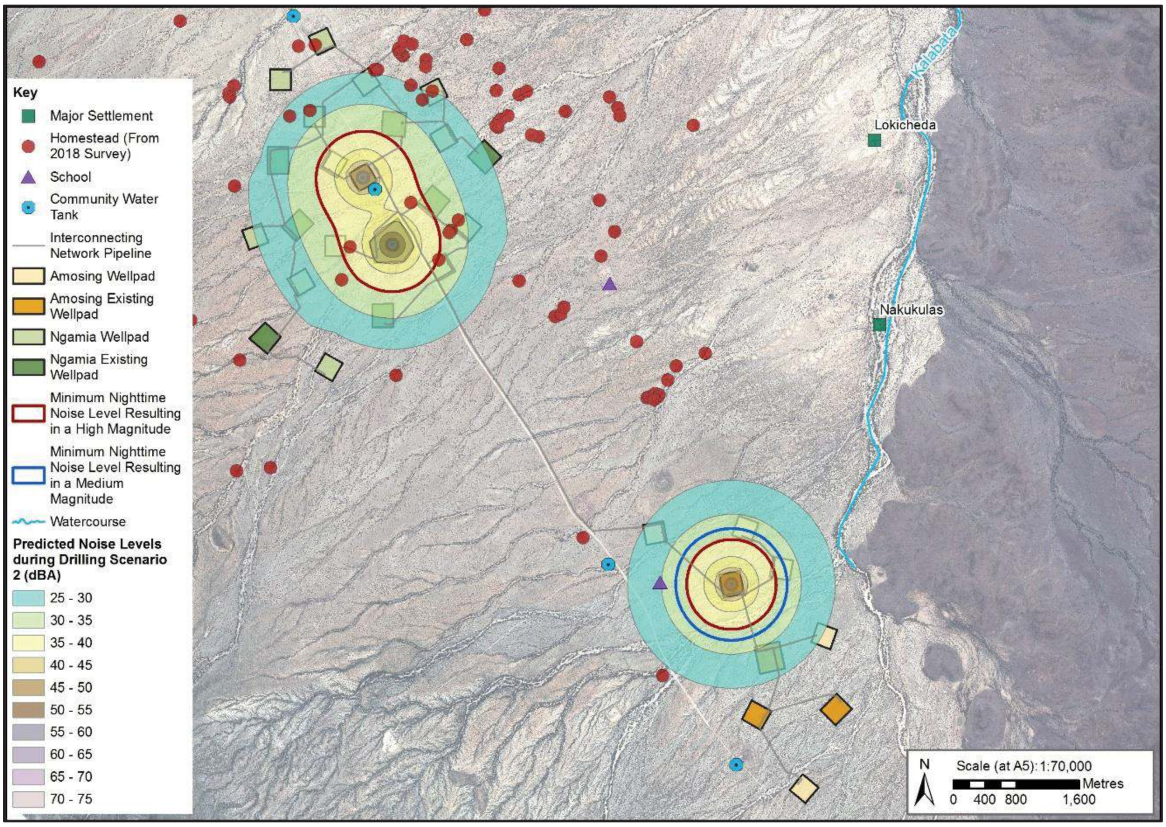

Figure 7.2-2: Predicted Noise Levels During Drilling Scenario 2

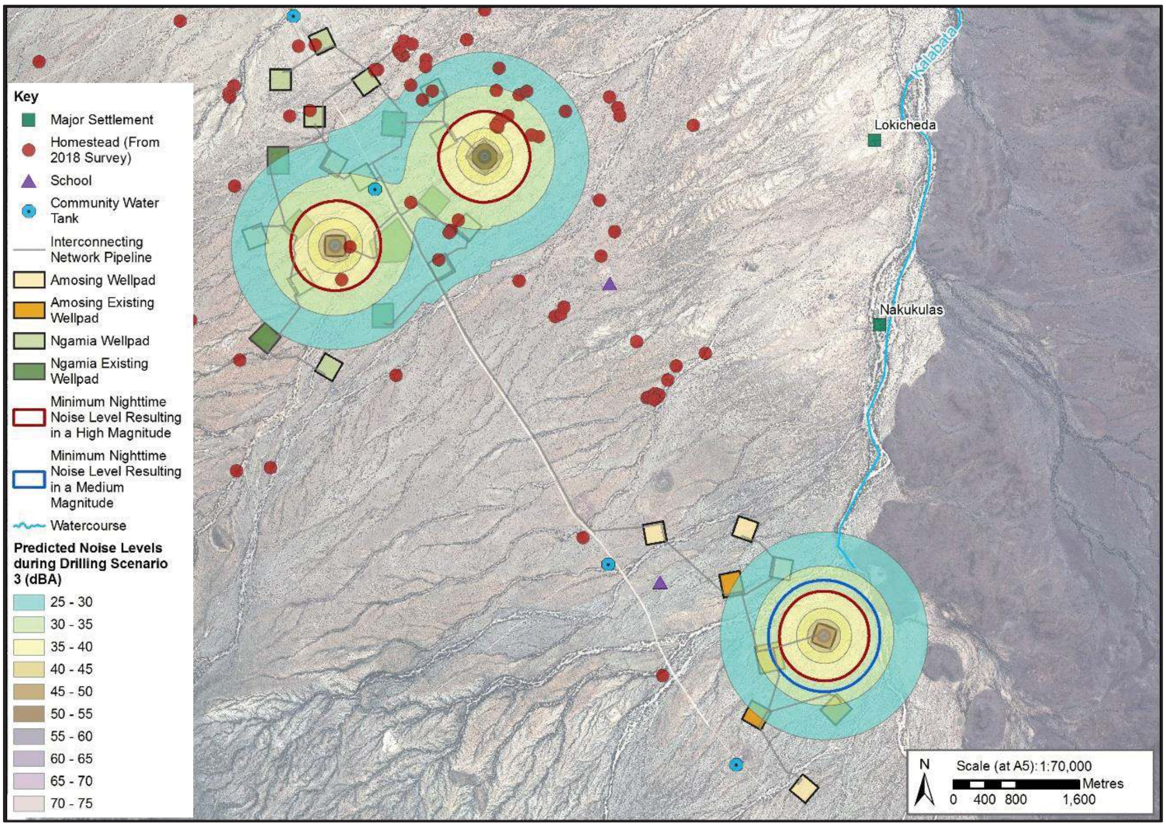

Figure 7.2-3: Predicted Noise Levels During Drilling Scenario 3

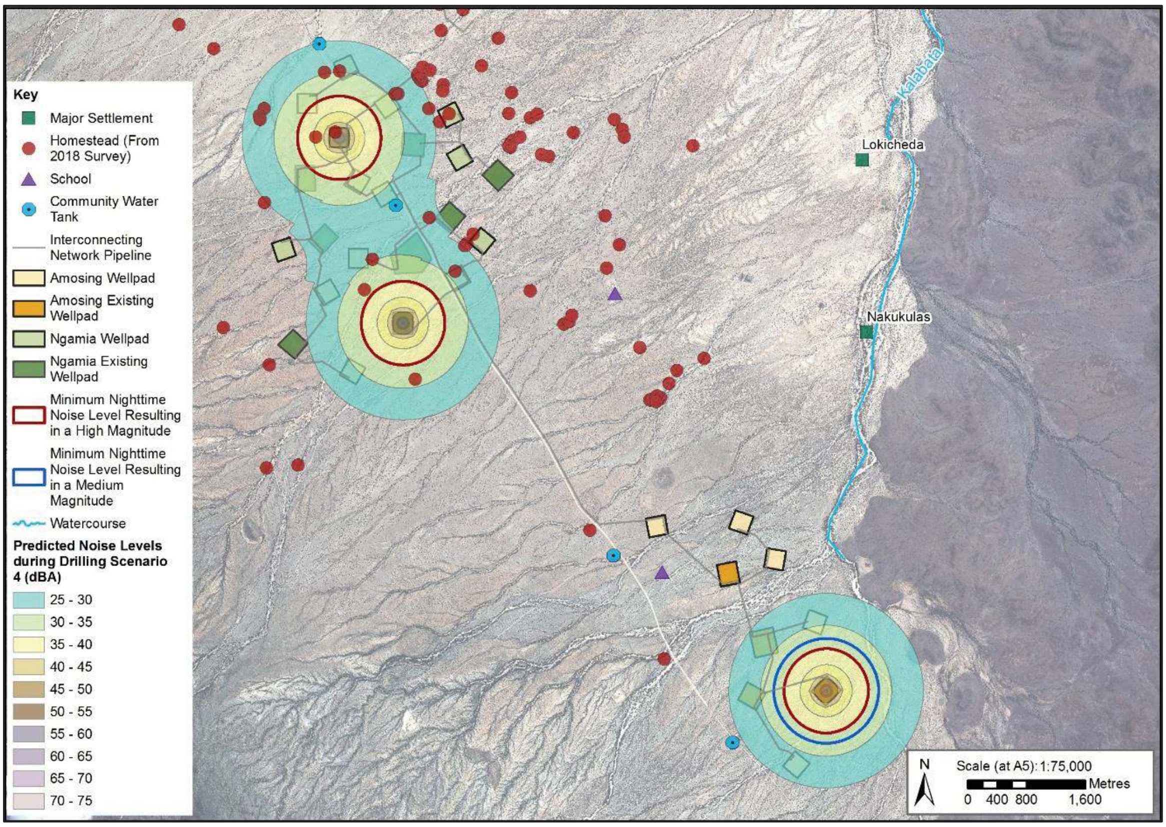

Figure 7.2-4: Predicted Noise Levels During Drilling Scenario 4

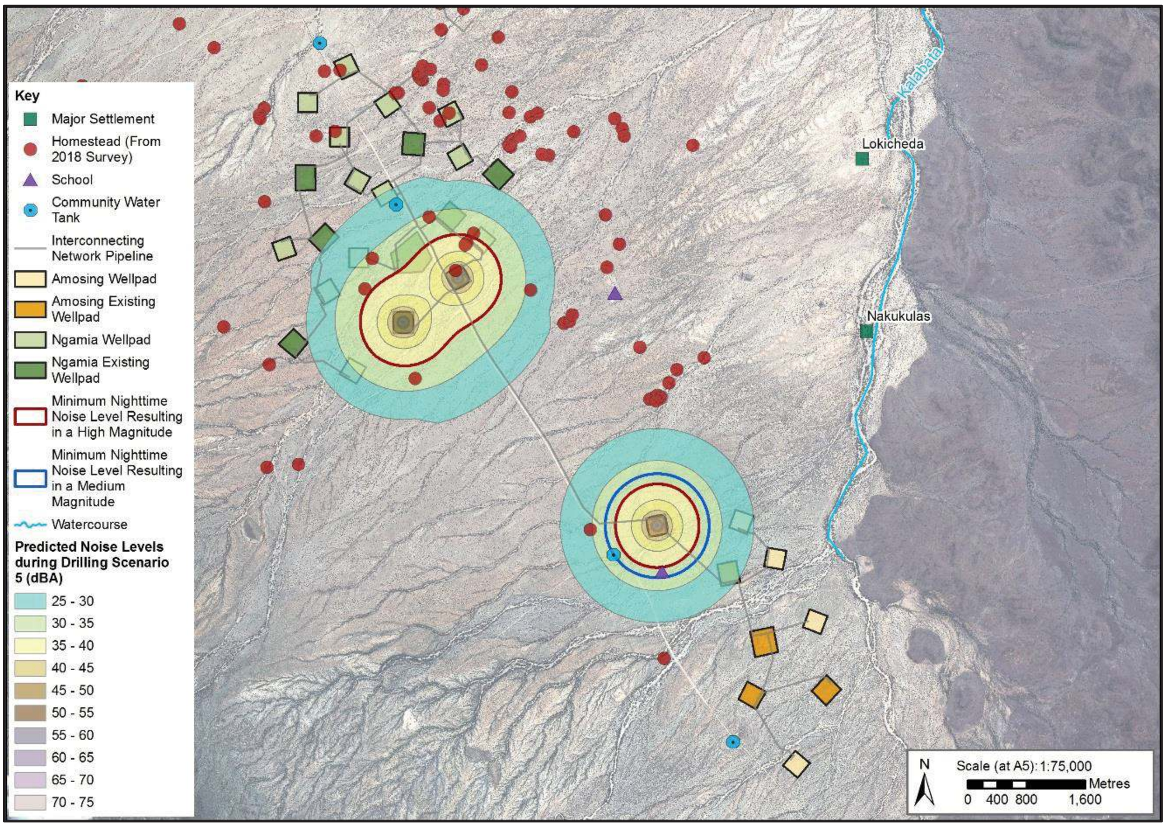

Figure 7.2-5: Predicted Noise Levels During Drilling Scenario 5

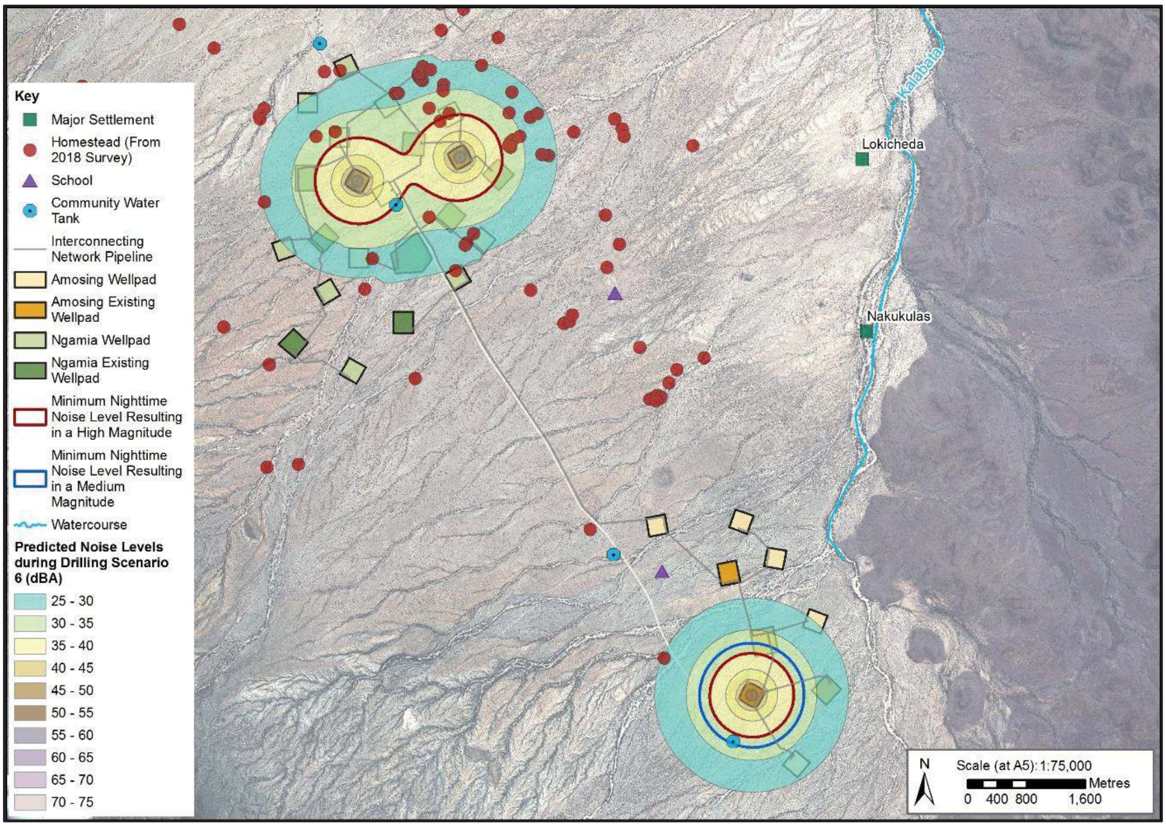

Figure 7.2-6: Predicted Noise Levels During Drilling Scenario 6

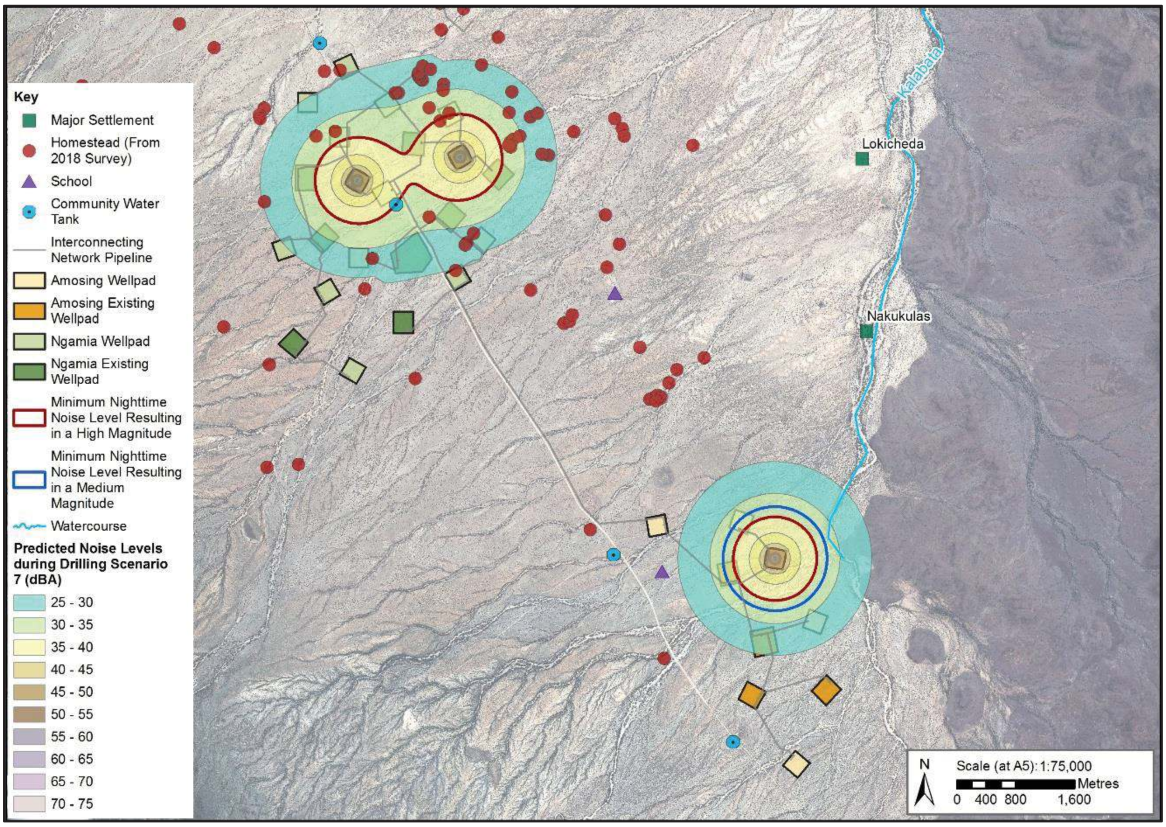

Figure 7.2-7: Predicted Noise Levels During Drilling Scenario 7

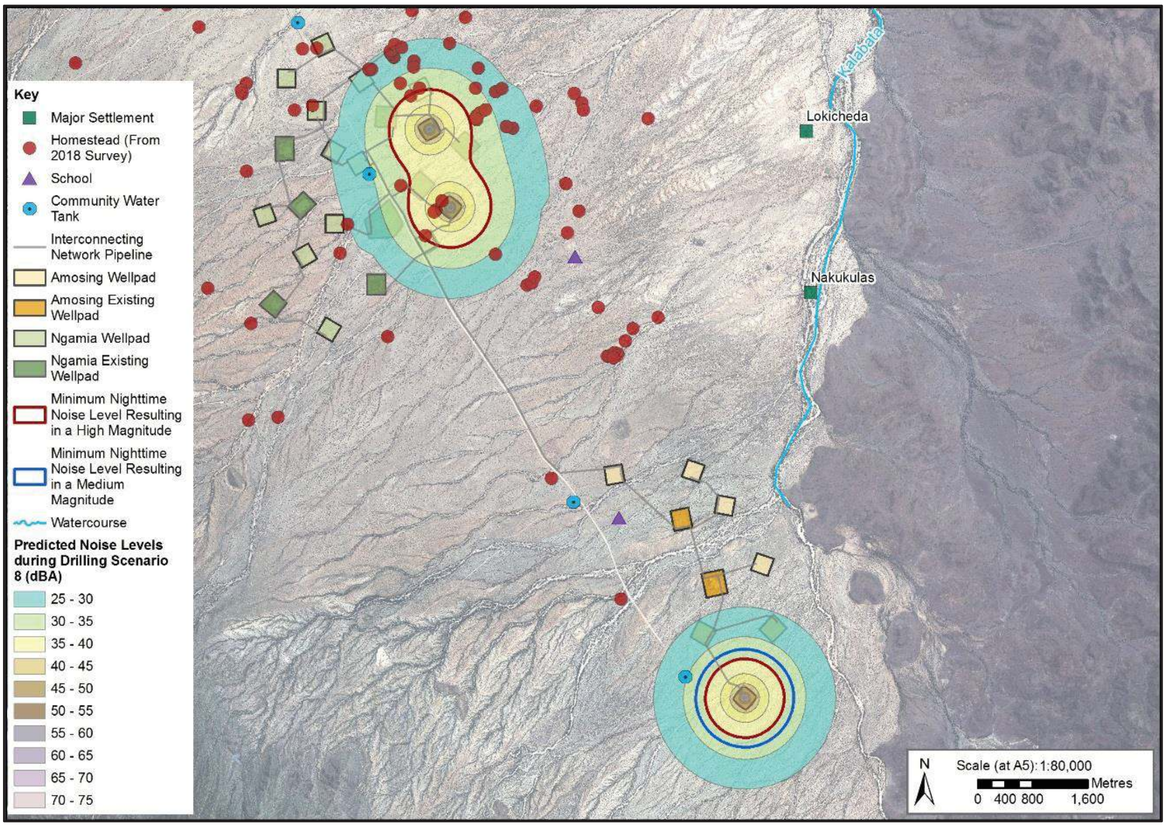

Figure 7.2-8: Predicted Noise Levels During Drilling Scenario 8

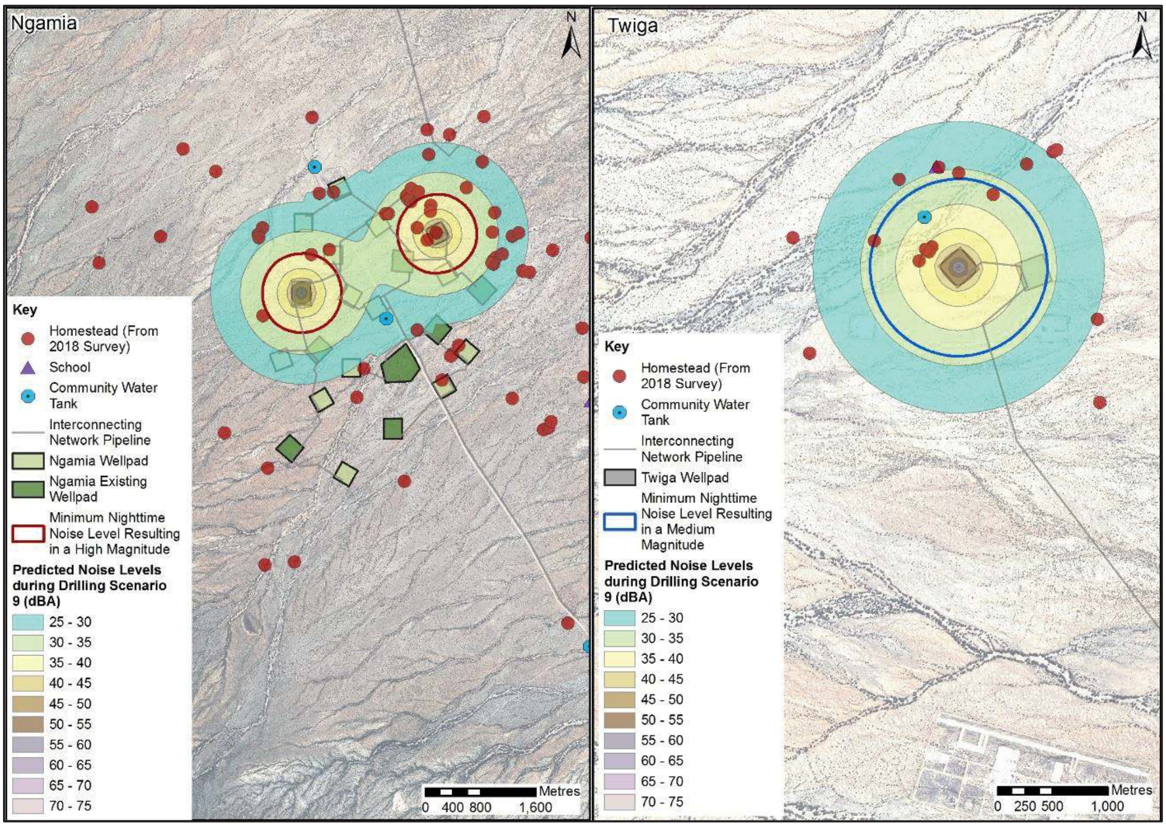

Figure 7.2-9: Predicted Noise Levels During Drilling Scenario 9

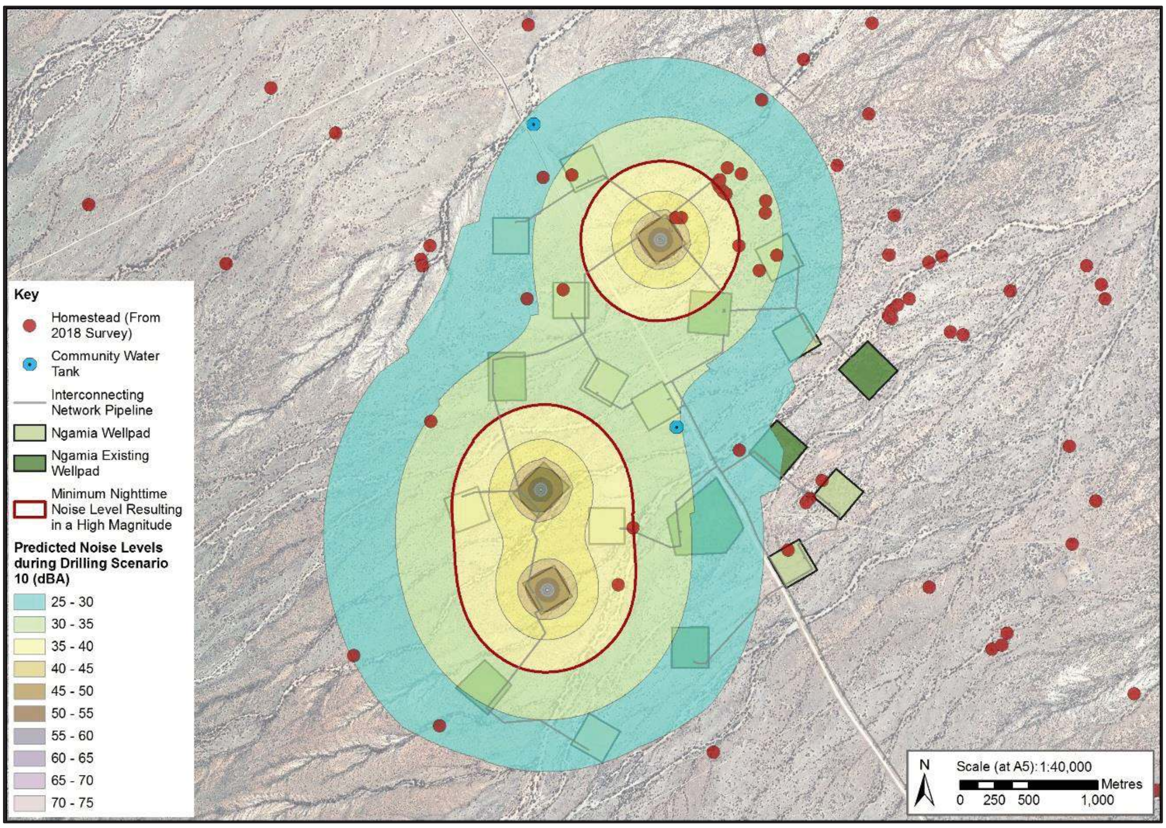

Figure 7.2-10: Predicted Noise Levels During Drilling Scenario 10

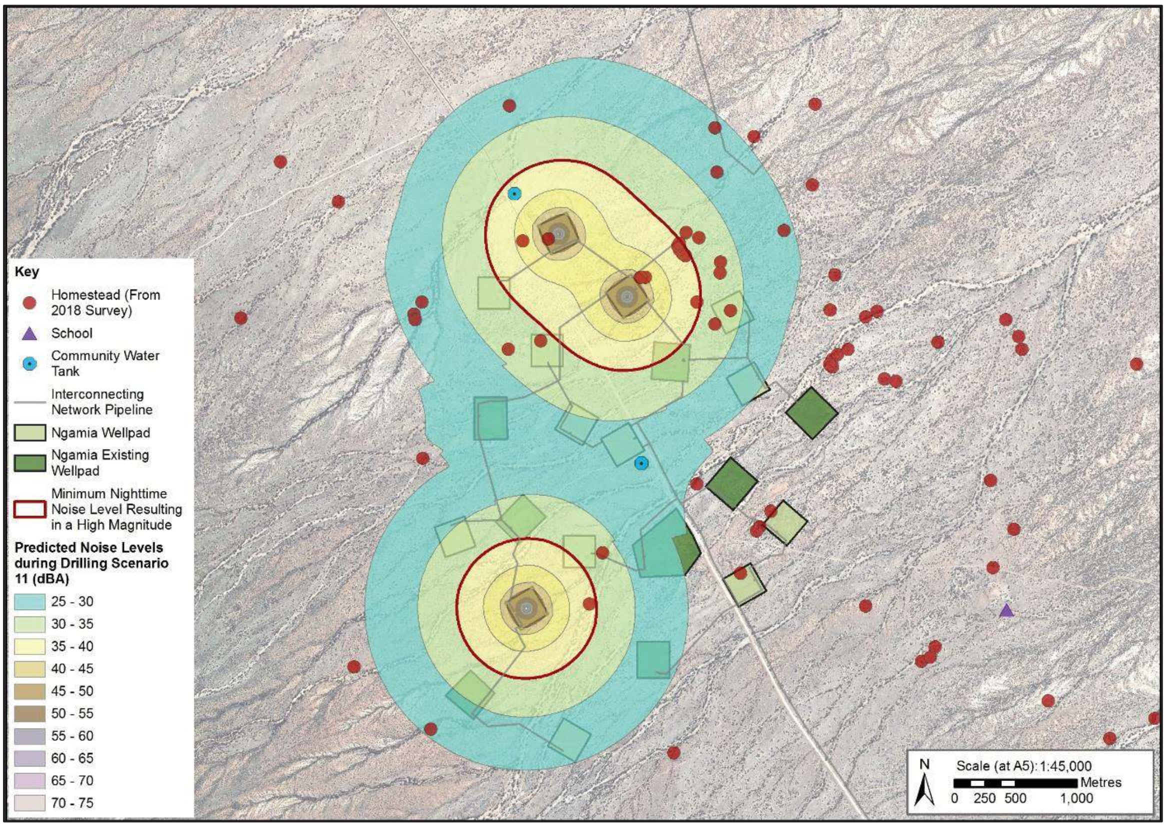

Figure 7.2-11: Predicted Noise Levels During Drilling Scenario 11

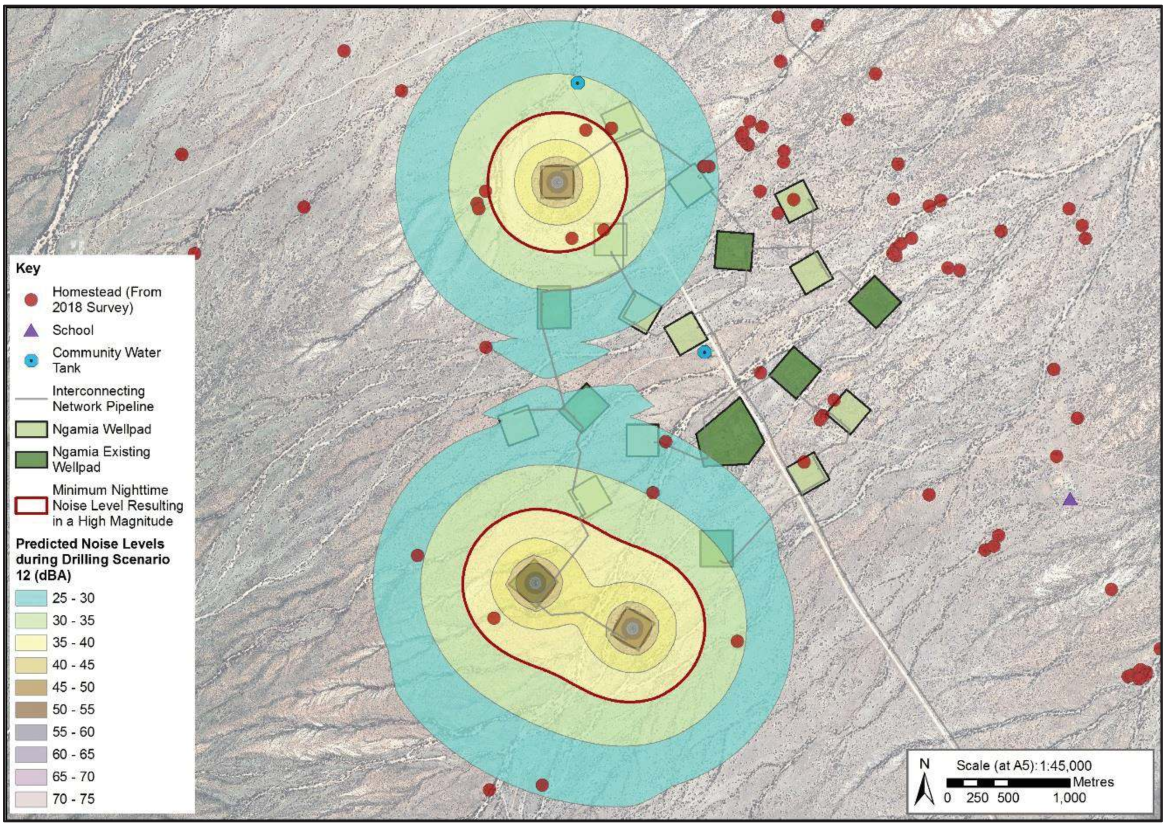

Figure 7.2-12: Predicted Noise Levels During Drilling Scenario 12

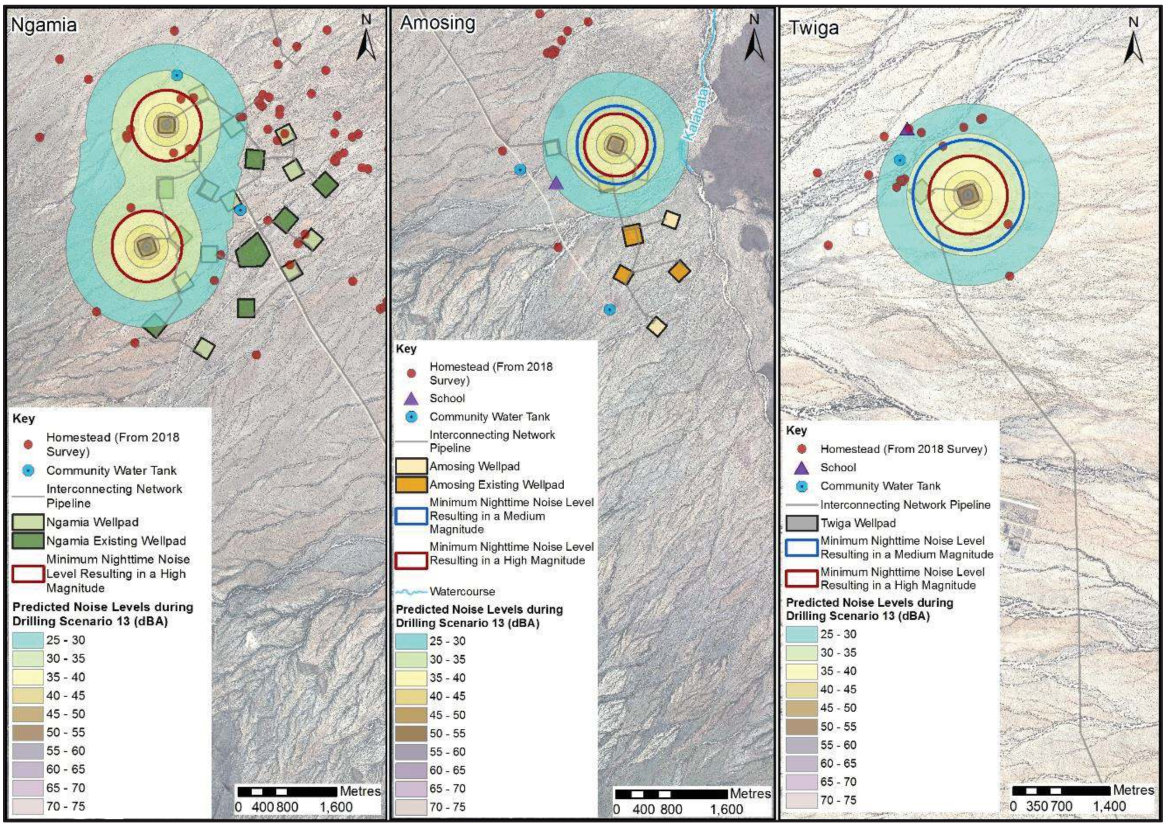

Figure 7.2-13: Predicted Noise Levels During Drilling Scenario 13

Table 7.2-11: Construction Phase Noise Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
PAP (High) within the areas of predicted high magnitude	Construction of Project Components	High – Short-Term – Temporary	Major	Implement a communication plan involving relevant Traditional leaders and local administrative leaders to inform PAP and pastoralists of the Project construction schedule and to encourage avoidance or minimal exposure. As a minimum the following needs to be communicated: ■ Within 0 to 75 m from the perimeter of the following, noise levels may lead to hearing impairment if exposure occurs for a 24 hour period according to the WHO Guidelines for Community Noise, 1999. ▪ The TAN wellpads ▪ The infield flowlines RoW, ▪ The CFA ▪ The landfill ▪ The water pipeline RoW ■ In the area directly outside this perimeter, noise will change due to the Project up to that similar to a car driving 100 km/hr on a blacktop road at a distance of 30 m but should not lead to any hearing impairment through sustained exposure.	Low – Short-Term – Temporary	Minor
PAP (High) within the areas of predicted high magnitude	Construction of airstrip upgrade works	High – Short-Term – Temporary	Major	Exert influence to encourage the owners of the airstrip to consider the implementation of a communication plan involving relevant Traditional leaders and local administrative leaders to inform PAP and pastoralists of the Project construction	Low – Short-Term – Temporary	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				schedule and to encourage avoidance or minimal exposure. As a minimum the following needs to be communicated: ■ Within 0 to 75 m from the perimeter of the airstrip, noise levels may lead to hearing impairment if exposure occurs for a 24 hour period according to the WHO Guidelines for Community Noise, 1999. ■ In the area directly outside this perimeter noise will change due to the Project up to that similar to a car driving 100 km/hr on a blacktop road at a distance of 30 m but should not lead to any hearing impairment through sustained exposure.		
PAP (High) within the areas of predicted medium magnitude	Construction of Project Components	Medium – Short-Term – Temporary	Moderate	Implement a communication plan involving relevant Traditional leaders and local administrative leaders to inform PAP and pastoralists of the Project construction schedule and to encourage avoidance or minimal exposure.	Low – Short-Term – Temporary	Minor
Transient Human Receptor (High) within the areas of predicted high and medium magnitude	Construction of Project Components	Medium – Short-Term – Temporary	Moderate		Low – Short-Term – Temporary	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
PAP (High) within the areas of predicted high magnitude	Well Drilling	High – Short-Term – Temporary	Major	Implement a communication plan involving relevant Traditional leaders and local administrative leaders to inform PAP and local pastoralists of the Project drilling schedule and to encourage avoidance. As a minimum the following needs to be communicated: In the area surrounding the wellpad fence-line (during drilling) noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.	Low – Short-Term – Temporary	Minor
PAP (High) within the areas of predicted medium magnitude	Well Drilling	Medium – Short-Term – Temporary	Moderate		Medium – Short-Term – Temporary	Minor
Transient Human Receptor (High) within the areas of predicted high and medium magnitude	Well Drilling	Medium – Short-Term – Temporary	Moderate		Medium – Short-Term – Temporary	Minor-

7.2.10.2 Construction - Vibration

Site-specific SD plots are commonly used as a blast design tool since maximum peak ground vibration levels can reasonably be predicted at specific distances from a blast. Table 7.2-12 shows the maximum suggested explosive loads for various distances from the construction blasting operation based on the proposed guideline limits of 5 mm/s and 117 dBL respectively as well as proposed guideline limits for concrete (100 mm/s) and switches (30 mm/s) for the Turkwel Dam. This is shown graphically in Figure 7.2-14.

Table 7.2-12: Maximum Explosive Loads to Comply with Proposed Ground and Air Vibration Limits

Distance [(a)] (m)	Max. Explosive Charge Weight (kg) [(b)]			
	Residential Receptors [(c)]		Turkwel Dam	
	PPV = 5 mm/s SD = 38.7 m/kg$^{1/2}$	PSPL = 117 dBL SD = 110.0 m/kg$^{1/3}$	PPV = 30 mm/s [(d)] SD = 12.6 m/kg$^{1/2}$	PPV = 100 mm/s [(e)] SD = 6.0 m/kg$^{1/2}$
100	6.7	0.8	63	278
200	27	6	252	1111
300	60	20	567	2500
400	107	48	1008	4444
500	167	94	1575	6944
600	240	162	2268	10000
700	327	258	3086	13611
800	427	385	4031	17778
900	541	548	5102	22500
1000	668	751	6299	27778

(a) Distance between the blast and the sensitive receptor.
(b) Assuming the attenuation models proposed above.
(c) Kenyan guidelines
(d) Proposed guideline for switches at Turkwel Dam
(e) Proposed guideline for concrete at Turkwel Dam
PSPL = Peak Sound Pressure Level

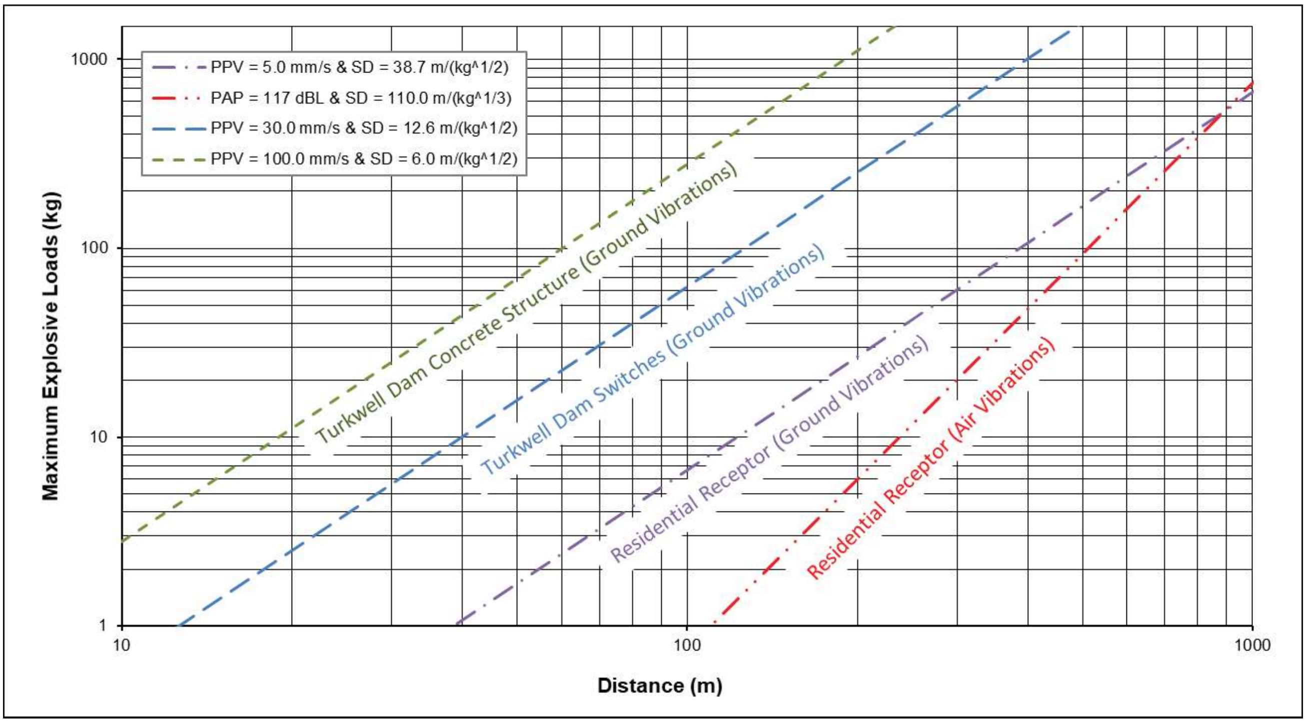

Figure 7.2-14: Maximum Explosive Charge Weights to Comply with Ground and Air Vibration Limits

The results demonstrate that the air vibration limit of 117 dBL is the more restrictive guideline when determining the maximum explosive loads for the construction blasting. This does not consider blasts where blasting mats are used (e.g., in close proximity to residential areas or the Turkwel Dam).

Construction vibration will be temporary, intermittent, and limited to blasting in the vicinity of the geotechnical work required for the water pipeline construction adjacent to the Turkwel Reservoir. The range in increased vibration levels associated with construction activities will depend primarily on the number and size of the blasting sources and their proximity to receptors (i.e., the Project vibration levels in the environment generally decreases as the distance between the receptor and blasting activities increases).

The vibration mitigation necessary to minimise the potential vibration effects during Project construction will be designed inherently into the Project. This mitigation includes reducing the explosive charge weight detonated at a given instant within the blast. Such mitigation strategies will be outlined specifically within the blast plan.

The potential impact will depend on the magnitude of blast-induced vibrations which will depend on the depth of rock to be blasted, the maximum explosive charge weight detonated per millisecond time interval within the blast (delay period) and the separation distance between the blast and the receptor. As the specific locations of the required rock blasting have yet to be determined, the blast design must comply with the vibration limits discussed in Section 7.2.4 and the vibration attenuation models described above. Therefore, the magnitude is negligible, and the significance is considered **Negligible** and will not be considered further for impact classification.

7.2.10.3 Operation - Noise

Truck Traffic on the Transport Route

The estimated maximum number of truck movements per year during the operation period is less than the truck movements expected during construction (negligible impact). Therefore, truck movements on the transport route during operations are expected to have a negligible impact on traffic noise levels and a negligible significance and therefore there will be no further assessment or impact classification.

Kapese Airstrip

The existing Kapese airstrip will be updated to allow for the use of larger aircrafts. The existing operations at the Kapese airstrip include three flights per week. An additional two flights per week due to the Project are anticipated, occurring during the daytime period. Noise levels are expected to increase, on occasion, due to the arriving and departing flights, but the noise will be temporary, intermittent, and short in duration.

Due to the limited information regarding the aircraft activity, types of aircraft and flight schedule, it has been assumed that noise levels from the future aircrafts will be at the same level as existing aircrafts. If the additional flights occur on different days than the existing flights, the predictable worst-case daytime scenario remains the same as the existing operations (i.e., one flight per day). If an additional flight occurs on the same day as an existing flight, the daytime average noise levels are expected to increase by approximately 3 dB, which would result in a magnitude rating of negligible and a negligible significance. Based on the negligible significance, no further assessment is required and there is no mitigation.

Project Operations - CFA, Wellpads, Turkwel Dam, and Landfill

The quantitative assessment of the operation of the CFA, wellpads, Turkwel Dam, and landfill was completed through noise prediction modelling to predict the potential noise levels in the AoI as a result of Project noise emissions. The Worley Parsons FEED noise modelling report in Annex I details the model inputs and sound power levels. The equipment was assumed to operate continuously for 24-hours per day. The noise prediction model for the noise assessment of the operation of the landfill was based on Project information.

As stated in Section 7.2.8, two noise barriers are included in the design of the Project and therefore the noise assessment. Within the CFA the assessment included a 6 m tall barrier to the north, east, and west of the ground flare and a 10 m tall barrier to the north, east, and west of the power generation units (i.e WHRUs and GTGs).

The operational phase impact assessment with respect to noise from the CFA is presented in Table 7.2-13.

CFA Operations

This scenario considers predicted noise levels from CFA operations. Predicted noise results are presented in Figure 7.2-15. As the CFA is anticipated to operate continuously for 24 hours per day, only the night-time criteria has been considered as it is more stringent. The measured average baseline noise level during the night-time period representative of Ngamia and the CFA was 42.0 dBA. Therefore, for PAP a low magnitude occurs when the Project produces a noise level greater than 42.0 dBA (i.e., greater than 3 dB increase in baseline noise level[6]). A high magnitude occurs when the Project produces a noise level greater than 45 dBA, the night-time WBG EHS Guidelines limit.

For transient receptors (where the WBG EHS Guidelines is not applicable), a low magnitude occurs when the Project produces a noise level greater than 42.0 dBA, a medium magnitude occurs when the Project produces a noise level greater than 45.3 dBA (i.e., greater than 5 dB increase in baseline noise level), and a high magnitude occurs when the Project produces a noise level greater than 51.5 dBA (i.e., greater than 10 dB increase in baseline noise level).

The results indicate that the highest predicted noise level at the permanent homestead (according to the 2018 survey) nearest to the CFA is 43.5 dBA, resulting in a low magnitude and minor significance.

For transient receptors, the area where a high magnitude is predicted (i.e., Project noise levels greater than 51.5 dBA) is entirely within the CFA fence-line. The area where a medium magnitude and **Moderate** significance is predicted (i.e., Project noise levels greater than 45.3 dBA) extends approximately 100 m to the

[6] The combination of baseline noise (42.0 dBA) and Project produced noise (>42.0 dBA) result in an increase in overall noise level that is greater than 3 dB above baseline (i.e. baseline noise (42 dBA) + Project noise (>42 dBA) = >45 dBA).

north-west of the CFA fence-line. Figure 7.2-15 presents the area within which a medium magnitude is expected.

In order to mitigate these impacts, TKBV will produce and implement a communication plan to engage relevant Traditional Leaders and local administrative leaders to encourage avoidance. Signage should be put in place prior to operations, to further communicate this. If this mitigation is implemented the resulting significance would be reduced to **Minor**. As a minimum the following needs to be communicated:

- In the area surrounding the CFA, noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.

Noise impacts on camp locations are considered from the perspective of occupational exposure and are therefore outside the scope of this ESIA.

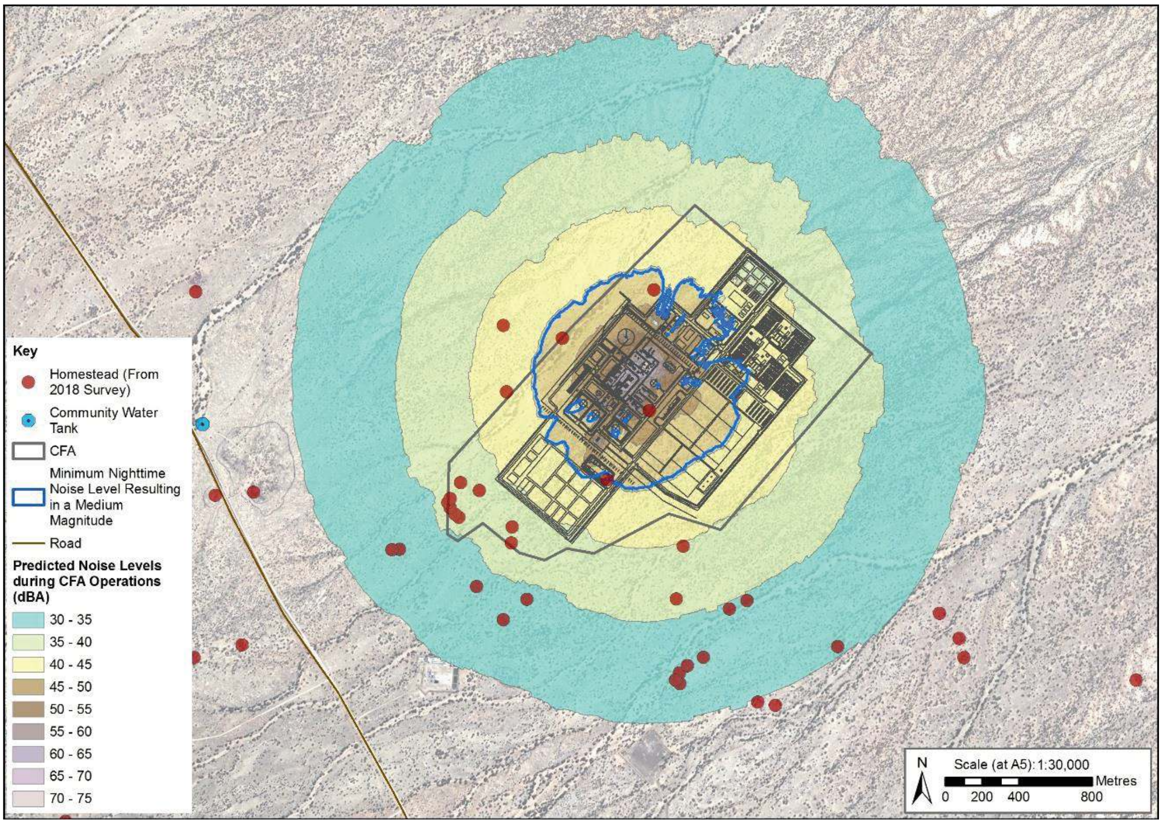

Figure 7.2-15: Predicted Noise Levels during CFA Operations

Wellpad Operations

This scenario considers wellpad operation. Wellpads are expected to operate continuously for 24 hours per day and therefore only the night-time criteria have been considered as it is more stringent. Wellpads are located in the TAN fields, which have measured average night-time baseline noise levels of 27.9 dBA, 29.3 dBA, and 42.0 dBA , respectively.

The highest predicted noise level during wellpad operation at a PAP was 27.9 dBA, which results in a negligible magnitude and a negligible significance and therefore there will be no further impact classification for PAP.

As indicated in Figure 7.2-16 to Figure 7.2-18, the maximum predicted noise level outside of the fence-line of a wellpad with a jump-over line (NG-09, NG-12, NG-21, TW-04, AM-11 and AM-19) is 41.0 dBA. This results in a negligible magnitude for transient receptors in Ngamia. However, the impact magnitude is high for transient receptors within approximately 10 m of the Amosing and Twiga wellpad fencelines (i.e., greater than 10 dB change from baseline noise level). This results in a major or moderate significance within 10 m or 36 m of the fence-lines, respectively, and a low impact and **Minor** significance beyond 36 m from the fence-line. Figure 7.2-16 to Figure 7.2-18 present the areas within which high and medium magnitudes are expected.

To mitigate the impacts, TKBV will implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance, and will erect signage prior to operations to further communicate the risks. As a minimum the following needs to be communicated:

- In the area surrounding wellpads TW-04, AM-11 and AM-19 noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.

As indicated in Figure 7.2-16 to Figure 7.2-18, the maximum Project noise level outside of the wellpad fenceline of a wellpad without a jump-over line is 36.5 dBA. This results in a negligible magnitude for transient receptors in Ngamia. However, the impact magnitude is medium for transient receptors within approximately 10 m of the Amosing and Twiga wellpad fence-lines, resulting in a moderate significance. Beyond 10 m of the fenceline, the magnitude of the impact is low and the significance is minor. Figure 7.2-16 to Figure 7.2-18 present the areas within which a medium magnitude is expected.

In order to mitigate these impacts TKBV will produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance. Signage should be put in place prior to operations, to further communicate the risks. With this mitigation in place, the resulting impact significance would be **Minor** outside the Amosing and Twiga fenceline**.** As a minimum the following needs to be communicated:

- In the area surrounding wellpads TW-04, AM-11 and AM-19 noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.

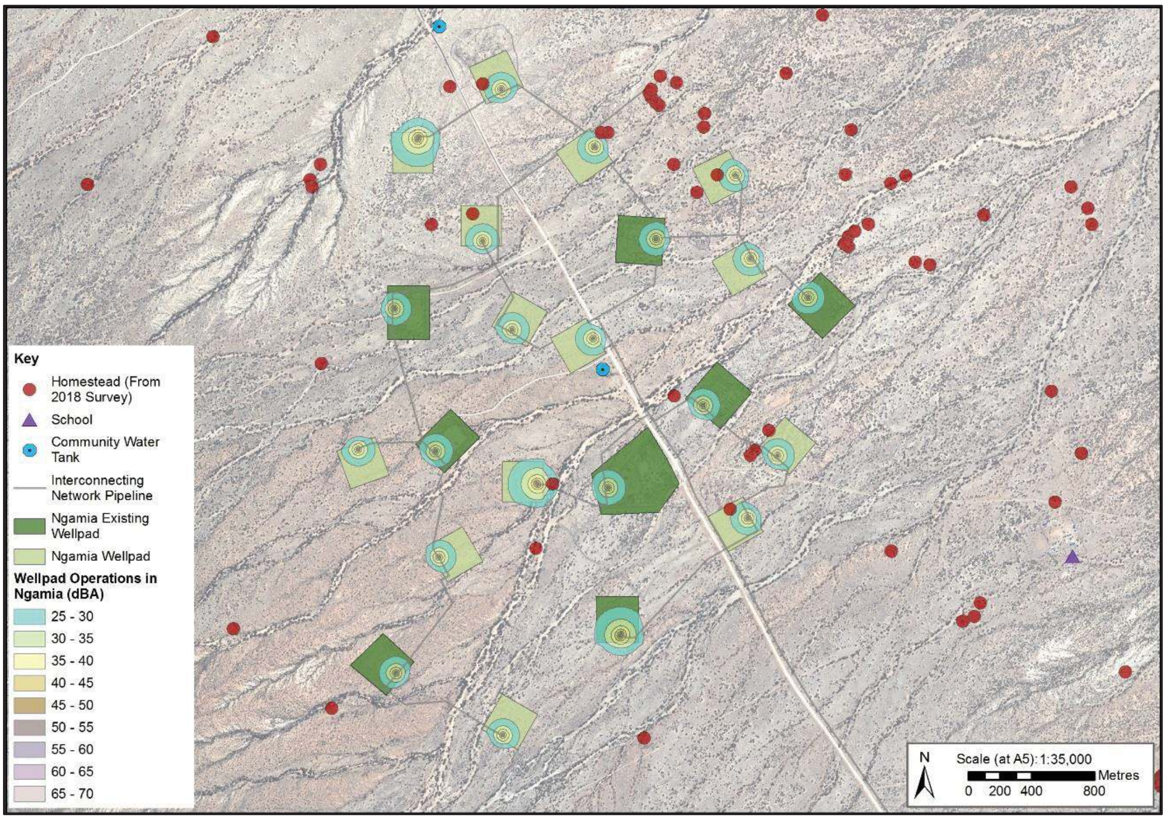

Figure 7.2-16: Predicted Noise Levels During Wellpad Operations in Ngamia

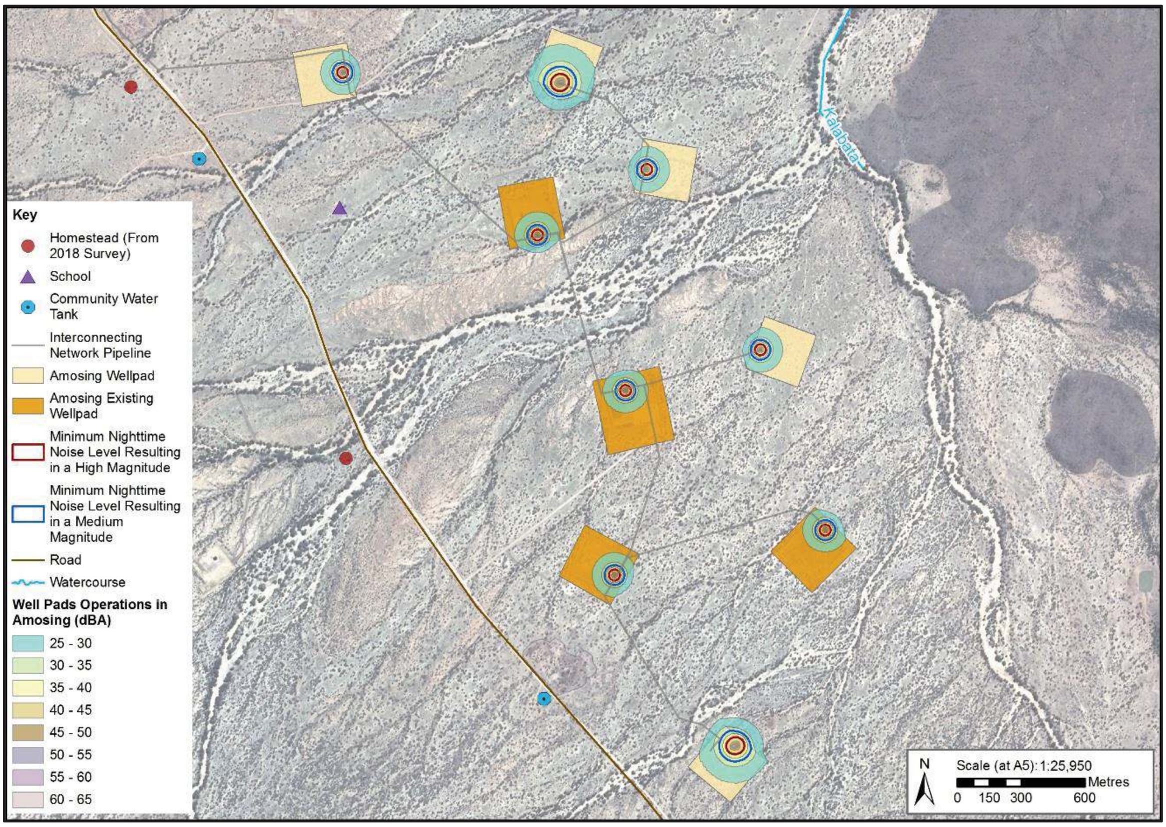

Figure 7.2-17: Predicted Noise Levels During Wellpad Operations in Amosing

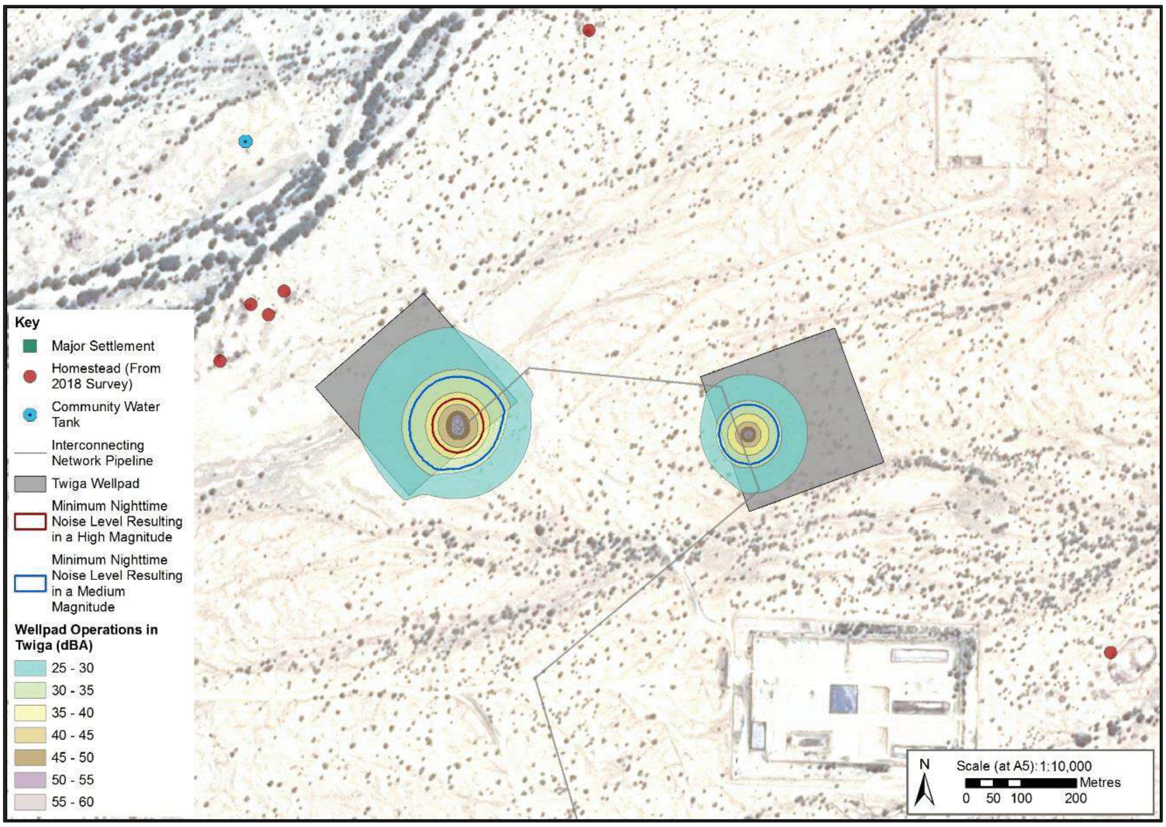

Figure 7.2-18: Predicted Noise Levels During Wellpad Operations in Twiga

Turkwel Dam Operations

This scenario considers the operations of the Project sources at the Turkwel Dam. Noise prediction results are presented in Figure 7.2-19. As the Project noise sources at the Turkwel Dam are expected to operate continuously for 24 hours per day, only the night-time criteria has been considered as it is more stringent. The baseline noise level was not measured at this location; therefore, a conservative approach has been taken to assume the minimum measured average baseline noise level of 27.9 dBA during the night-time for the noise impact assessment at this location.

The predicted noise level due to the pumps at the Turkwel Dam at the nearest PAP is 29.6 dBA. Considering a baseline noise level of 27.9 dBA, this results in an impact of low magnitude and minor significance.

The maximum predicted noise level associated with the pumps at the Turkwel Dam outside of the water pipeline RoW is 44.6 dBA, which would be a high magnitude for transient receptors resulting in a major significance. A medium magnitude and a moderate significance is achieved when the predicted noise level is less than 37.4 dBA, which occurs at a distance up to 270 m away from the Turkwel Dam pontoon. A low magnitude and a minor significance is achieved when the predicted noise level is less than 31.2 dBA, which occurs at a distance up to 400 m away from the Turkwel Dam pontoon. Figure 7.2-19 presents the areas within which high and medium magnitudes are expected. In order to mitigate the impacts, TKBV will produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance. Signage should be put in place prior to operations, to further communicate the risks. With this mitigation in place, the resulting impact significance would be **Minor.** As a minimum the following needs to be communicated:

- In the area surrounding the Turkwel Dam pumps noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.

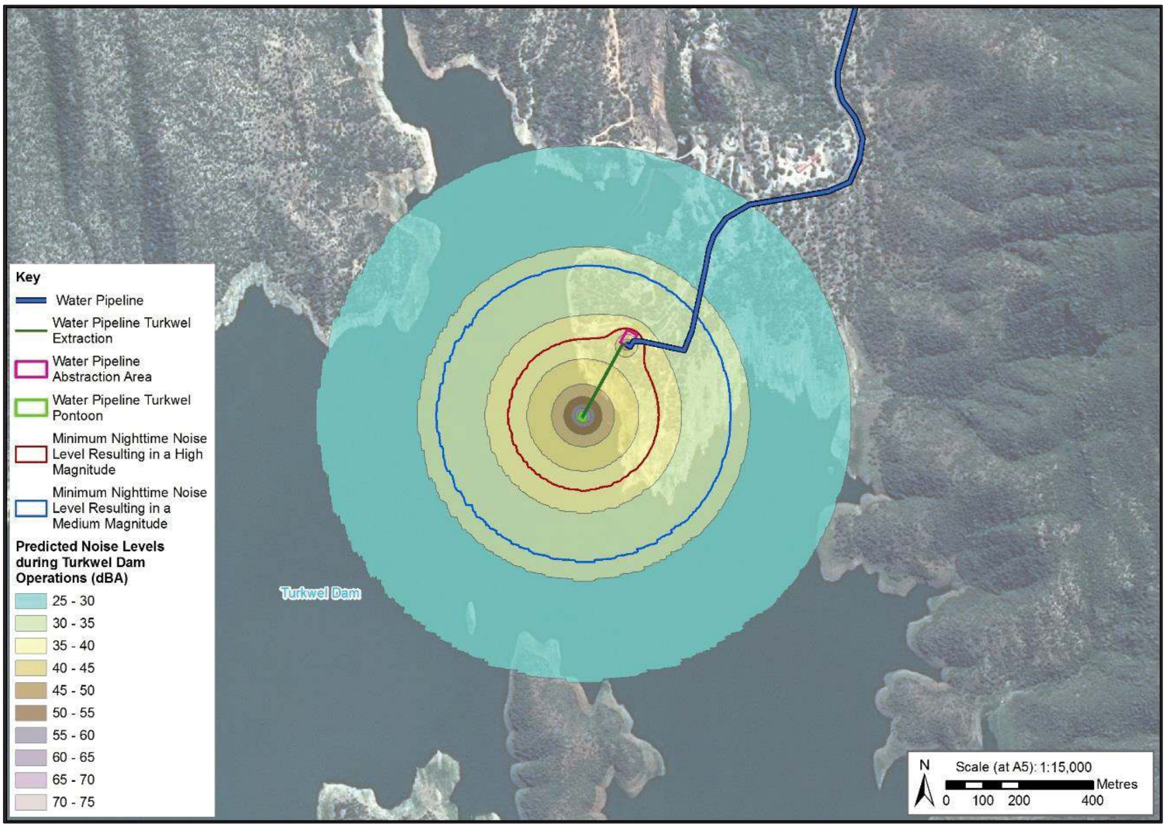

Figure 7.2-19: Predicted Noise Levels During Turkwel Dam Operations

Landfill Operations

This scenario considers noise levels from landfill operations, with the results presented in Figure 7.2-20. As the landfill is expected to operate continuously for 24 hours per day, only the night-time criteria has been considered as it provides a more stringent limit. The measured average baseline noise level during the night-time period in Ngamia was 42.0 dBA.

The predicted noise level at the nearest PAP to the landfill is 39.4 dBA, which is an impact of negligible magnitude. The maximum predicted noise level outside of the landfill fence-line is 51.0 dBA, which would be a medium magnitude for transient receptors, and therefore a moderate significance. A low magnitude and a minor significance is achieved when the predicted Project noise level is less than 45.3 dBA, which occurs more than approximately 36 m away from the landfill fence-line. Figure 7.2-20 presents the area within which a medium magnitude is expected.

In order to mitigate the impacts, TKBV will produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance. Signage should be put in place prior to operations, to further communicate the risks. With this mitigation in place, the resulting impact significance would be **Minor.** As a minimum the following needs to be communicated:

- In the area surrounding the landfill, noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.

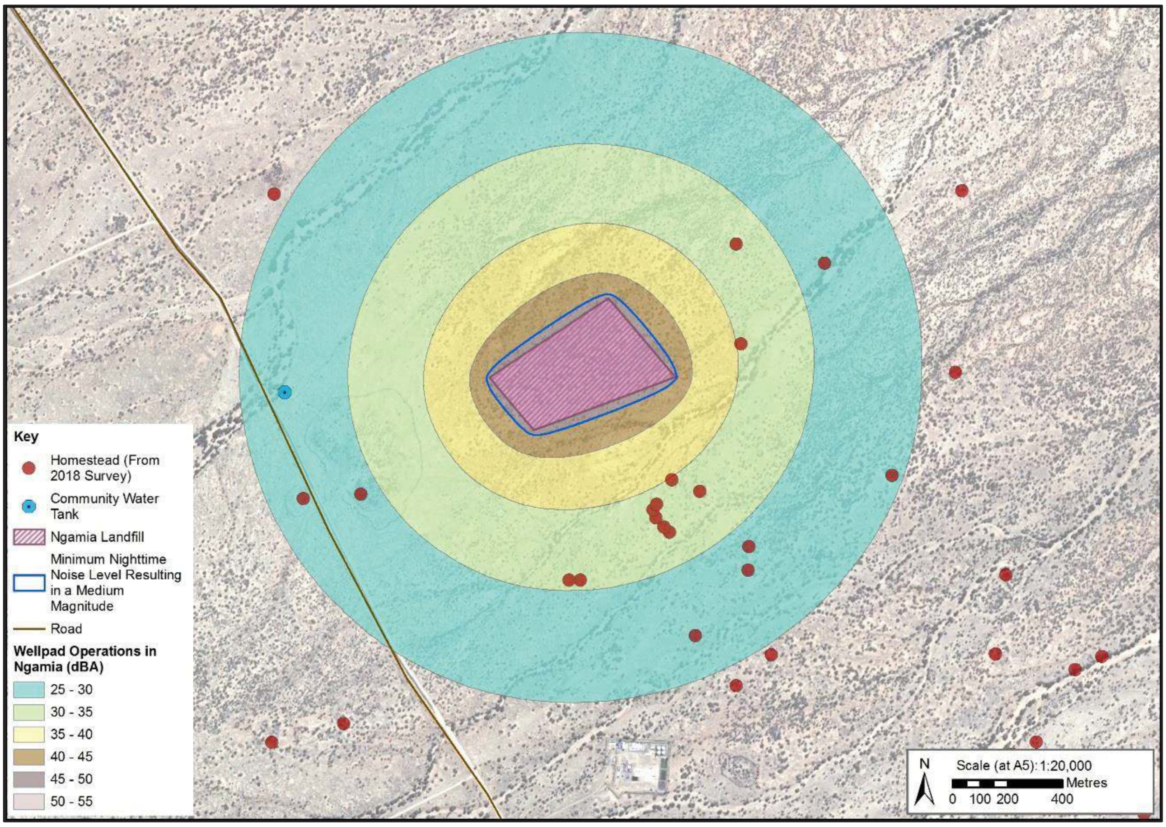

Figure 7.2-20: Predicted Noise Levels During Landfill Operations

Table 7.2-13: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Transient Human Receptor (high)	CFA Operations	Medium – Medium-Term – Temporary	Moderate	Produce and implement a communication plan to engage relevant Traditional Leaders and local administrative leaders to encourage avoidance. As a minimum the following needs to be communicated: ■ In the area surrounding the CFA noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate this.	Low – Medium-Term – Temporary	Minor
Transient Human Receptor (high)	Wellpads in Amosing or Twiga with jump-over lines (TW-04, AM-11, AM-19)	High – Medium-Term – Temporary	Major	Produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding wellpads TW-04, AM-11 and AM-19 noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.	Low – Medium-Term – Temporary	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Transient Human Receptor (high)	Wellpads in Amosing or Twiga without jump-over lines	Medium – Medium-Term – Temporary	Moderate	Produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding wellpads (excluding TW-04, AM-11 and AM-19) noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.	Low – Medium-Term – Temporary	Minor
Transient Human Receptor (high)	Turkwel Dam pumps	High – Medium-Term – Temporary	Major	Produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding the Turkwel Dam pumps noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.	Low – Medium-Term – Temporary	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Transient Human Receptor (high)	Landfill Operations	Medium – Medium-Term – Temporary	Moderate	Produce and implement a communication plan involving relevant Traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding the landfill noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.	Low – Medium-Term – Temporary	Minor

7.2.10.4 Operation - Vibration

Blasting will cease at the end of the construction phase. No impacts are expected during the operation phase.

7.2.10.5 Decommissioning

The Project has an operational design life of 25 years. At this stage it is not possible to anticipate the situation at that time. However, should any ground disturbance or demolition be required which will result in noise and vibration at least equivalent mitigation measures implemented during the construction phase will be applied during decommissioning. No sources of emissions to noise are anticipated in addition to those already assessed.

7.2.11 Summary of Mitigation

7.2.11.1 Noise

The following additional mitigation was identified:

- Communication plans will be implemented involving relevant Traditional Leaders and local administrative leaders to inform PAP and local pastoralists of the Project construction schedule and to encourage avoidance or minimal exposure;
- Erection of signage to further communicate risks; and
- TKBV to exert influence over the owners of the airstrip to consider similar mitigation measures.

7.2.11.2 Vibration

No mitigation is required for the Project to have a minor impact significance on vibration.

7.2.12 Summary of Residual Impacts

7.2.12.1 Noise

The residual impact significance that results from the combination of receptor importance and predicted impact magnitude is classified as minor to negligible.

7.2.12.2 Vibration

If the monitored blasting vibrations are maintained below the regulatory limits, no residual impacts are anticipated.

7.3 Water Quantity

7.3.1 Introduction

This section provides an assessment of the potential impacts of the Project on surface and groundwater quantity (i.e. flows, levels and availability), and also includes consideration of the potential risk to third parties as a result of changes to flood risk. Impacts have been determined using a qualitative assessment methodology presented in Section 3. Where potential impacts have been identified, these are considered in turn and mitigation are set out where necessary to ensure that any potential impacts are reduced as far as practicable.

7.3.2 Area of Influence

The AoI is presented in Section 3.13. Potential receptors located within the AoI have been identified as part of the baseline studies. Receptors that have been carried forward into the assessment are presented in Section 7.3.6.

7.3.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.3-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.3-1: Criteria for Determining Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ Water resources of international importance, high quality, regional or national scale and limited potential for substitution/replacement (not applicable for water resources considered in this ESIA)
High	■ Water resources recognised as being important at a national scale (e.g. strategically important for national water security); ■ Water resources with a high quality, used at a local scale as a water resource and limited potential for substitution/replacement; ■ Water resources with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement; and/or ■ Humans living in areas at increased flood risk.
Medium	■ Water resources of regional importance; ■ Water resources with a medium quality and rarity, local scale and limited potential for substitution/replacement; and/or ■ Water resources with a low quality and rarity, regional or national scale and limited potential for substitution/replacement.
Low	■ Water resources with limited or no known importance; and/or ■ Water resources with a low quality and rarity.

7.3.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between ‘negligible’ and ‘high’, as described in Table 7.3-2.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project, which in the case of this assessment applies to downstream surface watercourses or water bodies and floodplains.

Table 7.3-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Loss of resource/receptor, loss of quality and integrity of the resource/receptor, severe damage to key characteristics, features or elements (e.g. to water flows, water levels, or the availability of a water resource or to flood risk).	Large scale or major improvement to resource/receptor quality, extensive restoration or enhancement.
Medium	Partial loss of resource/receptor, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements (e.g. to water flows, water levels, or the availability of a water resource or to flood risk).	Some benefit to key characteristics, features or parameters describing resource/receptor quality.
Low	Some measurable change in/damage to attributes, quality or vulnerability (e.g. to water flows, water levels, or the availability of a water resource or to flood risk). Minor loss of, or alteration to, key characteristics, features or elements.	Minor benefit to, or addition of, one or more key characteristics, features or parameters describing resource/receptor quality.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing resource/receptor quality (e.g. water flows, water levels, or the availability of a water resource or to flood risk).	

The definitions applied to resulting negative significance categories for the purposes of this assessment are summarised as follows:

- Major: If adverse, impacts with this significance represent key factors in the decision-making process or the feasibility of the Project. They are generally, but not exclusively, associated with human health or features of international or national importance and/or resources/features that are unique, which, if lost, cannot be replaced or relocated.
- Moderate: If adverse, impacts with this significance may contribute to the decision-making process. These impacts are generally, but not exclusively, expected to be important at a regional or local scale.
- Minor: These impacts may be raised as local issues but are unlikely to be of importance in the decision-making process. Nevertheless, they are of relevance in the detailed design of the Project.
- Negligible: Impacts that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

All beneficial impacts, from minor to major, may contribute to the decision-making process.

7.3.5 Key Guidance and Standards

- The Kenyan policy and legislation and the international guidance and standards presented in Section 2.0 are relevant to this assessment. The following are of particular relevance:
- The National Water Policy (2012);
- National Water Masterplan 2030 (2014);
- The Water Act (2016) and subsidiary legislation;
- Climate Change Act (2016);
- The Turkana County Water Act (2019);
- WBG EHS Guidelines (2007);
- WBG EHS Guidelines: Water and Sanitation (2007);
- IFC PS 1 (2012); and
- IFC PS 3 (2012).

7.3.6 Receptors of Interest and Importance

The focus of this assessment is on changes to the quantity of water within the AoI. Baseline environmental information indicates the importance and scarcity of water in the AoI. This emphasis is reflected in the relevant legislation[6].

Using the Project Description and the baseline water environment information presented in Section 6 of this ESIA, the following water environment receptors have been identified as being susceptible to changes in quantity (levels and flows, and therefore availability):

[6] The Kenya Water Act also enforces the requirement to have a permit to construct boreholes and wells, that abstraction amounts need to be reasonable, to reduce the potential for water losses and to prevent contamination/pollution of water

- Surface water in reservoirs, permanent rivers, seasonal rivers and the extensive network of ephemeral streams and drainage luggas[7]; and
- Groundwater in shallow aquifers predominantly located along river valleys and the edge of the volcanic deposits and deeper aquifers.

In addition to the receptors that could be impacted by changes in water quantity/availability, this assessment also considers the potential for changes in the water environment to increase erosion and change flood risk that could have an impact on human receptors. Specific water environment receptors that fall within these general categories, and that will be considered in this assessment are presented in Table 7.3-3.

Table 7.3-3: Receptors and Importance

Receptor	Importance	Comment
Kalabata River (Project infrastructure, including wellpads and CFA, located within catchment)	Medium	An ephemeral watercourse that is fed by direct precipitation, run-off and ephemeral flow from luggas. The Kalabata River feeds into the Kerio River, which ultimately flows into Lake Turkana. Shallow groundwater associated with this river is used as a water supply throughout the region (e.g. through hand dug wells in the dry riverbed, see shallow groundwater receptor).
Malmalte River (Make-up water pipeline crosses watercourse)	High	Located to the east of the Turkwel Reservoir and flows into the Turkwel River. Local water source in West Pokot with limited potential for substitution due to limited surface water resources in Kenya.
Turkwel River	High	The Turkwel River is downstream of enabling works for the water pipeline. It is used for water supply and irrigation with limited potential for substitution due to limited surface water resources in Kenya.
Seasonal rivers and ephemeral streams/drainage luggas (as identified in the baseline) (Project infrastructure, including wellpads, CFA and infield flow lines, located within seasonal water courses)	Medium	Surface flows rarely used as a water resource. Limited potential for substitution due to limited surface water resources in Kenya. Shallow groundwater associated with these systems is used for water supplies throughout the region (e.g. through dug wells), see shallow groundwater receptor.
Turkwel Reservoir (Make-up water to be abstracted from reservoir)	High	Used for power generation through a hydroelectric scheme. Discharge from the turbines provide flow in the Turkwel River.
Shallow groundwater aquifers (alluvial/colluvial aquifers and near surface volcanics) (Receptor underlies Project infrastructure)	High	Shallow groundwater near to the surface, including in river/stream/lugga bed sediments, as a water supply throughout the region with limited potential for substitution. Proximity to the surface and the potential for recharge through sandy soils and superficial deposits means there are likely to be pathways

[7] For the purposes of this work, permanent/perennial rivers are those where water is present above ground level all year round. Seasonal/ephemeral watercourses include seasonal rivers, seasonal streams and luggas. Seasonal rivers are the larger watercourses that have temporary flow above the ground surface only during the wet seasons. Seasonal streams also only have flow during the wet seasons, but are more minor watercourses. Lugga is the term for the transitory network of drainage channels that direct surface water run-off during intense rainfall events towards the more defined channels. These are typically shallow, migratory and form a wide dendritic network. Seasonal rivers, seasonal stream and luggas may have water below the ground surface in the river beds in the dry season that can be exploited as water resources through dug wells in or adjacent to the riverbeds.

Receptor	Importance	Comment
		between activities at the surface and the water supplies provided by these receptors.
Deep groundwater (typically igneous bedrock)	Low	Existing deeper Project boreholes (screened at depths of up to 252 m below ground level); used for Project water and some of which are provided to local communities. Potential for importance as a water supply, but likely to have low quality due to high salinity and yields can be poor. Limited recharge potential from the surface.
Homesteads (indicative of PAP)	High	Homesteads (indicative of PAP) located downstream of the Project infrastructure which could be subject to any changes in flood risk

Impacts on groundwater levels and changes to surface water flow regimes (including increases to flood risk) have the potential to impact water availability and areas that are habitable. Other receptors could be impacted because of changes in surface water or groundwater quantity/availability that are considered in this assessment. These include:

- Existing water users – livestock and humans that use local community water supplies (including dams, water pans, shallow hand dug wells in luggas, hand pumped wells, and boreholes), which are considered in context with wider social issues in Section 7.9.
- Existing water users – non-human biota (i.e. ecological/aquatic habitats), which are considered further in context with wider biodiversity issues in Section 7.7.

7.3.7 Sources of Impacts

Potential sources of impact of a range of magnitudes that will occur throughout the life of the Project are set out below by Project phase.

7.3.7.1 Construction Phase

Based on the Project Description and the understanding of the baseline water quantity conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to water quantity (and therefore availability) during the construction phase. The potential sources of impact and routes by which they could impact water quantity are as follows:

- Construction of areas of hardstanding and buildings - potential changes to groundwater recharge.
- Construction activities near or within watercourses (e.g. vegetation removal, channel diversions and construction of bunds/ditches/trenches) – potential changes to drainage patterns, run-off regimes, river flows, erosion patterns and flood risk.
- Construction of subsurface features – potential passive dewatering and/or changes in local groundwater levels and flow patterns.
- Project water requirements – sourcing early construction phase (first 18 months) water has the potential to impact water availability for existing groundwater users (initially via availability of groundwater, including in dug wells).
- Project water requirements – sourcing construction phase water from the Turkwel Reservoir (month 18 – 36 of construction) has the potential to impact on water levels in the Turkwel Reservoir.

- Discharges – discharges/drainage of water or treated effluent have the potential to change baseline flows, erosion rates and downstream flood risk.

7.3.7.2 Operational Phase

Based on the Project Description and the understanding of the baseline water quantity conditions (i.e. flows, levels and availability) that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to water quantity during the operational phase. The potential sources of impact and routes by which they could impact water quantity are as follows:

- Project water requirements – sourcing operational water from the Turkwel Reservoir has the potential to impact on water levels in the Turkwel Reservoir.
- Discharges – discharges/drainage of water or treated effluent during the operational phase have the potential to change baseline flows, erosion rates and downstream flood risk.

Those impacts that were identified as originating in the construction phase but have durations that are predicted to extend into the operation phase, are not re-assessed as part of this stage. Such impacts include the changes to the surface water or groundwater flow regimes or recharge to groundwater as a result of facility construction.

7.3.7.3 Climate Change

Climate change predictions with respect to rainfall, evaporation and flooding can be highly variable. The uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Niño events. Most climate predictions suggest there will be an increase in temperature and rainfall, and of extreme weather events (i.e. rainfall intensity and droughts).

Temperature increases of up to 2.5°C are predicted by 2060 (Ministry of Foreign Affairs of the Netherlands, 2018). Projections presented in the UNDP Climate Change Country Profile for Kenya consistently indicate an increase in total annual rainfall over Kenya. In addition, the proportion of rain falling in heavy rainfall events is predicted to increase (McSweeney C., New M. and Lizcano G. 2010). However, other studies predict a potential decrease in future rainfall in Kenya. Funk et al. (2010), for example, predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean. Generally, a wetter climate is predicted with more intense wet seasons, and increase in the number of extreme wet days, and less severe droughts during October-November-December and March-April-May.

It is likely that increased rainfall volumes and intensity will result in increased run-off, river flows, erosion and flooding. In the short term, climate change is likely to be less significant. However, climate change during operations has the potential to contribute to impacts on buried aspects of the Project through exposure and damage if the design has not considered climate change within the Project lifetime. This also has the potential for changes in run-off, erosion and flooding to impact facilities located near surface watercourses through erosion damage or inundation by flood waters.

There is uncertainty over predicted changes to river flows as a result of changes in weather patterns linked to forecast climate change. Some climate change models predict a 20% increase in Kenya's river flows by 2030 resulting from extreme runoff during intense rainfall events (Avery S. 2013). Increases in runoff rates would lead to more erosion and flooding.

Changes in the rainfall and run-off regimes could also impact reservoir water levels. Increased rainfall and run-off in the Turkwel Reservoir catchment could lead to increased water input and higher reservoir levels, but increased temperatures could increase evaporation, which would reduce water levels. If rainfall reduces due to climate change this could also result in reduced reservoir water levels. Water levels in the reservoir are currently around the optimum, but below the maximum, for power generation at the hydroelectric dam. The sides slopes of the reservoir are understood to be steep, so there are few other water users (e.g. fishing and water taken for human water supply). If water levels reduce, the power generation capacity would reduce, access could become more difficult if fishing or water extraction for supply is taking place, and Project water security could be affected.

Different groundwater systems are likely to react in different ways to climate change. Shallow aquifers recharged by rainfall and with short residence times will react more quickly to changes in recharge and are likely to be those most affected. If rainfall reduces due to climate change, or changes in rainfall patterns and intensity result in more run-off and less infiltration to ground, climate change could reduce recharge to aquifers and lead to reduced resource availability. This would not necessarily impact the Project because groundwater is only planned to be used in the short term. Deep fossil groundwater is unlikely to be impacted by climate change directly because recharge is already negligible.

7.3.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.3.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on water quantity/availability:

- The abstraction point of the water pipeline from the Turkwel Reservoir will be from upstream of the dam, in the reservoir itself – this will mean no change to the amount of water that passes through the power station turbines and is discharged into the Turkwel River. Therefore, compared to the baseline, will result in no change to the downstream flow regime in the Turkwel River.
- New roads will be designed to manage run-off at rates equivalent to pre-construction and in line with Kenyan water standards – this will mean there will be little change to run-off rate and the surface water flow regime.
- The section of water pipeline that passes under the Malmalte River will be installed by HDD and the buried section will originate outside the riparian corridor – by using HDD rather than cut-and-fill, the construction works will not involve excavation of ground in or near the river bed, which could alter flow regimes and affect the available area of the functional flood plain.
- Facility locations and drainage will be designed to redirect surface water flows, including flood flows around wellpads where possible – localised redirection of surface water flows will maintain the water within the same catchment to result in reduced potential disturbance to baseline conditions.
- Clean surface water from wellpads will be discharged to nearby lugga, and drainage will be designed to minimise downstream flood risk – this will lead to the reduction in unnecessary water loss through clean water becoming contaminated and the management of discharge rates will reduce the potential change in downstream flood risk.
- Selection of water sources - the initial source of water supply during construction will be from existing boreholes. This will mean no new boreholes will be installed; although abstraction rates at the boreholes will be greater that the baseline conditions. After approximately 18 months[8] from the start of construction, the water supply will be taken solely from the Turkwel Reservoir. This will reduce the long-term impacts

[8] There is potential that a longer construction period may be required (up to 24 months). If this is the case, then a risk assessment will be undertaken based on the information available at the time to review the sustainability of continued use of existing boreholes for an additional 6 months

on the groundwater environment that could result from the long-term abstraction of water from boreholes beyond the initial 18 months.

- Existing roads will be used where possible – avoiding the construction of new roads where existing ones can be used (with or without upgrade) reduces the requirement for unnecessary earth movement and, therefore, the potential to generate suspended solids that could pollute the surface water environment.
- There are no planned abstractions from luggas/streams – these smaller surface watercourses would be sensitive to abstractions. Avoiding taking water from these will mitigate changes to the baseline surface water flow regime in these watercourses.
- Where possible, works in watercourses will be in periods of low or no flow – this will reduce the potential for changing the surface water flow regime in the channel.

7.3.8.2 Good International Industry Practice

In addition to the mitigation specified within the Project Description, this section presents accepted good practice that will also be implemented in order to remove or reduce the magnitude of potential impacts.

All Project Phases

- All abstractions from, or discharges to either groundwater or surface water will be within the volumes permitted under licence from NEMA – the potential impact of reduced surface water flows/levels and of groundwater levels due to abstraction, or the impact on flows and flooding downstream in the case of discharges, is considered where permitting in order to limit impacts. Therefore, by operating within the permitted limits of the licence, the impacts will be managed.
- Abstraction and discharge monitoring will be undertaken as stated in the licence – licences will typically specify locations and limits of abstraction volumes or discharge rates. Therefore, by operating within the permitted limits of the licence, the impacts will be managed.

7.3.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were identified during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- Concern regarding impact on water surfaces from 33 wellpads.
- Concerns related to the use of water from Turkwel Dam which might induce potential conflict with West Pokot.
- Concern regarding water scarcity and potential solutions provided by Project proponent.
- Concern that water resources might be depleted by the Project activities.

7.3.10 Impact Classification

Taking into account the baseline water environment setting (Section 6.4), the relevant incorporated environmental measures (Section 7.3.8), and the potential sources of impact (Section 7.3.7) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

The determination of impact magnitude is supported by the findings presented in the following documents, all of which are presented in Annex I:

- The Flood Risk Assessment (Worley Parsons, Kenya South Lokichar Foundation Project Flood Risk Assessment, reference KSLFP-0000-EG-STU-0001, dated February 2019);
- Strategic Water Supply for Development, Technical Report 1.1. Sean Avery for Tullow Oil dated 8 October 2015;
- Strategic Water Supply for Development, Internal Paper 10 – Optimum Intake Location at Turkwel Dam, Richard Boak and Sean Avery, dated December 2016;
- Strategic Water Supply for Development – Turkwel Dam Option. The South Lokichar Development and Other Water Demands. An Objective Perspective and Way Forward, Sean Avery, dated October 2018;
- Golder document 1433956.628 – Hydrotest Water Philosophy (Golder, 2019a); and
- Golder document 1433956.636 - Assessment of the predicted zones of influence of planned groundwater abstractions (Golder, 2019b).

The qualitative assessment of impacts uses the receptor importance (as assigned in 7.3.6), the magnitude of impact and the assessment matrix presented in Section 3.7 to evaluate the environmental impact significance. The direction and timescale of each impact linkage is assigned.

7.3.10.1 Construction Phase

The impact classification process focuses on the potential impacts to water quantity that could result in significant impacts. As such some potential impacts can be "*scoped out*" where there is insufficient linkage between the source of impact and receptors, or the magnitude of this impact would be negligible when taking account of incorporated environmental measures.

The following bullets provides qualitative evaluation of impacts which are not considered for further impact classification:

- Construction of areas of hardstanding and buildings could result in reduced infiltration to groundwater. The baseline environment work identified that recharge to deeper groundwater aquifers is limited in the Project area. The greatest recharge of groundwater typically occurs in the mountains. There will also be some recharge of shallow alluvial aquifers adjacent to rivers from surface water. The Project will reuse existing infrastructure where possible; thereby reducing the amount of new hardstanding. The area taken up with Project infrastructure is also small compared to the wider water catchment areas. The drainage is being designed to mimic baseline flow patterns and rates, and clean run-off is being kept separate from water affected by Project activities to reduce the amount of water that will be treated. Given this, it is predicted that the impact magnitude will be negligible and the significance of the impact on deep groundwater and shallow groundwater is **Negligible**.
- Construction of subsurface features (e.g. sumps, pits, buried pipelines, foundations and trenches) and the backfilling of features such as trenches once pipework has been laid, has the potential to change hydraulic properties, and groundwater levels and flow regimes. Such changes would be localised and very small scale given the proposed depth of excavations. It is predicted that the impact magnitude will be negligible and the significance of the impact on deep groundwater and shallow groundwater is **Negligible**.
- There is potential that changes to drainage regimes within catchments due to construction activities may result in the redistribution of water into different luggas when compared to baseline conditions. However, for localised drainage and luggas, maintaining the natural drainage patterns is part of the design measures.

Predicted impact magnitude is therefore assessed as negligible and the impact significance on these receptors is **Negligible**.

The following potential sources of impact are, therefore, the focus of further impact classification:

- Discharges of water from drainage systems and sumps, from sanitation systems, from waste management areas, or water used for pipeline hydrotest could impact natural drainage patterns and increase erosion.
- Changes to flood risk due to Project infrastructure and drainage changing flood flow mechanisms in luggas and in run-off regimes.
- Water abstractions from boreholes potentially impacting groundwater levels - water will be needed to supply construction camps, local communities and the Project during construction. Water will also be required for drilling, concrete production, dust suppression, and hydrostatic testing ('hydrotesting') pipelines. The proportions required for each element will vary through the construction period. Initially, all construction phase water will come from existing boreholes. All of the proposed abstraction boreholes already exist (i.e. no new wells will be required); however, some of the boreholes are currently operational and some boreholes are not being abstracted from). The number of operational boreholes and the volume abstracted will increase compared to baseline abstractions (i.e. existing boreholes that are currently not in use will be brought into use).
- Water abstraction from the Turkwel Reservoir potentially impacting surface water levels - from 18 months into the construction phase onwards (potentially extending up to 24 months), construction water will come via a pipeline from the Turkwel Reservoir, replacing the abstraction from groundwater boreholes; and
- Changes in flow regimes due to work in or near water courses - changes to drainage patterns and run-off regimes resulting in changes to which watercourses receive the run-off and the volumes of run-off to watercourses. Construction activities in watercourses themselves also have the potential to alter existing river flows, erosion patterns and flood risk through temporary diversion or damming.

The impact assessment is discussed in more detail in the sub-sections below. The construction phase impact classification is presented in Table 7.3-5. Any additional mitigation is also presented in that table.

Water Discharges

Without mitigation, discharges of water or treated effluent to existing watercourses (including that from pipeline hydrotesting) could result in changes to drainage regimes, erosion patterns and downstream flood risk; particularly to watercourses with little baseline flow, or long periods of no baseline flow (i.e. ephemeral streams and the local drainage lugga network). The impact magnitude without mitigation is predicted to be direct medium (negative), short term, and temporary because they can be reversed if discharges cease. The impact significance to ephemeral streams and the lugga network is **Minor**.

The incorporated mitigation measures mean that discharge locations and rates will be controlled through GIIP (i.e. undertaken under a valid effluent discharge license issued by NEMA).

In addition, a water management philosophy (included in Annex I – document 1433956.628) promoting water use reduction and reuse will be applied to hydrotesting. This includes: testing pipework and flowlines/trunklines in short sections so less water is needed at any one time; water reuse between test sections and secondary use of water. Discharges of used water will be made with awareness of potential ecological and human receptors (with respect to pollution control, flows and flood risk), and undertaken in a way that limits increases in erosion.

Therefore, including the incorporated and additional mitigation, the predicted impact magnitude on ephemeral streams and the lugga drainage network is considered to be reduced to negligible and the impact significance on these receptors is **Negligible**.

Changes in Flood Risk

The Worley Parsons Flood Risk Assessment (Annex I) focussed on flood risk to the Project infrastructure at Amosing and Ngamia, however the flood model outputs (1 in 100-year return period event) have also been used to assess the potential change in flood risk to third parties (homesteads). Figure 7.3-1 and Figure 7.3-2 present estimated flood depths with the Project infrastructure in place and incorporated flood mitigation applied.

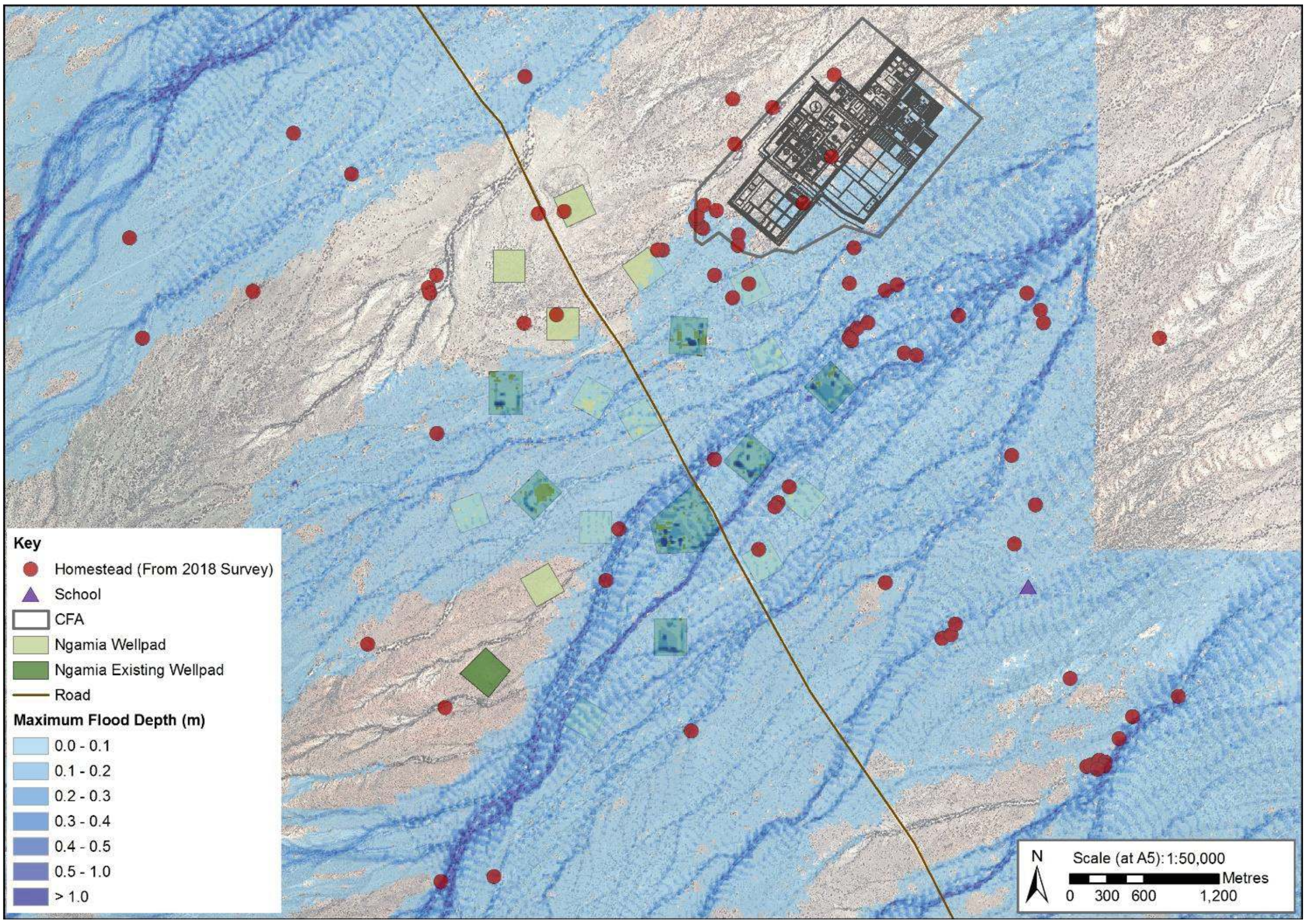

Figure 7.3-1: 1 in 100-Year Return Period Flood Model Output Around Ngamia and the CFA with Flood Mitigation Applied (Source: Worley Parsons, 2019)

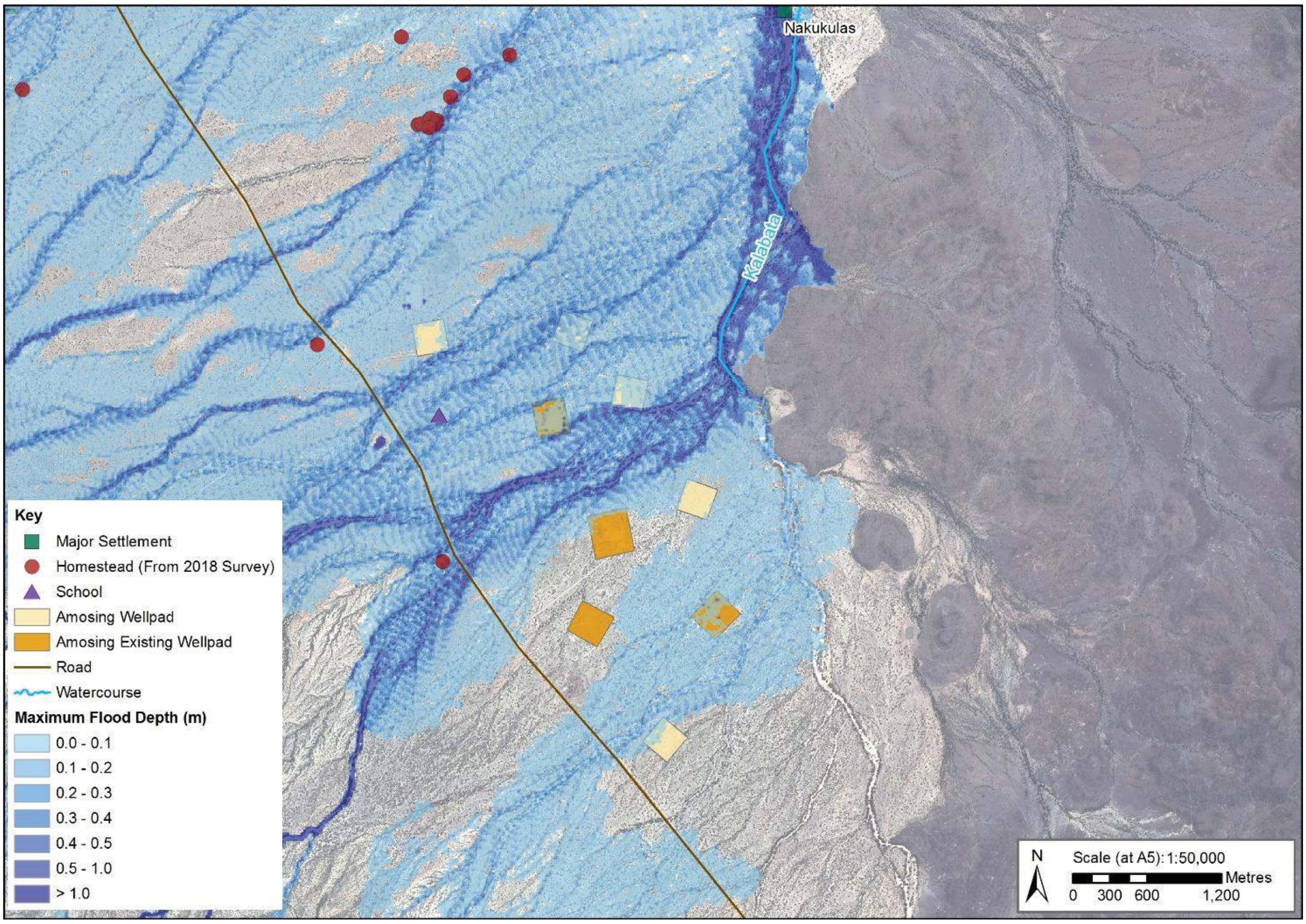

Figure 7.3-2: 1 in 100-Year Return Period Flood Model Output Around Amosing with Flood Mitigation Applied (Source: Worley Parsons, 2019)

The assessment of flood risk to third parties involves comparing the Project scenario (i.e. with the incorporated flood mitigation in place) to the baseline scenario. Figure 7.3-3 and Figure 7.3-4 present difference plots between these two scenarios, which show the increase or decrease in flood depths due to presence of the Project infrastructure and associated incorporated flood mitigation. Typically, this results in predicted flood depths reducing (by up to 5 cm) at the infrastructure location and directly downstream and increasing upstream of and where the flood waters are diverted around the infrastructure. The assessment of risk to third parties involves an interrogation of changes in flood depths for third parties as a consequence of developing the Project. Figure 7.3-3 and Figure 7.3-4 show that there is a maximum increase of 5 cm in areas outside of the luggas that are already predicted to be flooded to depths of between 0.1 to 1 m (see Figure 7.3-2 and Figure 7.3-3).

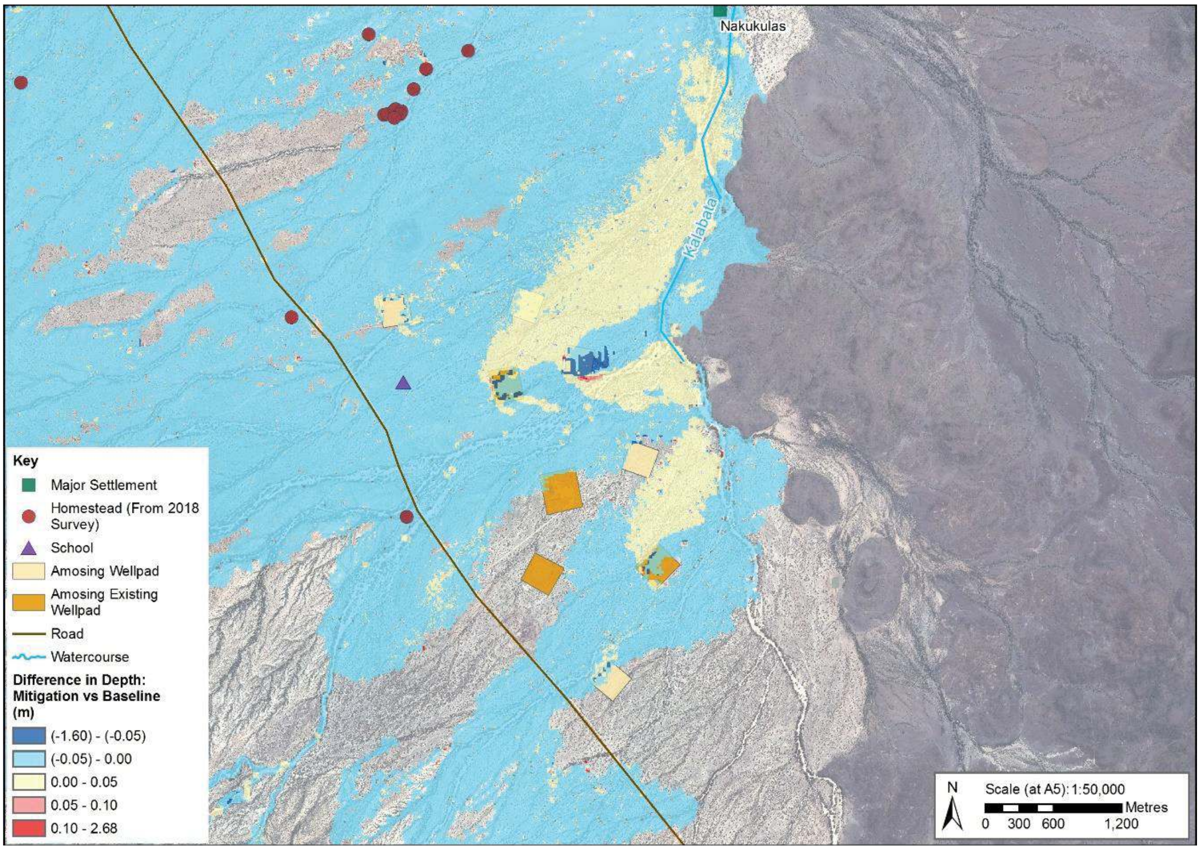

Figure 7.3-3: Difference Plot (Infrastructure and Mitigation vs. Baseline) Showing Change to Flood Risk During a 1 in 100-Year Return Period Event near Amosing

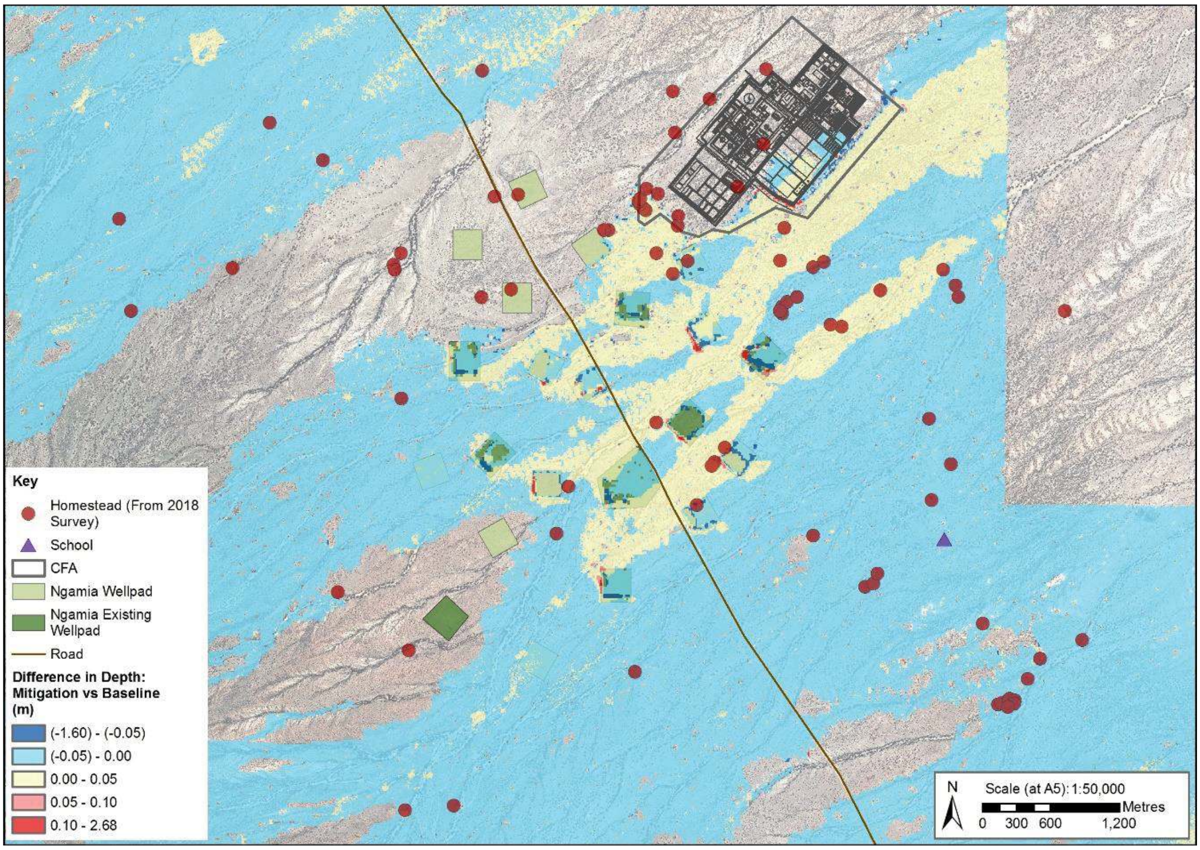

Figure 7.3-4: Difference Plot (Infrastructure and Mitigation vs. Baseline) Showing Change to Flood Risk During a 1 in 100-Year Return Period Event near Ngamia

With the incorporated flood mitigation in place, the increased flood risk to third parties leads to an impact magnitude of low (adverse). The associated residual impact significance on humans living downstream of the infrastructure is **Minor.** The impact will be medium term as it will extend beyond construction and last throughout operations**.**

Changes in Groundwater Levels Due to Water Abstractions from Wells

The conceptual understating of groundwater in the AoI is that there can be groundwater in near surface aquifers (typically alluvial/colluvial deposits and near surface volcanics) and deep aquifers (typically in the igneous bedrock). During exploration activities, many wells in Plio-Holocene sediments and in the basaltic lava layers of the Auwerwer Volcanics were proven to bear little water. Most water was struck in the interflow sediments between the lavas (Avery, 2016). Strata in the Lokichar basin are known to be highly variable in thickness and extent, so the presence, lateral extent and thickness of aquifer units, and layers that might provide hydraulic barriers to flow, is difficult to predict.

The proposed Project abstraction wells have screens at various depths in order to target groundwater. Most have more than one screened section. Some screened sections are in an igneous unit that is over 75 m below ground level and others are in more sandy deposits in the top 16 m to 40 m below ground level. It is possible that the deeper groundwater is present in discrete lenses or units of varying areal extent. If these are hydraulically separate from each other, changes to water levels in one aquifer unit would not necessarily affect another (e.g. abstraction from a deeper aquifer might not result in changes in groundwater levels in a shallow aquifer in the same location, and vice versa).

The geological information available for some of the wells suggests that there is a 4 m to 10 m thick clayey layer present that could restrict vertical hydraulic connection between some water bearing strata at different depths in the same area. In addition, the water strikes when drilling the boreholes were often 50 m to 100 m or more below ground level, but the resting water level in the installed well were much closer to the surface, which in combination with the conceptual understanding of the hydrogeology of the area suggests the deeper water bearing units may be confined. However, some boreholes such as East Lokichar and Ngamia East have one of their screened sections in nearer surface sandy deposits (i.e. top 20 m). The fact that descriptive drilling logs are not available for all boreholes, the fact the geology is highly variable and the absence of near-surface monitoring wells means that it is not currently possible to conclusively state that the separate water bearing units at the abstraction wells are not hydraulically connected. On this basis, this assessment has been completed on the assumption that both deep and shallow aquifers could be hydraulically connected.

In order to identify areas where drawdown (i.e. lowering) of groundwater levels due to abstraction would impact groundwater availability (including the availability of shallow groundwater in seasonal dug wells) Golder has completed predictive work (Annex I – document 1433956.636) to estimate the potential distance from the proposed groundwater abstractions where groundwater lowering can be expected, i.e. the radius of influence. The results are presented in Table 7.3-4 and the predicted radii of influence are shown in Figure 7.3-5.

Table 7.3-4: Estimate of Radius of Influence

Well Name	Proposed Abstraction Rate (m^3/d)	Estimate of Radius of Influence (m) Based on Pumping Test Data	Sensitivity Analysis of Radius of Influence (m) Based on Literature Value of Specific Yield [(b)]
Kengomo 1	130	460	610
Kengomo 2	100	140	710
Nakukulas 9 [(a)]	200	No data available	
Kaeng'akalalio C	90	70	150
Nabolei	90	210	470
Ngamia East [(b)]	240	No data available (estimated to be greater than East Lokichar WBHC)	
Nakukulas 10 [(b)]	170	No data available (estimated to be greater than East Lokichar WBHC)	
East Lokichar WBHC	170	520	1,150
Ekunyuk	180	83	420
Ewoi	190	200	450

(a) For the three wells that pumping test data has not been available a qualitative methodology has been applied in order to provide an indicative radius of influence.
(b) Due to lack of confidence in the specific yield value estimated using field data, conservative sensitivity analyses have been completed using literature values for specific yield

After 18-months of pumping, the indicative radius of influence for Nakukulas 9 and Nakukulas 10 is estimated to be between 2,500 m (specific yield of 0.1) and 5,600 m (specific yield of 0.02 – sensitivity analysis). The information known about the Ngamia East well suggests that similar hydrogeological conditions to the Kengomo wells are present; therefore, an indicative radius of influence between 500 m and 750 m is inferred. The impact is predicted to extend up to 1,150 m from the wells in the case of East Lokichar WBHC.

The abstraction is predicted to lower groundwater levels at the wells themselves by up to 84 m; this then reduces to no drawdown at the maximum extent of the radius of influence, creating a cone of depression of the groundwater around the abstraction borehole.

Based on the calculations undertaken to determine the above impacts, it is considered likely that any abstractions within 200 m of any of the abstraction wells could be derogated as a result of abstraction from the Project wells. The most significant combination of drawdown and radius of influence is at Kengomo 1 where a drawdown of 5 m is estimated at a distance of 200 m by considering a logarithmic drawdown relationship between the estimated pumping well drawdown of 35 m and radius of influence of 460 m.

Whilst it is understood that it is likely that groundwater at depth will be present in discrete unit, there is insufficient data exist to indicate whether the targeted groundwaters form discrete aquifer units or act as one, and there is no information to confirm or reject the possibility that there could be hydraulic connection between groundwater in the screened strata and groundwater in the near surface. Therefore, is has been assumed that drawdown in water bearing units at depth would also be experienced at surface in response to pumping. Consequently, surface watercourses in the radii of influence that are reliant on shallow groundwater for baseflow and surficial habitats reliant on shallow groundwater could be impacted by the groundwater abstraction if groundwater levels are drawn down to a level below which they can still provide input to surface water. This could also mean that water normally present in shallow groundwater in the river beds (even when the surface water is not flowing) might also be lowered, which could impact those who use water from shallow dug wells.

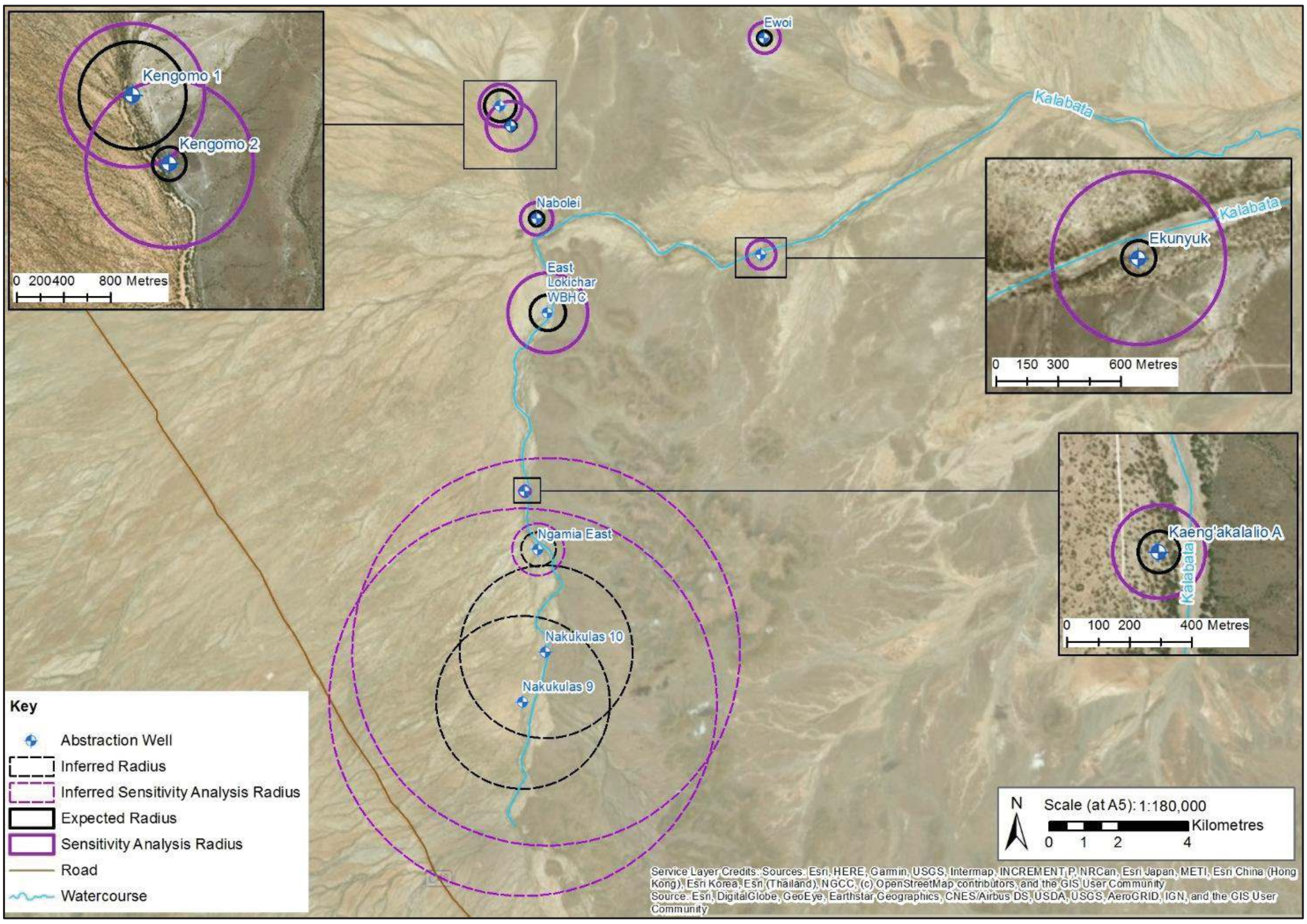

Figure 7.3-5: Indicative Radii of Influence After 18 Months Abstraction

As shown on Figure 7.3-5, there are watercourses located within the radii. The potentially impacted sections of the main watercourses and major luggas, located within the radii, are shown on Figure 7.3-6. Homesteads identified during 2018 survey (as described in the Land baseline in Section 6.9) located near the impacted areas are also shown.

Although local communities rely on water supplies provided by TKBV from community water points, people do also use shallow groundwater in hand dug wells as other water supply sources. These sources, and the users, have the potential to be impacted by a lowering of groundwater levels because water may become less available or inaccessible.

Without any mitigation, the estimated drawdown is predicted to be measurable and could result in a partial loss of a resource within the radius of influence. Therefore, the impact magnitude is predicted to be medium (adverse). The impact to groundwater will be direct and the impact to surface water will be indirect. The associated impact significance on seasonal rivers/ephemeral streams/luggas within the radius of influence is **Negligible** as all the watercourses are ephemeral and only flow during extreme events**.** For conservatism, the assessment assumes there could be hydraulic connectivity between the shallow and deep aquifers, so that abstractions from strata at depth could impact water levels and availability in both deep and shallow aquifers. The impact significance on shallow groundwater is **Moderate**. This impact is a potential source of impact to habitats (discussed further in Section 7.7, including mitigation measures for sensitive receptors including Turkana toad and an undescribed beetle) and those using shallow hand dug wells. The impact significance on deep groundwater is **Minor**. The impact will be temporary and short term because pumping for the Project will cease after 18 months and groundwater levels should rebound over time.

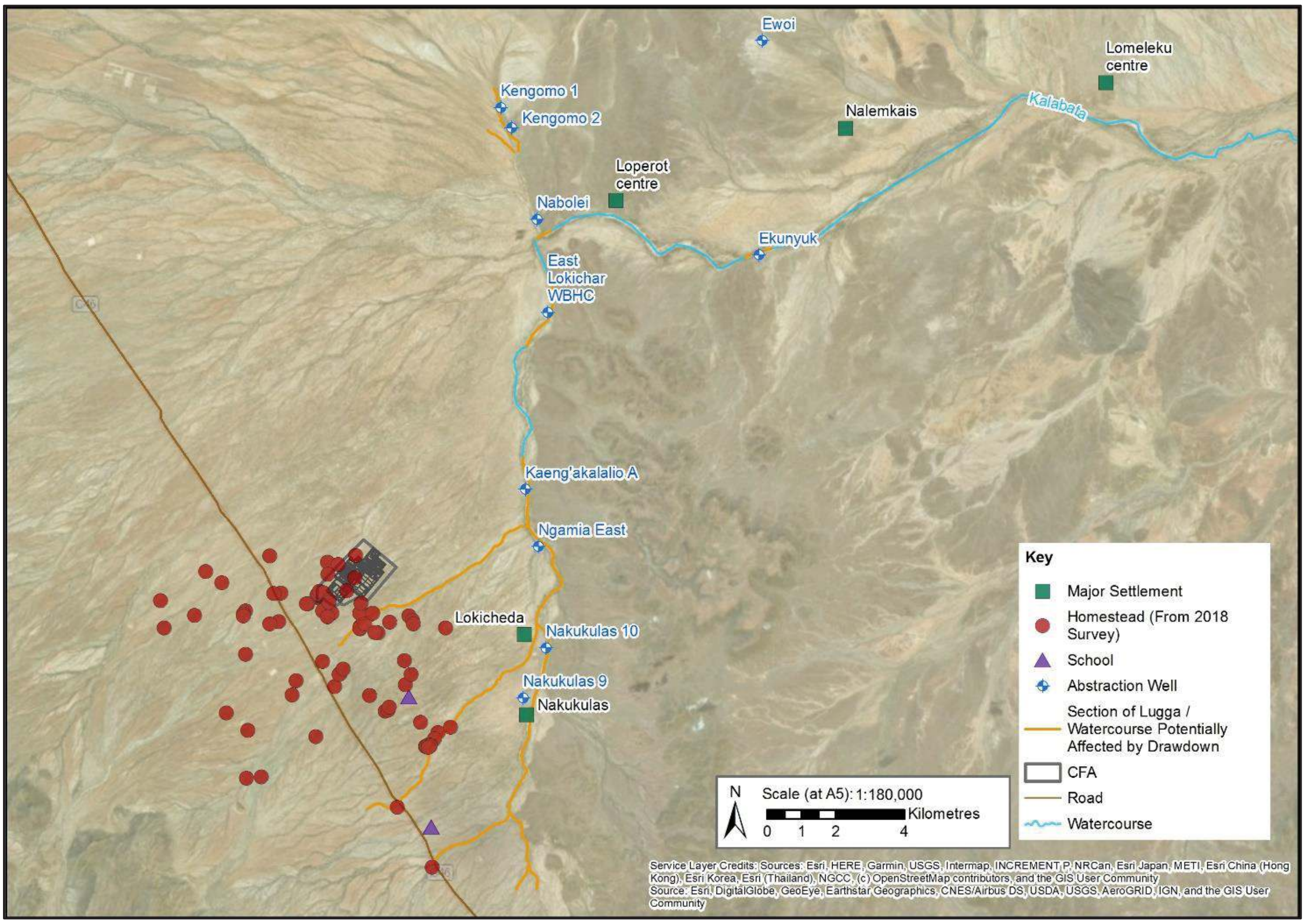

Figure 7.3-6: Potentially Impacted Sections of Watercourses and Major Luggas After 18 Months Abstraction.

The extent of the radius of influence could be reduced by reducing abstraction rates. In order to do this, a lower water demand or alternative supplies would be needed. It is understood that the proposed water demand from the wells is enough to cover the construction need and continue providing the volume already supplied to local water users. It is planned that surface water in the Turkwel Reservoir will replace the groundwater source after 18 months, which is already a design mitigation that reduces the area of impact on groundwater levels. However, this does not mitigate the source of impact for the first 18 months of construction.

It is assumed that the Project water requirement during the first 18 months of construction cannot be reduced further, so no other mitigation to reduce the impact can be applied. A communication plan will be put together for existing local water users (PAP) within the predicted radii of influence to help them identify alternative sources of water (i.e. existing bowser fed water points and reticulated wells) and TKBV will communicate with PAP so they understand that hand dug wells in luggas in the zones identified may not be able to be used during the 18 month abstraction period.

Analysis, mitigation measures and monitoring of critical habitat indicators, relating to these impacts are presented in Section 7.7.

Taking into account the action plan (Section 7.7) to develop this impact assessment element further and identify mitigation based on the outcome, the predicted magnitude of residual impact to the water environment is low (resulting in a **Minor** residual impact significance on seasonal rivers/ephemeral streams/luggas and a **Minor** residual impact significance on shallow groundwater).

Changes in Reservoir Levels Due to Water Abstraction

Water abstraction from the Turkwel Reservoir has the potential to impact surface water levels in the reservoir. Tullow has undertaken a range of assessments in order to select the most appropriate long-term source of make-up water, and, as part of that, the potential impacts on the source were considered. These include the following, which are all presented in Annex I:

- Strategic Water Supply for Development, Technical Report 1.1, Sean Avery for TKBV, dated 8 October 2015;
- Strategic Water Supply for Development, Internal Paper 10 – Optimum Intake Location at Turkwel Dam, Richard Boak and Sean Avery, dated December 2016; and
- Strategic Water Supply for Development – Turkwel Dam Option. The South Lokichar Development and Other Water Demands. An Objective Perspective and Way Forward. (Avery, 2016c)

The main points from these pieces of work can be summarised as follows:

- Project water demands from the reservoir were minimal compared to other water losses, including evaporation from the reservoir.
- Water abstraction at a rate of 0.278 m^3/s over the Project lifetime could result in reservoir water levels being lowered by up to 3.4 m over the Project lifetime (Avery, 2015). Note - this rate equates to approximately 24,000 m^3/d, or over 150,000 bwpd, which is more than is required by the current Project Description (13,116 bwpd during construction, rising up to 104,000 bwpd during operation).
- Daily changes in water levels at the same rate are predicted to be between 0.4 mm/day and 2.2 mm/day.
- A lower average daily water abstraction rate of 7,000 m^3/d (approximately 44,000 bwpd) resulted in a predicted 0.3 mm/d reduction in reservoir levels (Boak and Avery, 2016). Using historical reservoir levels (1991 to 2013) and an abstraction rate of 0.157 m^3/s (13,600 m^3/d) over that 22-year period, the predicted reduction in reservoir levels was up to 2 m (Avery, 2018). The graph is reproduced in Figure 7.3-7. The rate used in the prediction is more than the construction phase requirement and slightly less than the peak operational phase requirement.

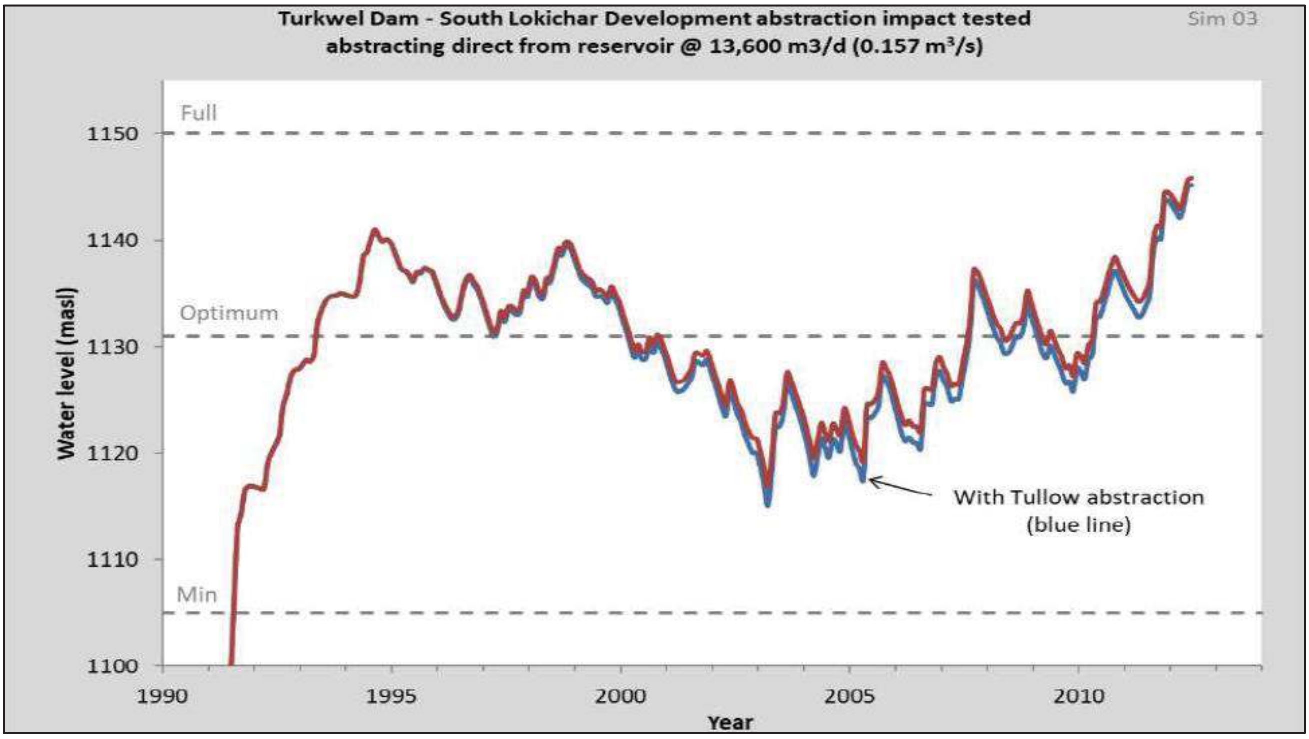

Figure 7.3-7: Turkwel Reservoir Water Level Simulation (Source: Avery, S., 2018)

The predicted impact magnitude is considered to be direct low (negative) and the impact significance on reservoir water levels is **Minor**. The abstraction impacts will continue into the operational phase, so the duration of the impact will be medium term and are predicted to be temporary because they would reverse when the abstraction ceased.

There is no additional mitigation that is predicted to reduce this impact significance further. However, detailed design of water supply pipeline abstraction must be developed to allow for climate change effects on Turkwel Reservoir. In addition, monitoring of reservoir abstraction rates and water levels is recommended to validate the predicted impacts and enable early identification of unexpected/unprecedented changes (compared to historical reservoir levels). An action plan should be developed in association with Kerio Valley Development Authority (KVDA) and instigated if unexpected and unacceptable impacts are identified (e.g. a reduction in power generation if reservoir levels unexpectedly fall below optimum levels as a result of Project abstraction).

Changes to Flow Regimes Due to Work in or Near Water Courses

The upstream infrastructure development will involve construction across/in luggas. Flowlines and other infrastructure will be installed across luggas by trenching and backfilling. The water pipeline construction will involve work adjacent, but some distance from the Malmalte River and across luggas. This section is subdivided into these three sets of works in order to predict the impacts separately and apply specific mitigation.

Incorporated mitigation describes that works in watercourses will ideally occur in periods of low or no flow to reduce the potential for changing the surface water flow regime in the channel. However, due to the length of construction time and the nature of construction, it is likely that some localised flows will be affected.

Infrastructure Development (Luggas)

If flows are present in luggas during works, they could be affected by works and the presence of the final completed infrastructure. Flows could be partially or completely blocked or diverted to different watercourses. Where infrastructure will remain in the luggas permanently, the function of the lugga may be lost. The predicted impact magnitude is considered to be direct high (negative) and the impact significance on these receptors is **Moderate**.

Where construction during periods of flow is unavoidable, construction activities that lead to changes in flow regimes should minimise impacts on the natural drainage regime, unless a hydrological and ecological assessment shows it is feasible to do otherwise. Flow will be diverted (e.g. through use of coffer dams) and redirected into the same watercourse further downstream. Where the lugga will be lost due to the presence of Project infrastructure, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment. An individual risk assessment will be completed on a case-by-case basis.

Where there could be local water users dependent on access to the flows, mitigation should include site specific assessments to identify water users in the vicinity to construction work, so that affected individuals and communities can be identified and communicated with regarding any potential changes in flow regime. Communication may involve redirecting the water users to other sources. The EPC Contractor will work with TKBV to produce and implement the communication plan with local traditional leaders.

Taking into account the additional mitigation, the potential residual impact on smaller seasonal rivers, streams and local drainage luggas is predicted to be low (resulting in a **Minor** residual impact significance).

Flowline Development (Luggas)

If flows are present in luggas during works, they could be affected by works to install the flowlines that cross them. The pipework will be buried and the working method is anticipated to be trenching and backfill. During trenching, flows could be partially or completely blocked or diverted to different watercourses. If the channel is not reinstated after the trenching is completed, the luggas would be permanently lost. The predicted impact magnitude is considered to be direct high (negative) and the impact significance on these receptors is **Moderate**.

Where construction during periods of flow is unavoidable, construction activities that lead to changes in flow regimes should minimise impacts on the natural drainage regime, unless a hydrological and ecological assessment shows it is feasible to do otherwise. Flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. Channels will be reinstated after trenching is complete. If this is not possible, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment. An individual risk assessment will be completed on a case-by-case basis.

Where there could be local water users dependent on access to the flows, mitigation should include site specific assessments to identify water users in the vicinity to construction work, so that affected individuals and communities can be identified and communicated with regarding any potential changes in flow regime. Communication may involve redirecting the water users to other sources. The EPC Contractor will work with TKBV to produce and implement the communication plan with local traditional leaders.

Taking into account the additional mitigation, the potential residual impact on smaller seasonal rivers, streams and local drainage luggas is predicted to be low (resulting in a **Minor** residual impact significance).

Water Pipeline Development (Malmalte River and Luggas)

HDD is the selected drilling method for installing the water pipeline beneath the Malmalte. This will avoid in-channel works that could affect flow. The working area associated with the HDD operation will be adjacent to the river. The potential impacts on flows from associated discharges are addressed in other parts of this section, and possible impacts on water quality are addressed in Section 7.4. The impacts and effect significance on the flow regime in the Malmalte River are considered to be **Negligible**.

The rest of the water pipeline will need to cross luggas. As with the flowline development, the water pipeline will be buried and installed via a backfilled trench. This will result in interrupted flows while the trench is in place and in the luggas being permanently lost if the original channel is not reinstated. The predicted impact magnitude is considered to be direct high (negative) and the impact significance on these receptors is **Moderate**.

Where construction during periods of flow is unavoidable, construction activities that lead to changes in flow regimes should minimise impacts on the natural drainage regime, unless a hydrological and ecological assessment shows it is feasible to do otherwise. Flow will be diverted (e.g. through use of coffer dams) and redirected into the same watercourse further downstream. Channels will be reinstated after trenching is complete. If this is not possible, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment. An individual risk assessment will be completed on a case-by-case basis.

Where there could be local water users dependent on access to the flows, mitigation should include site specific assessments to identify water users in the vicinity to construction work, so that affected individuals and communities can be identified and communicated with regarding any potential changes in flow regime. Communication may involve redirecting the water users to other sources. The EPC Contractor will work with TKBV to produce and implement the communication plan with local traditional leaders.

Taking into account the additional mitigation, the potential residual impact on smaller seasonal rivers, streams and local drainage luggas is predicted to be low resulting in a **Minor** residual impact significance.

Table 7.3-5: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Kalabata River (medium)	Abstraction of groundwater for initial construction water requirements - reduction in baseflow due to lowered groundwater levels	Medium (indirect, temporary, short term, negative)	Minor	Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring before construction at potential critical habitat indicator locations identified in the BMP. The baseline will be established prior to the commencement of construction. The data should be analysed to develop water level trigger and control levels. (combined with other mitigations described under biodiversity). Once baseline is established, an action plan will be developed for the exceedance of water level and tree stress trigger levels to avoid long term stress of potential critical habitat. Actions may include targeted irrigation during groundwater abstraction. Baseline (pre-application) monitoring and post-licence monitoring of levels in aforementioned shallow monitoring wells and existing abstraction well levels and yields. Requirements for both to be set in cooperation with the Regulator. A communication plan for existing local water users within the predicted impacted area to identify alternative sources of water (i.e. existing bowser fed water points and reticulated wells) and to help PAP understand that hand dug wells in luggas in the zones identified may not be able to be used during the 18 month abstraction period.	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Seasonal rivers/streams and drainage luggas (medium)	Water Discharges	Medium (direct, temporary, short term, negative)	Minor	Adoption of a hydrotest water management philosophy to promote efficient water use, reuse and disposal.	Negligible	Negligible
	Construction activities near or within watercourses - Infrastructure Development	High (direct, temporary to permanent, short term to long term, negative)	Moderate	Site specific assessments (based on TKBV agreed methodology) to identify any local water users dependent on access to local water supplies, identified and communicate to PAP with regarding any potential changes in flow regime. Communication may involve redirecting the water users to other sources. Produce and implement the communication plan with local traditional leaders. Where the lugga will be lost due to the presence of Project infrastructure within the watercourse, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment. Channels will be reinstated after trenching is complete. If this is not possible, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment	Low	Minor
	Construction activities near or within watercourses - Flowline Development	High (direct, temporary to permanent, short term to long term, negative)	Moderate		Low	Minor
	Construction activities near or within watercourses - Water Pipeline Development	High (direct, temporary to permanent, short term to long term, negative)	Moderate		Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Abstraction of groundwater for initial construction water requirements - reduction in baseflow due to lowered groundwater levels	Medium (indirect, temporary, short term, negative)	Minor	Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring before construction at potential critical habitat indicator locations identified in the BMP. The baseline will be established prior to the commencement of construction. The data should be analysed to develop water level trigger and control levels. (combined with other mitigations described under biodiversity). Once baseline is established, an action plan will be developed for the exceedance of water level and tree stress trigger levels to avoid long term stress of potential critical habitat. Actions may include targeted irrigation during groundwater abstraction. Baseline (pre-application) monitoring and post-licence monitoring of levels in aforementioned shallow monitoring wells and existing abstraction well levels and yields. Requirements for both to be set in cooperation with the Regulator.	Low	Minor
Turkwel Reservoir (high)	Abstraction of water for make-up water requirements during the latter stages of the construction phase	Low (direct, temporary, medium term, negative)	Minor	Monitoring of abstraction volumes and reservoir levels. An action plan will be developed (in association with KVDA and instigated if unprecedented changes in reservoir level occur. Detailed design of water supply pipeline abstraction developed to allow for climate change effects on Turkwel Reservoir.	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Groundwater - shallow aquifers (high)	Abstraction of groundwater for initial make-up water requirements	Medium (direct, temporary, short term, negative)	Moderate	Mitigation and monitoring (humidity, ecology and shallow groundwater) of potentially critical habitats is described in Section 7.7. Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring before construction at potential critical habitat indicator locations identified in the BMP. The baseline will be established prior to the commencement of construction. The data should be analysed to develop water level trigger and control levels. (combined with other mitigations described under biodiversity). Once baseline is established, an action plan will be developed for the exceedance of water level and tree stress trigger levels to avoid long term stress of potential critical habitat. Actions may include targeted irrigation during groundwater abstraction. Baseline (pre-application) monitoring and post-licence monitoring of levels in aforementioned shallow monitoring wells and existing abstraction well levels and yields. Requirements for both to be set in cooperation with the Regulator.	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Groundwater - deep aquifers (low)	Abstraction of groundwater for initial make-up water requirements	Medium (direct, temporary, short term, negative)	Minor	Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring before construction at potential critical habitat indicator locations identified in the BMP. The baseline will be established prior to the commencement of construction. The data should be analysed to develop water level trigger and control levels. (combined with other mitigations described under biodiversity). Once baseline is established, an action plan will be developed for the exceedance of water level and tree stress trigger levels to avoid long term stress of potential critical habitat. Actions may include targeted irrigation during groundwater abstraction. Baseline (pre-application) monitoring and post-licence monitoring of levels in aforementioned shallow monitoring wells and existing abstraction well levels and yields. Requirements for both to be set in cooperation with the Regulator.	Low	Negligible
Human residences (high)	Flood Risk downstream of infrastructure	Low (indirect, temporary, medium term, negative)	Minor	None	Low	Minor

7.3.10.2 Operational Phase

The main potential impacts to water quantity during the operational phase are:

- The ongoing water abstraction from the Turkwel Reservoir - permanent operational facilities (including all accommodation facilities) will have some water requirements for welfare and maintenance. There will also be a demand for make-up water that will be used to inject into the oil reservoir. The demand for that water will be high initially and decline throughout the 25-year operation period but will not cease until operations cease. The water is intended to be sourced via a pipeline from the Turkwel Reservoir. As the operational phase is anticipated to last 25 years, climate change could result in additional changes to water availability. Therefore, this potential source of impact is assessed further.

Changes in Reservoir Levels Due to Water Abstraction

Details of the predicted impact on reservoir water levels as a result of abstraction are presented in Section 7.3.10.1. The prediction of an approximately 2 m decrease in reservoir levels was based on an abstraction of rate of 0.157 m^3/s (13,600 m^3/d). That assessment did not include climate change. The Project water demand during operation is up to 104,000 bwpd (16,534 m^3/d), but this peak demand only lasts for the first three years. The demand then decreases over the 25-year operation phase to around 10,000 bwpd (~1,600 m^3/d). The average demand during the operational phase is between 5000 m^3/d and 6000 m^3/d. Therefore, the decrease in reservoir water levels could be slightly more than 2 m in the first three years but will be less than 2 m for the majority of the operational phase.

The predicted direct low (negative) impact magnitude will start during construction and continue into operations. Therefore, the duration is medium term, resulting in a **Minor** significance. The abstraction impacts were predicted to be temporary because they would reverse when the abstraction ceased.

Given the potential for climate change to alter rainfall (in timing, duration and intensity), temperature and evaporation, it is possible that the reservoir water resource available may change through the operational phase and change the magnitude of the impact on water levels.

As the Project moves through the operational phase, the changes in climate will add to this impact. The impact prediction relates to the peak impact, and changes in reservoir water levels due to climate change will mostly occur later in the operational phase when the abstraction rates have decreased from the peak demand. Therefore, a reduced impact from the reduced abstraction are likely to be cumulatively affected by changes in reservoir water levels due to climate change. The timing of these changes and the scale of the changes are not possible to predict.

Mitigation comprises the continued implementation of the mitigation measures identified during the construction phase, plus the development and implementation of a climate change management plan, which should include assessments of the security of water supply from the Turkwel reservoir, taking into account to account for climate change scenarios).

The operational phase impact assessment with respect to water resources is presented in Table 7.3-6.

Table 7.3-6: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Turkwel Reservoir (high)	Continued abstraction for make-up water requirements – including climate change	Low (direct, temporary, medium term, negative)	Minor	Continued monitoring of abstraction volumes and reservoir levels and instigated of the action plan if unprecedented changes in reservoir level occur. Development and implementation of a climate change management plan (including supply security assessment to account for climate change scenarios).	Low	Minor

7.3.10.3 Decommissioning Phase

The predicted sources of impact to water quantity at the decommissioning phase are considered to be limited to the ongoing abstraction of water from the Turkwel Reservoir. It is anticipated that water use during the decommissioning phase will be considerably less than earlier phases. Water use is anticipated to be limited to general housekeeping purposes, decommissioning camps supply and dust suppression. Therefore, there will be negligible impact on water levels as a result of abstractions at the decommissioning phase.

Five years prior to the planned ‘End of Project’, a Decommissioning Plan will be developed for agreement with the appropriate authorities.

Future management of the water pipeline will be agreed with the relevant authorities and stakeholders.

7.3.11 Summary of Mitigation

In addition to the incorporated mitigation measures, the following additional mitigation and monitoring is recommended to reduce the predicted impact significance to minor or below:

- Mitigation and monitoring (humidity, ecology and shallow groundwater) of potentially critical habitats is described in Section 7.7.
- Baseline (pre-application) monitoring and post-licence monitoring of levels in the shallow monitoring wells and existing abstraction well levels and yields. Requirements for both to be set in cooperation with the Regulator.
- A communication plan for existing local water users within the predicted impacted area to identify alternative sources of water (i.e. existing bowser fed water points and reticulated wells) and to help PAP understand that hand dug wells in luggas in the zones identified may not be able to be used during the 18 month abstraction period..
- Adoption of the water management philosophy to promote efficient water use, reuse and disposal.
- Site specific assessments (based on TKBV agreed methodology) to identify any local water users dependent on access to local water supplies, identified and communicate to PAP with regarding any potential changes in flow regime.
- Where construction during periods of flow is unavoidable, construction activities that lead to changes in flow regimes should minimise impacts on the natural drainage regime, unless a hydrological and ecological assessment shows it is feasible to do otherwise. Flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. An individual risk assessment will be completed on a case-by-case basis.
- Channels and luggas will be reinstated after trenching is complete. If this is not possible, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment.
- Discharges will occur in the same catchment as the abstraction that supplies the water, unless a hydrological and ecological assessment shows it is feasible to do otherwise.
- Abstraction rates will not exceed those in the Project Description. Reservoir abstraction volumes and levels will be monitored to provide confidence in and validate the predicted impacts. An action plan will be developed and instigated if unprecedented changes in reservoir level occur.
- A detailed design of the reservoir abstraction will be developed to allow for possible climate change scenarios.

- A climate change management plan (including supply security assessment to account for climate change scenarios) will be developed to make sure an adequate supply from the reservoir, or alternative, can be maintained for the Project.
- Determination of a reservoir water use review level, below which Project abstraction would impact other reservoir water sues (including power generation). Development of associated action plan that will be implemented should unacceptable impacts be identified.

7.3.12 Summary of Residual Impacts

The initial prediction of water quantity impacts identified impacts with predominantly minor or negligible significance. Moderate significance impacts were predicted for development in seasonal rivers/streams and drainage luggas and for the abstraction of groundwater from shallow aquifers.

Taking account of the additional mitigation, the moderate significance impacts are predicted to be reduced to minor significance residual impacts. All residual impacts to water quantity are predicted to be **Minor** or **Negligible**.

7.4 Water Quality

7.4.1 Introduction

This section provides an assessment of the potential impacts of the Project on surface and groundwater quality. Potential impacts have been determined using a qualitative assessment methodology. Where potential impacts have been identified, these are considered in turn and mitigation is set out where these are considered necessary to ensure that any potential impacts are reduced as far as is practicable.

7.4.2 Area of Influence

The AoI is presented in Section 3.13. Potential receptors located within the AoI have been identified as part of the baseline studies. Receptors that have been carried forward into the assessment are presented in Section 7.4.6.

7.4.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.4-1 for water quantity is also relevant to this water quality section.

7.4.4 Magnitude of Impact

The characterisation of the duration and nature of the impact for water quality (i.e. temporary or permanent, and direct or indirect) is as described in Section 7.3.4. The assessment criteria for water quality impact magnitude is presented in Table 7.4-1.

Table 7.4-1: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Loss of resource/receptor, loss of quality and integrity of the resource/receptor, severe damage to key characteristics, features or elements. Water concentrations exceed baseline concentrations and water quality standards for parameters that could affect human health.	Large scale or major improvement to resource/ receptor quality, extensive restoration or enhancement.
Medium	Partial loss of resource/receptor, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements. Water concentrations exceed baseline concentrations and water quality standards for parameters that are unlikely to affect human health.	Some benefit to key characteristics, features or parameters describing resource/receptor quality.
Low	Some measurable change in/damage to attributes, quality or vulnerability. Minor loss of, or alteration to, key characteristics, features or elements. Water concentrations exceed baseline concentrations but do not exceed water quality standards.	Minor benefit to, or addition of, one or more key characteristics, features or parameters describing resource/ receptor quality.
Negligible	No, or very minor (immeasurable), change to baseline characteristics, features or parameters describing resource/receptor quality.	

7.4.5 Key Guidance and Standards

In addition to the water policy and legislation documents highlighted in Section 7.3.5, the following are of particular relevance to water quality:

- Water Quality Regulations, 2006;
- The Environmental Management and Coordination (Water Quality) Regulations, 2006; and
- The Kenya Standard KS 459-1: 2007 (ISC 13.060.20) (Drinking Water – Specification. Part 1: The requirements for drinking water. Third Edition), which has been used to compile the Project standards for water quality and emissions.

7.4.6 Receptors of Interest and Importance

The focus of this assessment is on the quality water within the AoI. Baseline environmental information indicates the importance and scarcity of water in the AoI. This emphasis is reflected in the relevant legislation[9].

Using the Project Description and the baseline water environment information presented in Section 6, the same receptors have been identified as those presented for water quantity in Section 7.3.6 as being susceptible to changes in water quality.

7.4.7 Sources of Impacts

Potential sources of impact of a range of magnitudes that will occur throughout the life of the Project are set out below by Project phase.

7.4.7.1 Construction Phase

Based on the Project Description and the understanding of the baseline water quality conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to water quality (and therefore usability) during the construction phase. The potential sources of impact and routes by which they could impact water quality are as follows:

- Construction activities near or within watercourses (including vehicle movements) – ground disturbance could lead to changes in sediment transport/water quality.
- Nitrates from blasting – use of explosives for blasting through the hard rock to construct sections of the water supply pipeline has the potential to release nitrates that could result in the increase of nitrates in groundwater as the residue is transported down towards the groundwater with recharge.
- Leaching from backfill materials – if non-inert materials are introduced to the subsurface whilst excavations are backfilled, these could leach and result in the introduction of potentially contaminative substances to groundwater.
- Heat from well commissioning tests – potential changes to the temperature of the surrounding water environment, which can also induce changes in chemical reactions and bacterial growth, which can alter water quality.
- Concrete batching – potential to lead to contamination of the water environment through run-off with increased suspended solids, a more alkaline pH, and higher alkalinity.

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[9] The objective of the Environmental Management and Co-Ordination (Water Quality) Regulations is to prevent pollution of water, prohibit the discharge of effluent to the environment that has a quality that contravenes the standards, and prevent abstraction without an environmental impact assessment license.

The Kenya Water Act also enforces the requirement to have permission to construct boreholes and wells, that abstraction amounts need to be reasonable, to reduce the potential for water losses, and to prevent contamination/pollution of water.

- Pipeline flushing and hydraulic testing – the discharge of used water could introduce chemicals added to the water and any substances cleared from the inside of the pipework during flushing.

7.4.7.2 Operational Phase

Based on the Project Description and the understanding of the baseline water quality conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to water quality during the operational phase. The potential sources of impact and routes by which they could impact water quality are as follows:

- Heat from the operational well heads and oil and hot water in the connecting pipelines – potential changes to the temperature of the surrounding water environment, which can also induce changes in chemical reactions and bacterial growth, which can alter water quality.
- Operational waste – leaching from stored operational waste (either locally to its generation or at the IWMF), or inappropriate disposal of the waste, could lead to a change in water quality in the receiving waterbody.

7.4.7.3 Climate Change

Climate change has more potential to directly affect water availability than water quality. A discussion of predicted climate change impacts on the water environment is presented in section 7.3.7. Climate change effects on water quality are more likely to be secondary as a result of changes in availability.

Changes in surface water flow regimes will result in changes to the volumes of water and the times when water flows are low and high. Higher flows would lead to greater erosion leading to suspended solid mobilisation and poorer water quality, but the greater volume of water during higher flows would also result in greater dilution.

Changes in the availability of groundwater as a resource (potentially as a combination of reduced recharge and greater demand from an increased population) could lead to poorer water resources having to be exploited. In the case of aquifers that have existing areas of poor water quality (e.g. high salinity at depth), over abstraction of these aquifers could lead to the poorer water being drawn towards the abstraction point and the abstracted water quality declining.

7.4.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to Project infrastructure (design measures) or are widely accepted GIIP.

7.4.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on water quality:

- The gathering network will be insulated to reduce heat loss (to maintain oil temperature, but also reduce transfer of heat to surrounding environment) - this will reduce the potential for changes to the temperature of surrounding or nearby groundwater and surface water.
- The pipework at, and between, wellpads will be buried and depths will be increase under roads and watercourses – this will reduce the possibility of damage (deliberate or accidental) that could otherwise lead to leaks and subsequent water contamination.

- Existing infrastructure has been identified for use where possible (e.g. existing roads instead of new ones) – this will reduce the need for the creation of new infrastructure, which will in turn result in less earth movement and reduced suspended solids creation that could pollute the water environment.
- The flare pit will be cement lined – lining areas where potential contaminants could be present creates a barrier between the surface and the groundwater environment, which reduces the potential for those contaminants to reach groundwater by infiltration. In addition, a lined pit will allow contaminated run-off to be captured and collected, rather than be allowed to flow overland to surface water.
- Pits located at the wellpads and used for the collection of drilling wastes will be lined with HDPE – lining the pits with HDPE creates a barrier between the surface and the groundwater environment, which reduces the potential for any contaminants that might be present in the drilling waste to reach groundwater by infiltration.
- The cellars at the wellpads will be concrete or steel lined – lining the cellars creates a barrier between the surface and the groundwater environment, which reduces the potential for any contaminants that might be present in the drilling waste to reach groundwater by infiltration.
- The cellars will have sumps - the sumps will allow any fluid within the footprint of the wellpad itself will be captured and held before collection and treatment at IWMF.
- There will be oil interceptors in the wellpad drainage ditches - oil will be captured, removed and disposed of appropriately to Project waste facilities
- The section of water pipeline that passes under the Malmalte River will be installed by HDD and the buried section will originate outside the riparian corridor – by using HDD rather than cut-and-fill, the construction works will not involve excavation of ground in or near the river bed and the potential for generating suspended solids that would be mobilised into the river water; thereby removing this potential source of pollution.
- Septic tanks will be managed – wastewater from camps and any other welfare facilities (i.e. toilets, wash areas) will be collected in septic tanks and the effluent will be treated at the STP in the IWMF.
- All substance storage (chemicals and fuels) will be bunded – all on-site hazardous materials storage will feature a secondary containment system, in line with WBG EHS Guildlines, 2007. By locating substances in dedicated storage areas with appropriate flooring and bunding, spills/leaks can be contained and addressed rather than being able to enter the water environment.
- The landfill will be lined with geosynthetic and clay liners. It will also be engineered with a drainage layer and leak detection layer. HPDE liner will be used for the lining and capping – by fully engineering the landfill, the potential for discharge through the base or sides and transport into the groundwater environment is reduced.
- Organic waste should not be deposited in the landfill.
- There will be blow out preventors on wellheads during drilling – this will reduce the potential for hydrocarbons to be release at the surface during drilling and polluting the water environment by contact with surface water.
- Synthetic based mud drilling fluids will be recycled – by reusing substances, smaller quantities are required for storage and there is less potential for stored substances to present a source of contamination to the water environment.

- Hydrotest water will be reused where possible then directed to settlement ponds – this will reduce the potential for any additives to the water, or contaminants that may have come from inside the pipes, to be discharged to the surface water environment.
- Inert material will be used for backfilling and no foreign materials will be allowed in excavations. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled – this will reduce the potential for leaching of contaminants to groundwater.
- There will be controlled discharge of uncontaminated water - no discharge of any effluent into the water environment will take place without a valid effluent discharge license issued by NEMA (as per the Environmental Management and Co-ordination (Water Quality) Regulations) – this will enable management of the potential to release polluting substances into the water environment.

7.4.8.2 Good International Industry Practice

In addition to the mitigation specified within the Project description, this section presents accepted good practice that will also be implemented in order to remove or reduce the magnitude of potential impacts.

Construction Phase

- Dampening down of roads and construction areas will be undertaken if large quantities of resuspended dust are reported or observed – this will reduce the amount of dust that could be blown towards nearby watercourses and contribute to increases in suspended solid concentrations.
- The EPC contractor will produce and implement a waste management plan for all construction wastes.
- Any blasting that is required will be undertaken in accordance with an appropriate permit.
- Any soil movement, storage or compaction will be undertaken in a manner that limits the creation of loose material or reduces erosion potential, thereby reducing the potential for the generation of increased suspended solids outside of the working area.
- Works in, or adjacent to watercourses (within six meters and a maximum of thirty meters from the highest ever recorded flood level) shall not take place without consent from NEMA (as per the EMCA (Water Quality) Regulations, 2006) – appropriate consent and management of such activities will reduce the potential for releases of pollutants, including suspended solids, into the water environment.
- Drilling fluid quantities will be monitored – the volumes of drilling fluids used and returned will be monitored to enable rapid identification if unacceptable volumes are being lost to the ground. This will allow the potential for the loss to the ground, and potentially groundwater, of drilling fluids and any additives in it to be identified early and actioned.

Operational Phase

- Oil volume monitoring and management in storage facilities will be used to identify losses as soon as is practicable. Action plans will be followed if leaks are detected to reduce the potential for water contamination. Details of the leak monitoring procedure, monitoring locations, monitoring frequency and action plans will be recorded – this will reduce the potential for substance release, entry to the water environment and pollution.
- Wastes generated during operations will be transferred to the IWMF and landfill for disposal – managing waste at dedicated facilities that have been designed and constructed with the intention to limit the potential release of substances to the environment will reduce the potential for releases to impact the water environment.

- Waste will be segregated and there will be promotion of waste reuse and recycling at temporary waste facilities – this will reduce the amount of waste that has to be disposed of and allow the best route for disposal or reuse of different types of waste to be identified, which reduces the potential to unintended discharges to the environment.
- Ash from the waste treatment processes within the IWMF will be disposed of to landfill – this reduces the potential of unintended discharges of potentially contaminative substances to the environment.
- Treated sewage effluent will be reused or disposed of as irrigation water. There will be no discharge of any effluent into the water environment without a valid effluent discharge license issued by NEMA (as per the Environmental Management and Co-Ordination (Water Quality) Regulations) – this this reduces the potential of discharges of potentially contaminative substances to the environment.
- Waste being taken to landfill will be recorded and defined for specific cells that have been constructed as required for that waste stream – hazardous waste will be identified and sent to specifically engineered landfill cells to reduce the potential of discharges to the water environment.

All Project Phases

- All perimeter wellpad drainage will be regularly inspected in order to keep contact and non-contact water separate – this will reduce the potential for substance release, entry to the water environment and pollution.
- Infield flowline pressure will be monitored - this will enable losses of pressure, which could indicate leaks, to be identified and actioned as soon as is practicable – this will reduce the potential for substance release, entry to the water environment and pollution.
- Septic tank system, the tanks will be properly designed, installed and maintained to prevent contamination of groundwater.
- Sewage and effluent will be treated at the IWMF to appropriate standards before disposal – any disposals to the water environment will be to an appropriate standard for the receiving receptor; thereby reducing the potential of contamination.
- Good practice landfill construction and capping will be undertaken – to reduce the potential of discharges to the water environment.
- Handling, storage, treatment and disposal of hazardous substances will be in line with appropriate standards to reduce pollution potential. The procedures for all stages of hazardous substance handling, storage, use and disposal will be defined in management plans and followed, which reduces the potential for leaks and spills.
- Transfer of hazardous materials from tanks will take place in areas with surfaces sufficiently impervious to avoid loss to the environment. The surface will be sloped to a collection or a containment structure not connected to municipal wastewater/storm water collection system.
- Substance inventory and monitoring will be undertaken to track what substances and quantities are present at different locations – this will enable a better understanding of the sources of potential impact to the water environment, appropriate storage to be identified, and for loses to be identified and actioned as soon as is reasonably practicable.
- Substance storage areas, facilities and equipment will be regularly inspected in order to identify leaks. This will include, but not be limited to, storage areas, yards, warehouses, welfare facilities, generators and pumps – good practice inspection and maintenance regimes will be detailed in management plans and followed to allows leaks to be identified and actioned as soon as is reasonably practicable.

- Appropriate inspection and maintenance of oil interceptors will be undertaken and recorded – this will enable the performance to be maintained and oil to be separated out from water and reduce the potential for discharges of contaminative substances.
- The Project will apply effective spill prevention, control and response procedures for non-emergencies to control releases that could pollute the water environment. Provision of, and training in use of spill containment equipment will be implemented where they are required.
- When selecting chemicals and materials this will, where practicable, aim to avoid or minimise the use of hazardous materials. Consideration will be given to selecting the items with the lowest potential for environmental harm possible without loss of effectiveness.
- Any discharges to the water environment will be to Kenyan water standards and under licence – discharges will be at or better than the rates and quality limits detailed in the consent to reduce the potential impact of poor water quality on the water environment.

7.4.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were identified during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- Stakeholders raised concern on water that is used by the project and if this water could get mixed with underground water.
- Stakeholders reported unpleasant smell of water with potential to cause diseases to people and animals.
- Stakeholders raised concern regarding water pans used by individuals and what will happen to these if they are located within the project area.

7.4.10 Impact Classification

Taking into account the baseline water environment setting (Section 6.7), the relevant incorporated environmental measures (Section 7.4.8) and the potential sources of impact (Section 7.4.7) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

7.4.10.1 Construction

The impact classification process focuses on the potential impacts to water quality that could result in significant impacts. As such some potential impacts can be "*scoped out*" where there is insufficient linkage between the source of impact and receptors, or the magnitude of this impact would be negligible when taking account of incorporated environmental measures.

The following bullets provide qualitative evaluation of impacts which are not considered for further impact classification:

- Construction of subsurface features (e.g. sumps, pits and trenches) and the backfilling of features such as trenches once pipework has been laid, has the potential to introduce foreign materials to the ground. Given the incorporated design measures and good practice, the potential for non-inert material to present a source of contamination is considered to be limited. It is predicted that the impact magnitude will be negligible and the significance of the impact on deep groundwater and shallow groundwater is **Negligible**.

- Blasting, which can generate high concentrations of nitrates, will only take place in a very localised area near the reservoir end of the water supply pipeline. Given the limited extent of blasting, and that the minimum amount of explosives would be used, it is predicted that the impact magnitude will be negligible and the significance of the impact on deep groundwater and shallow groundwater is **Negligible**. Additionally, any blasting that is required will be undertaken in accordance with an appropriate permit.
- The discharge of used flushing and hydrotesting water has the potential to introduce to the receiving surface water or groundwater environment any chemicals added to the water and any substances cleared from the inside of the pipework during flushing (e.g. rocks/fines, metal/plastic fragments, welding residue or manufacturing lubricants). There is no intended discharge of hydrotest water to the water environment, in line with the hydrotest philosophy (Annex I). Water will be used, reused where possible, treated and sent to evaporation ponds, and the residue will be disposed of to the Project waste facilities. Therefore, there is no potential for changes to the quality of surface water or groundwater as a result of the discharge of hydrotesting water. The impact magnitude will be negligible and the significance of the impact on all water receptors is **Negligible**.
- Treated discharges of process contact water or effluent will be controlled and undertaken under a valid effluent discharge license issued by NEMA. Therefore, the quality of surface water or groundwater will be maintained to approved standards, and so no impact is expected as a result of the discharge of treated water. The impact magnitude will be negligible and the significance of the impact on all water receptors is **Negligible**.
- Heat radiating out into groundwater from the heated oil extraction and transfer infrastructure - oil in the pipeline needs to be heated to above the wax appearance temperature (62°C to 67°C) to maintain flows. To do this, the wells and associated pipework will be heated to temperatures above existing water temperatures (typically below 35°C). Introducing a new heat source could alter the temperature of the existing water environment if heat can radiate out from the pipeline. Changes in ground/water temperature can also induce changes in chemical reactions and bacterial growth, which can alter water quality. However, the incorporated measures (e.g. the insulated gathering network) will reduce transfer of heat to surrounding environment. The predicted impact magnitude from heat increase on groundwater is considered to be low (negative). The impact significance on deep groundwater is **Negligible** and the impact significance on shallow groundwater is **Minor**. Flowing surface water would only be in contact with heated ground briefly, so impacts are not anticipated.

The following potential sources of impact are, therefore, the focus of further assessment:

- Earth movements and concrete production resulting in increased suspended solids in waterbodies - activities such as vegetation clearing; topsoil stripping; grading/levelling; excavating and storage of excavated materials; and vehicle movements may result in ground disturbance leading to increased suspended solids being washed into the surface water environment, thereby changing water quality. The mobilised soils could also result in leaching of their constituent minerals (e.g. metals) that could also change water quality. The production of concrete has the potential to lead to run-off contaminated with suspended solids, a more alkaline pH, and higher alkalinity. Impacts on groundwater quality are possible through vertical seepage into groundwater. Surface water could be directly impacted if spills or leaks occurred into surface water, or indirectly through contaminated run-off.
- Discharges from construction waste storage facilities - this could include soils, general waste from camps, waste oils and filters from mobile plant and equipment and generators, oily rags, waste solvents and used chemical drums. Leaching from stored construction waste could lead to a change in water quality in receiving waterbody through direct disposal into the water environment. Impacts on groundwater quality

are also possible through the infiltration of precipitation through waste, through the ground and into groundwater. Surface water could also be indirectly impacted through contaminated run-off.

The impact assessment is discussed in more detail in the sub-sections below. The construction phase impact assessment with respect to water resources is presented in Table 7.4-2. Any additional mitigation is also presented in that table.

Earth Movements and Concrete Production

Earthworks of any kind and the production of concrete can have the potential to increase suspended solids in surface water if the works take place near watercourses, or near them where there is the potential for the suspended solids to be transported by drainage or run-off. These suspended solids could also lead to a change in water quality with respect to parameters such as pH, alkalinity, and metal concentrations. Without mitigation, the potential impact magnitude to surface water is either direct or indirect (if the impact occurs in one watercourse and impacts a second watercourse downstream) high (adverse). The associated impact significance on the Kalabata, Malmalte and Turkwel Rivers and seasonal rivers and luggas, is **Moderate**, and the associated impact significance on the Turkwel Reservoir is **Major**. The predicted impacts will be short term and temporary and cease when the works cease.

In addition to the incorporated measures (e.g. using existing infrastructure where possible, dust suppression, and working under a consent for works in, or within, watercourses), the following additional specific mitigation can be adopted to further reduce the potential impact:

- Temporary erosion control measures will be installed prior to earth-moving activities, where required.
- Suspended solids management/control will be implemented (e.g. covering excavated soil mounds during periods of rainfall, good vehicle movement practices, sediment traps/filters, and settlement ponds).
- Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment.
- The amount of time trenches or other excavations will be open will be minimised.
- Where possible, there will be no construction in seasonal rivers and smaller streams/luggas when there is flow. If unavoidable, flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. An individual dynamic risk assessment will be completed by the EPC contractor on an individual case-by-case basis
- There will be monitoring of surface water/shallow groundwater quality upstream and downstream of the working area where working in or near sensitive surface water environments. Details of the monitoring programme and schedule will be defined in the ESMP (e.g. water sampling methodology).

Taking account of the additional mitigation, the predicted residual impact magnitude to nearby surface water bodies is low (negative). The impact significance on the main rivers or seasonal rivers and luggas is **Minor** and the impact significance on the Turkwel Reservoir is also **Minor**.

Discharges/Releases From Waste Storage and Disposal Activities

Stored waste can leach contaminants that can enter the water environment (nearby surface water bodies and/or shallow groundwater). Without mitigation there is the potential that such releases could result in a decrease in water quality to a degree that baseline concentrations and water quality standards could be exceeded. Therefore, the impact magnitude to nearby surface water bodies and/or shallow groundwater is predicted to be indirect high (negative). The impact significance on the main rivers (i.e. the Kalabata, which is closest to the Project waste facilities) or seasonal rivers and luggas is **Moderate** and the impact significance on shallow groundwater is **Major**. The impact would remain as long as the waste source remains. Waste does degrade over time and the source concentrations of contaminants will decrease. Therefore, the impact would be temporary until the waste is removed or the source is depleted and long term because waste will remain in the landfill beyond the end of the operational phase.

In addition to the incorporated measures, a construction waste management plan will be produced and implemented and all wastes will be stored and disposed of. If any piling is required in the area of waste storage, this will be undertaken in a manner that reduces the potential for pathway creation between the surface and groundwater. This will reduce the residual magnitude to low (negative) and impact classification on both the main rivers or seasonal rivers and on shallow groundwater to **Minor.**

Table 7.4-2: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
The Kalabata River (medium)	Construction activities near or within watercourses	High (indirect, temporary, short term, negative)	Moderate	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Suspended solids management/control will be implemented Temporary erosion control measures will be installed prior to earth-moving activities, where required. The amount of time trenches or other excavations will be open will be minimised. Monitoring of shallow groundwater quality in Kalabata. Details of the monitoring programme and schedule will be defined in the ESMP.	Low	Minor
	Discharges/ releases from waste storage and disposal activities	High (indirect, temporary, long term, negative)	Moderate	Produce and implement a construction waste management plan. If piling is undertaken in areas of waste storage, this will be done in a manner that reduces the potential for pathway creation between the surface and groundwater.	Low	Minor
The Malmalte River (medium)	Activities near or within the watercourse that are associated with the construction of the water pipeline	High (direct, temporary, short term, negative)	Moderate	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Suspended solids management/control will be implemented. Temporary erosion control measures will be installed prior to earth-moving activities.	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
The Turkwel River (medium)	Activities near or within the watercourse that are associated with the construction of the water pipeline	High (direct, temporary, short term, negative)	Moderate	The amount of time trenches or other excavations will be open will be minimised. Monitoring of surface water quality in sensitive environments. Details of the monitoring programme and schedule will be defined in the ESMP.	Low	Minor
Seasonal rivers/streams and drainage luggas (medium)	Construction activities near or within watercourses	High (direct or indirect, temporary, short term, negative)	Moderate	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Where possible, there will be no construction in seasonal rivers and smaller streams/luggas when there is flow. If unavoidable, flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. An individual dynamic risk assessment will be completed by the EPC contractor on an individual case basis. Suspended solids management/control will be implemented Temporary erosion control measures will be installed prior to earth-moving activities. The amount of time trenches or other excavations will be open will be minimised.	Low	Minor
	Discharges/ releases from waste storage and disposal activities	High (indirect, temporary, long term, negative)	Moderate	Produce and implement a construction waste management plan. If piling is undertaken in areas of waste storage, this will be done in a manner that reduces the	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				potential for pathway creation between the surface and groundwater.		
Turkwel Reservoir (high)	Construction activities near waterbodies, specifically along the ridge where the pontoon intake is proposed	High (direct or indirect, temporary, short term, negative)	Major	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Suspended solids management/control will be implemented Temporary erosion control measures will be installed prior to earth-moving activities in the area along the ridge where the pontoon intake is proposed. The amount of time trenches or other excavations will be open will be minimised. Monitoring of surface water quality. Details of the monitoring programme and schedule will be defined in the ESMP	Low	Minor
Groundwater - shallow aquifers (high)	Discharges/ releases from waste storage and disposal activities	High (indirect, temporary, long term, negative)	Major	Produce and implement a construction waste management plan. If piling is undertaken in areas of waste storage, this will be done in a manner that reduces the potential for pathway creation between the surface and groundwater.	Low	Minor

7.4.10.2 Operational Phase

This section focuses on the potential impacts to water quality that could foreseeably potentially result in significant impacts. Preliminary consideration of potential sources of impact, the likelihood of impact linkages being present and the magnitude of this impact has been undertaken to qualitatively identify impact linkages that would result in negligible impacts. These are detailed below and are then not considered further in the assessment:

- Treated discharges of process contact water or effluent will be controlled and undertaken under a valid effluent discharge license issued by NEMA. Therefore, the quality of surface water or groundwater will be maintained to approved standards, and so no impact is expected as a result of the discharge of treated water. The impact magnitude will be negligible and the significance of the impact on all water receptors is assessed to be **Negligible**.

The following potential sources of impact are the focus of further assessment:

- The storage and disposal of waste – operational waste could come from a range of sources, such as general waste from permanent camps, waste oils and filters from plant and equipment and generators, oily rags, waste solvents and used chemical drums. Leaching from stored operational waste (either locally to its generation or at the IWMF), or inappropriate disposal of the waste, could lead to a change in water quality in receiving waterbody through direct disposal into the water environment.
- Impacts on groundwater quality are also possible through the infiltration of precipitation through waste, through the ground and into groundwater. Surface water could also be indirectly impacted through contaminated run-off.
- Waste in the operational landfill will start to generate leachate. The leachate has the potential to contain above baseline concentrations of a range of substances (e.g. metals, major ions, various forms of nitrogen and hydrocarbons) depending on the wastes deposited. Should leachate leak through the base or sides of the landfill it could contaminate groundwater. If leachate increased to a level higher than the outer sides of a landfill cell, the leachate could overflow and enter the surface water environment.

Discharges/Releases from Waste Storage and Disposal Activities

Stored waste can leach contaminants that can enter the water environment (nearby surface water bodies and/or shallow groundwater). Waste disposed in the landfill will generate leachate that could, if not managed and contained, could also enter the water environment. Without mitigation there is the potential that such releases could result in a decrease in water quality to a degree that baseline concentrations and water quality standards could be exceeded. Therefore, the impact magnitude to nearby surface water bodies and/or shallow groundwater is predicted to be high (negative). The impact significance on the main rivers (i.e. the Kalabata, which is closest to the Project waste facilities) or seasonal rivers and luggas is **Moderate** and the impact significance on shallow groundwater is **Major**. The impact would remain as long as the waste source remains. Waste does degrade over time and the source concentrations of contaminants decrease. Therefore, the impact would be temporary until the waste is removed or the source is depleted and long term because waste will remain in the landfill beyond the end of the operational phase.

In addition to incorporated design measures, the following addition specific mitigation can be adopted to further reduce the potential impact:

- Drainage systems that are isolated from surface and groundwater will be used to capture leaks/leachate/floor water in the IWMF, which will reduce the potential for infiltration of leached substances into the ground and groundwater or flow to nearby surface water.

- Appropriately segregated drainage systems in and around IWMF will reduce the potential for rainfall to enter the IWMF via saturated overland flow and result in the increase generation of leachate.
- Landfill leachate monitoring and management will be undertaken in accordance with the permit to reduce the head of leachate on the base of the landfill (the greater the head the higher the potential for basal and sidewall leakage to occur). The monitoring will also provide early warning if leachate heads are at risk of reaching the top of the internal sidewalls and overtopping into the surface water drainage system.
- The surface water management system at the landfill will redirect rainfall run-off away from open landfill cells to reduce leachate generation rates.
- Implementation of a groundwater monitoring programme downgradient of the CFA and landfill.

Taking account of the incorporated measures and additional mitigation, the predicted residual impact magnitude to nearby surface water bodies and/or shallow groundwater is low (negative). The impact significance on the main rivers or seasonal rivers and luggas is **Minor** and the impact significance on shallow groundwater is **Minor**.

Table 7.4-3: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
The Kalabata River (medium)	Discharges/ releases from waste storage and disposal activities	High (indirect, temporary, long term, negative)	Moderate	Drainage systems that are isolated from surface and groundwater will be used to capture leaks/leachate/floor water in the IWMF. Appropriately segregated drainage systems in and around IWMF. Landfill leachate monitoring and management. There will be a surface water management system at the landfill. (e.g. drainage ditches and slope design) that will redirect rainfall run-off away from open landfill cells to reduce leachate generation rates.	Low	Minor
Seasonal rivers/streams and drainage luggas (medium)	Discharges/ releases from waste storage and disposal activities	High (indirect, temporary, long term, negative)	Moderate	Drainage systems that are isolated from surface and groundwater will be used to capture leaks/leachate/floor water in the IWMF. Appropriately segregated drainage systems in and around IWMF. Landfill leachate monitoring and management. There will be a surface water management system at the landfill (e.g. drainage ditches and slope design) that will redirect rainfall run-off away from open landfill cells to reduce leachate generation rates.	Low	Minor
Groundwater - shallow aquifers (high)	Discharges/ releases from waste storage and disposal activities	High (indirect, temporary, long term, negative)	Major	Drainage systems that are isolated from surface and groundwater will be used to capture leaks/leachate/floor water in the IWMF.	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				Appropriately segregated drainage systems in and around IWMF. There will be a surface water management system at the landfill (e.g. drainage ditches and slope design) that will redirect rainfall run-off away from open landfill cells to reduce leachate generation rates. Implementation of a Groundwater monitoring programme downgradient of the CFA and landfill.		

7.4.10.3 Decommissioning Phase

The potential impacts to water quality at the decommissioning stage are likely to be similar to those in the construction phase, such as the following:

- Demolition, earth movement, restoration/regrading of surfaces could lead to the increase of suspended solids in nearby watercourses;
- The storage, transport, handling and use of chemicals and fuel; leaks from which could lead to changes in water quality;
- Hydrocarbon release during well and pipework decommissioning;
- Leaching from waste; and
- Sanitation leaks and wastewater discharge (including discharges from camps).

It is not known what the accepted procedures will be at the time of the future decommissioning phase; however, potential mitigation to manage the impacts could include the following:

- Prior to the planned 'End of Project', a Decommissioning Plan will be developed for agreement with the appropriate authorities;
- Emptying/clearing/flushing and appropriate disposal of substances from pipes/storage/sumps prior to decommissioning;
- All underground equipment (pipeline) will be emptied of oil product, left in a clean state and left *in situ*;
- All above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use;
- All decommissioning waste will be handled, stored and managed through GIIP; and
- Decommissioning in accordance with Kenyan legislation - including disposal of waste/contaminated materials.

7.4.11 Summary of Mitigation

The following measures that are in addition to the incorporated design and GIIP measures presented can reduce the potential impact of the Project to water quality are detailed in the Project description:

- Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment.
- Where possible, there will be no construction in seasonal rivers and smaller streams/luggas when there is flow. If unavoidable, flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. An individual dynamic risk assessment will be completed by the EPC contractor on an individual case basis.
- A construction waste management plan will be produced and implemented.
- Suspended solids management/control will be implemented.
- Temporary erosion control measures will be installed prior to earth-moving activities (such as erosion matting/blankets and use of settlement ponds before discharge to surface water), where required.
- The amount of time trenches or other excavations will be open will be minimised.

- There will be monitoring of shallow groundwater/surface water in sensitive environments, such as the Kalabata River. This will take place before construction commences to confirm the baseline and then at locations upstream and downstream of the source of impact to enable changes as a result of the Project to be identified and mitigated. Further details will be provided in the ESMP.
- Drainage systems that are isolated from surface and groundwater: closed drainage systems (including hardstanding drainage layer) will be used to capture leaks/leachate/floor water in the IWMF.
- There will be appropriately segregated drainage systems in and around IWMF to separate clean water from contact/process water. The two drainage types will be managed, treated where necessary, and disposed of appropriately.
- There will be a surface water management system at the landfill. This will reduce the amount of run-off that can enter an open cell and create leachate.
- Landfill leachate monitoring and management will be undertaken in accordance with permit. This will include leachate level monitoring to make sure the levels do not exceed those accounted for in the risk assessment of the landfill that will be completed at the design stage.; Leachate quality will also be monitored to identify the composition of the leachate, which will enable validation of the hydrogeological risk assessment. In addition, should potential impacts to the water environment be identified, leachate quality monitoring will enable evaluation of whether the landfill could be the source. There should be a minimum of one sump and two remote monitoring wells that will be monitored in each landfill cell.
- Groundwater monitoring will be installed around the landfill and CFA. This will include both upgradient and downgradient monitoring wells. Downgradient monitoring will be undertaken at a minimum of two locations. The monitoring will include groundwater levels and groundwater quality to enable validation of the landfill hydrogeological risk assessment and identify any unexpected impacts. Monitoring should commence before construction of the facilities and continue throughout their lifetimes. The frequency of monitoring and substances monitored for will be determined based on the activities taking place at the potential sources.

7.4.12 Summary of Residual Impacts

The initial prediction of water quality impacts identified impacts with predominantly minor or negligible significance. Major significance impacts (without mitigation) were predicted to the Turkwel Reservoir as a result of construction activities in or near that waterbody and from discharges/releases from waste storage and disposal activities.

Moderate significance impacts (without mitigation) were predicted to the Kalabata, Malmalte and Turkwel rivers and the seasonal watercourses/luggas as a result of construction activities in or near the watercourse. Moderate significance impacts (without mitigation) were also predicted to the Kalabata River and seasonal watercourses/luggas from discharges/releases from waste storage and disposal activities.

Taking account of the additional mitigation that is proposed, the major and moderate significance impacts are predicted to be reduced to minor significance residual impacts. All residual impacts to water quality are predicted to be **Minor** or **Negligible**.

7.5 Soils, Terrain, Geology and Seismicity

7.5.1 Introduction

This section provides an assessment of the potential effects of the Project on, or to the Project from, soils, terrain, geology and seismicity/geohazards. Potential effects have been determined using a qualitative assessment methodology. Where potential impacts have been identified, these are considered in turn and mitigation is set out where necessary to ensure that any potential impacts are reduced as far as practicable.

As geology and seismicity/geohazards do not include environmental receptors, this impact assessment focuses exclusively on potential soils impacts. Seismicity risks are considered further in the Environmental Risks and Accidents chapter (Section 7.11)

7.5.2 Area of Influence

The AoI for soils is limited to the direct disturbance area of the Project infrastructure, and a 100 m buffer around it for indirect effects such as water/wind erosion and dust deposition. The AoI for soils is located within the Project AoI presented in Section 3.13 and is shown on Figure 7.5-1 below.

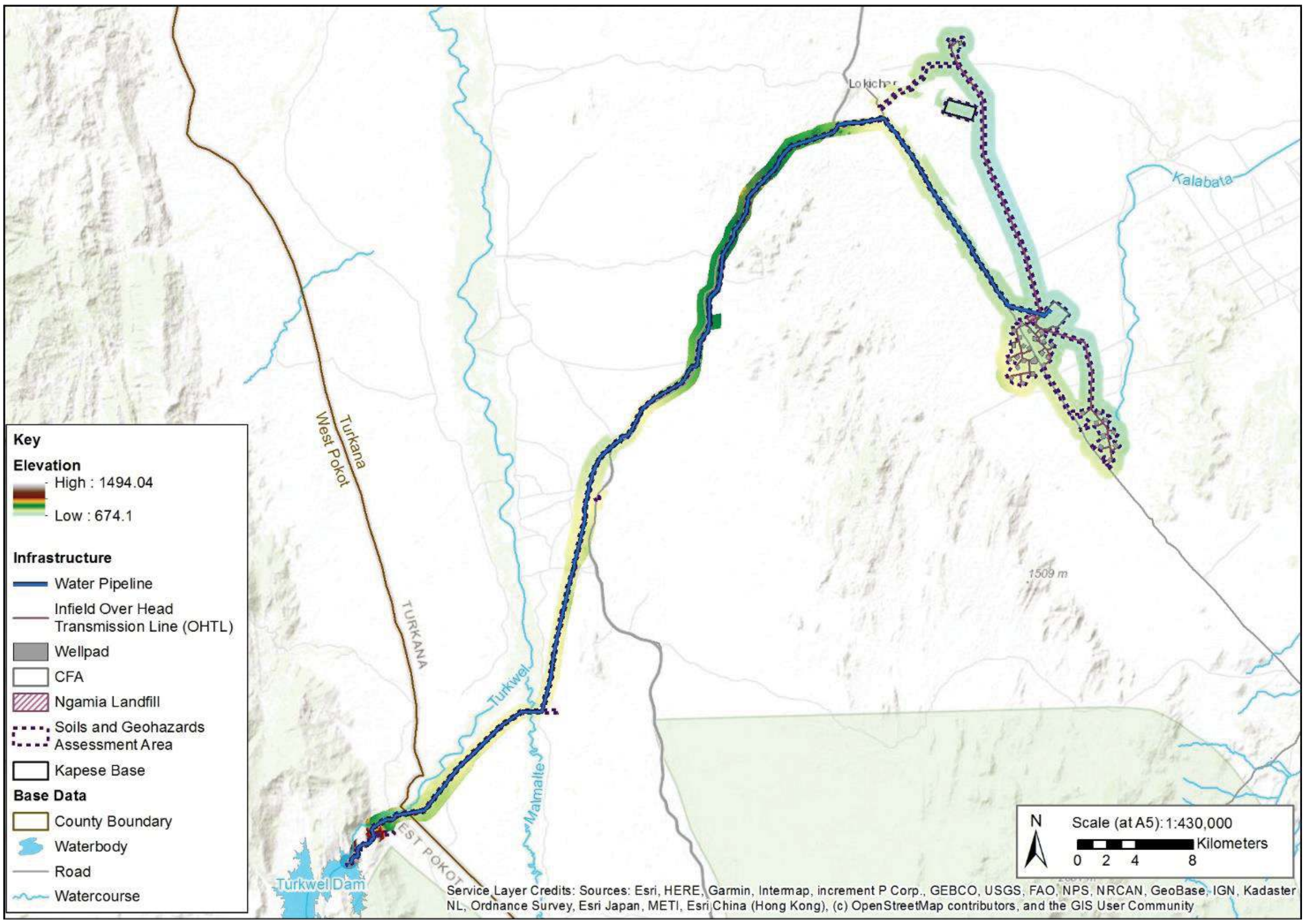

Figure 7.5-1: AoI for the Project on Soils, Showing Elevations for Context.

7.5.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.5-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.5-1: Criteria for Determining Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ Soils of international importance, high quality and rarity, regional or national scale and limited potential for substitution/replacement (not applicable in this ESIA)
High	■ Soils or land use of national importance; ■ Soils with a high quality, local scale and limited potential for substitution/replacement; and/or ■ Soils with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement.
Medium	■ Soils or land use of regional importance; ■ Soils with a medium quality and rarity, local scale and limited potential for substitution/replacement; and/or ■ Soils with a low quality and rarity, regional or national scale and limited potential for substitution/replacement.
Low	■ Soils or land use of local, limited or no known importance; and/or ■ Soils with a low quality and rarity, local scale.

7.5.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.5-2. These criteria allow for a qualitative assessment and are applied using professional experience and judgement.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period). The CFA/CPF will be constructed within the first 36 months;
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project.

Table 7.5-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Severe damage to soil quality and/or extensive loss of pastoral land use capability (grazing/agriculture). Concentrations of contaminants in soils exceeding baseline concentrations and standards for parameters that could affect human health.	Large scale or major improvement to pastoral land use capability (grazing/ agriculture), extensive restoration or enhancement above baseline conditions.
Medium	Measurable damage to soil quality and/or land use capability for pastoral farming (grazing/agriculture). Concentrations of contaminant in soils are likely to exceed baseline concentrations and standards for parameters that are unlikely to affect human health.	Some benefit to key soil quality characteristics or land use capability.
Low	Some measurable change in/damage to soil quality or vulnerability to pastoral land use capability (grazing/agriculture). Minor loss of, or alteration to, key soil quality characteristics or land use capability. With respect to soil quality, concentrations are unlikely to exceed baseline concentrations and standards (e.g. soil organic matter, salinity, pH/fertility, metal concentrations).	Minor benefit to, or addition of, one or more key soil quality characteristics that improves pastoral land use capability.
Negligible	No, or very minor (immeasurable), change to soil characteristics or parameters describing soil quality or pastoral land use capability (e.g. soil organic matter, salinity, pH/fertility, metal concentrations).	

The definitions applied to resulting significance categories for the purposes of this assessment are summarised as follows:

- Major: If adverse, impacts with this significance represent key factors in the decision-making process or the feasibility of the Project. They are generally, but not exclusively, associated with human health or features of international or national importance and/or resources/features that are unique, which, if lost, cannot be replaced or relocated.
- Moderate: If adverse, impacts with this significance may contribute to the decision-making process. These impacts are generally, but not exclusively, expected to be important at a regional or local scale.
- Minor: These impacts may be raised as local issues but are unlikely to be of importance in the decision making process. Nevertheless, they are of relevance in the detailed design of the Project.
- Negligible: Impacts that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

7.5.5 Key Guidance and Standards

The Kenyan policy and legislation documents presented in Section 2.2 and the international guidance and standards presented in Section 2.3 are relevant to this assessment. The guidance and standards that are relevant to the protection of geology and soils to which the Project will be required to conform are as follows:

- Kenyan policy and legislation, including:

  - Kenyan Government EMCA, 1999 and Amendments, 2018; and
  - Republic of Kenya National Environment Policy, 2013.
- National Soil and Water Conservation Project (Machakos District) FAO UN, 1989;
- IFC PS, 2012; and
- WBG EHS Guidelines, 2007.

The impact assessment mitigations were developed by applying international industry standards for pipeline and oil & gas facilities construction on undisturbed ground, including considerations for topsoil salvage, storage and replacement where applicable. These soil conservation and reclamation principles are common in the pipeline construction and oil and gas industry worldwide and are consistent with FAO UN standards.

7.5.6 Receptors of Interest and Importance

The focus of this assessment is on the quality of soil. Baseline environmental information indicates the importance and types of soil that occur in the AoI.

Using the Project Description and the baseline soil environment information presented in Section 6, the following primary soil resources have been identified as being susceptible to changes in soil quality:

- High importance agricultural (including grazing) land potential: disturbance of Cambisols, which are understood to occur on the pipeline route, due to pipeline construction, resulting in loss of organic matter and soil fertility; and
- Medium importance agricultural (including grazing) land potential: disturbance of Fluvisols and Lixisols due to pipeline construction, resulting in a loss of soil fertility or change in soil water content/drainage.

In addition to the receptors that could be impacted by changes in soil quality, this assessment also considers changes to soil quantity through the risk of erosion.

Table 7.5-2 illustrates the soil resources within the Project footprint and Table 7.5-3 presents the assigned importance for these resources following the criteria presented in Section 7.5.3.

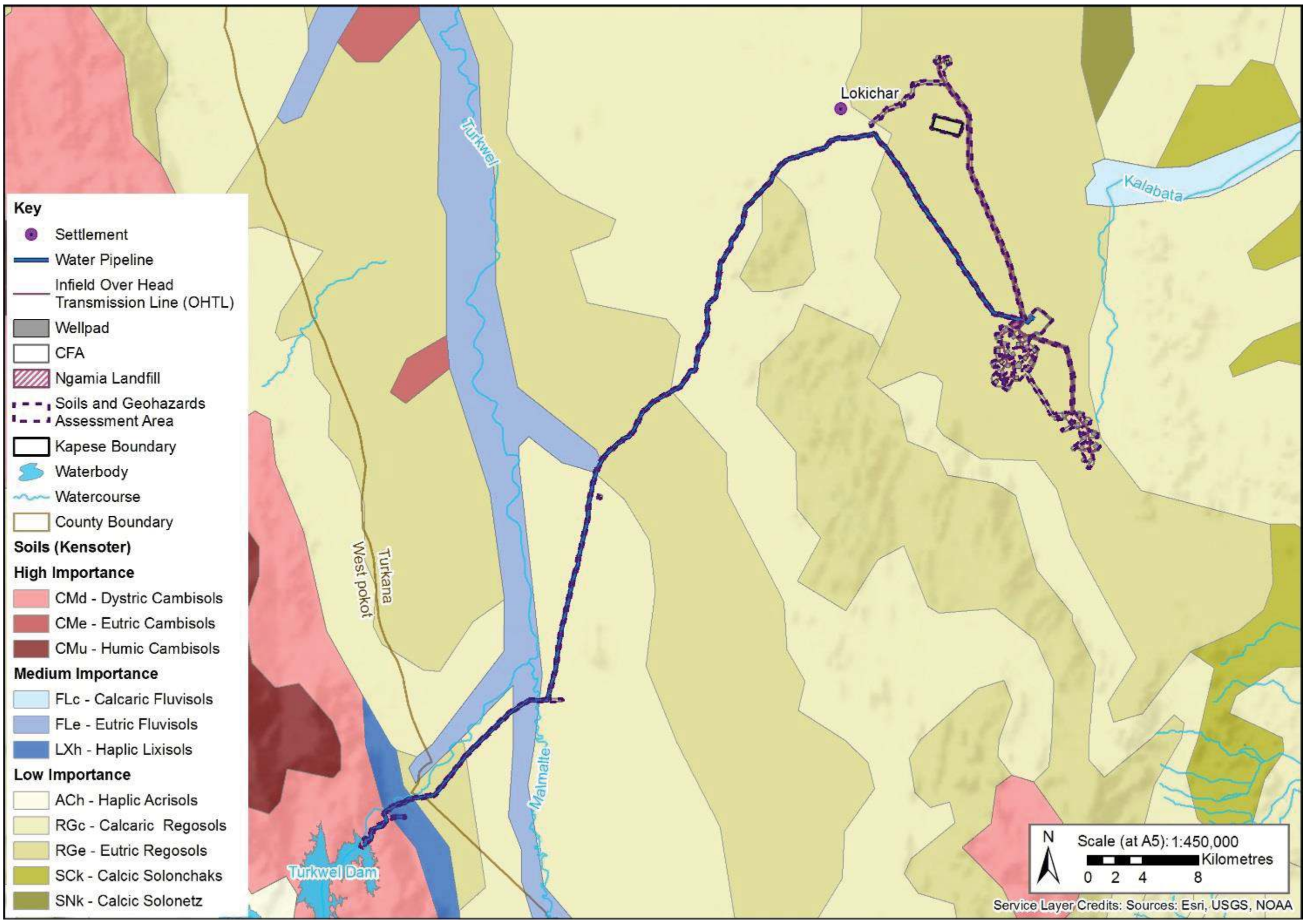

Figure 7.5-2: Soil Types in the AoI for the Project

Table 7.5-3: Receptors and Importance (Soil Quality, Quantity and Erosion Risk)

Receptor	Importance	Comment
Cambisols	High	Viable agricultural land potential but not as enriched with organic matter as the optimal soil types, and therefore less fertile. Sensitive to soil organic carbon loss.
Fluvisols	Medium	Important soils with cropland potential that require periodic flooding/high available water (e.g. rice). generally productive land for agriculture during dry and wet seasons. Sensitive to alterations in water holding capacity and soil loss as a result of water flows.
Lixisols	Medium	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Less fertile than Cambisols. Generally resilient to soil quality degradation due to strong moisture holding capacity and relatively low erodibility.
Regosols	Low	Poor agricultural land potential, limited potential for degradation of land use capability. Limited potential for degradation of land use capability due to wind/water erosion.

To aid in the evaluation of the magnitude of impact on soils due to erosion, the AoI was evaluated in GIS using the RUSLE (Revised Universal Soil Loss Equation) toolkit by inputting applicable parameters including:

- The LiDAR bare earth Digital Elevation Model (DEM) for the topographical factors;
- Soil erosivity values based on known literature values for the soil textural types found in the AoI (based on soil type receptors above);
- Rainfall Erosivity values based on actual regional rainfall intensity data from Global Rainfall Erosivity (ESDAC 2017); and
- Cover and management factors assuming bare soil.

The resultant output was rated into a relative erosion risk rating (low, moderate, high) that could be visualized and used for future mitigation/design measures.

7.5.7 Sources of Impacts

Potential sources of impact of a range of magnitudes that will occur throughout the life of the Project are set out below by Project phase.

7.5.7.1 Construction Phase

Based on the Project Description and the understanding of the baseline soil conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to either soil quality or soil loss due to erosion during the construction phase. The potential sources of impact and routes by which they could impact soil resources are as follows:

- Construction activities disrupting the surface soil crust or root mats resulting in localised loss of topsoil due to erosion (wind and/or water);
- Stripping of surface soil during construction resulting in admixing of subsoil into the topsoil and dilution of organic matter;
- High vehicle traffic during construction on ground surfaces causing compaction of medium and fine-textured topsoil (rutting) and subsoil;
- Earthworks construction activities associated with the physical disturbance of soil resources, their handling, storage, and replacement could lead to a change in soil quality and expose soil resources to elevated risk of soil erosion while soil is in stockpile and the landscape is altered (i.e. trench excavation); and
- Reclamation of the pipeline trenches will result in topsoil having been in storage and may have degraded due to organic matter loss, soil biodiversity loss, and/or erosion.

7.5.7.2 Operational Phase

Based on the Project Description the following aspects of the Project have been identified as presenting potential sources of impact to soil quality and/or pastoral land use capability during the operational phase:

- Presence of the backfilled make-up water pipeline and infield pipeline trenches – the pipework and associated backfill materials that will be installed within the trench will have different hydraulic properties to the original soils/rock that are excavated. This could lead to localised changes in soil drainage and soil water availability;
- Operation of the permanent Project infrastructure will result in a long-term loss of pastoral land use capability and will be degraded due to organic matter loss; and
- Heavy equipment traffic leading to compaction and rutting.

7.5.7.3 Climate Change

Climate change is not considered relevant to this section of the ESIA, as the soil taxonomy and soil characteristics are not expected to change due to climatic change, and the Project is not expected to accelerate taxonomic or soil chemical/physical property changes in correlation with climatic change.

7.5.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to Project infrastructure (design measures) or are widely accepted GIIP.

7.5.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on soil quality/availability:

- The water pipeline will be buried to reduce the possibility of damage at the surface (deliberate or accidental) that could otherwise lead to soil erosion or contamination;
- All substance storage (chemicals and fuels) will be bunded – all on-site hazardous materials storage will feature a secondary containment system, in line with WBG EHS Guildelines, 2007. By locating substances in dedicated storage areas with appropriate flooring and bunding, spills/leaks can be contained and addressed rather than being able to enter the environment.;
- Existing infrastructure has been identified for use where possible (e.g. existing roads instead of new ones) to reduce the need for creation of new infrastructure - the construction of which could have led to increased suspended solids and changes to infiltration; and
- Oil water separators will be installed and maintained, as appropriate.

7.5.8.2 Good International Industry Practice

- The Project will be constructed to comply with relevant laws/regulations and with environmental permits in place;
- Only inert backfill materials will be used for the trenching process to reduce the potential for introducing new sources of contamination;
- Waste disposal will be to a NEMA licensed facility to reduce pollution potential;
- The Project will apply effective spill prevention, control and response procedures for non-emergencies to control releases that could pollute the soil environment. Provision, and training in use, of spill containment equipment will be implemented where they are required;
- Operational waste (e.g. effluents from tank bottom water, storm water, and other waste) will be handled in a way that follows environmental legislative requirements and reduces pollution potential;
- When selecting chemicals and materials this will, where practicable, aim to avoid or minimise the use of hazardous materials. Consideration will be given to selecting the items with the lowest potential for environmental harm possible without loss of effectiveness;

- Transfer of hazardous materials from tanks to storage will take place in areas with surfaces sufficiently impervious to avoid loss to the environment. The surface will be sloped to a collection or a containment structure not connected to municipal wastewater/storm water collection system;
- The amount of time the water pipeline trenches will be open will be minimised;
- Topsoil will be salvaged, sorted and protected along the length of the pipeline trench and replaced following pipeline installation and trench backfilling. This will minimise degradation of soil quality and limit erosive losses of soil while in stockpile; and
- Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled.

7.5.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were captured during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- Question related to Project vibrations and any potential interference with the soil;
- Concern that construction on sloping land might bring soil erosion and question on mechanism in place to mitigate such impact; and
- Question on mitigation measures to address flash floods especially those that cause massive soil erosion.

7.5.10 Impact Classification

Taking into account the baseline soil environment setting (Section 6.3), the relevant incorporated environmental measures (Section 7.5.8), and the potential sources of impact (Section 7.5.7) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the non-negligible potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

7.5.10.1 Construction

The impact classification process prioritises potential impacts to soil that could result in significant impacts. As such some potential impacts can be "*scoped out*" where there is insufficient linkage between the source of impact and receptors, or the magnitude of this impact would be negligible when taking account of incorporated environmental measures.

The following bullets provides the qualitative evaluation of impacts which are not considered for further impact classification:

- High vehicle traffic during construction on ground surfaces causing compaction of medium and fine-textured topsoil (rutting) and subsoil. The Project will reuse existing infrastructure where possible; thereby reducing the amount of new hardstanding. The area taken up with Project infrastructure is also small compared to the wider soil availability and the soil is of relatively poor quality. Given this, it is predicted that the impact magnitude will be negligible and the significance of the impact is **Negligible**.
- Reclamation of the pipeline trenches will result in topsoil having been in storage and may have degraded due to organic matter loss, soil biodiversity loss, and/or erosion. However, with the incorporated environmental measures in place, such changes and the likely poor quality of the soil in disturbed areas,

impacts would be localised and very small scale. Therefore, it is predicted that the impact magnitude will be negligible, and the significance of the impact is **Negligible.**

Soil Quality

With the exception of the luggas interspersed throughout the area of the CFA, wellpads, landfill, and roads, the soils in the areas of permanent Project infrastructure are of low quality for pastoral use (Regosols) and lack a thick topsoil horizon with organic carbon enrichment and are mineral nutrient poor. It is expected that the Project will result in a low magnitude impact on soil quality / loss of pastoral land use capability, which, for a receptor of low importance, has a **Negligible** significance.

The two key impacts on soil quality during construction will be, firstly the temporary loss of agricultural land (Cambisols and Fluvisols on the Malmalte and Turkwel River valleys and the lands adjacent to the Turkwel Dam). This will have a low magnitude impact on soil, which, for receptors of high (Cambisols) and medium (Fluvisols) importance, will result in impacts of **Moderate** (Cambisols) and **Minor** (Fluvisols) significance.

The topsoil handling and storage (admixing, organic carbon loss, erosion) is expected to have a low magnitude impact on soil quality, which, for receptors of high (Cambisols) and medium (Fluvisols) importance, has a **Minor** significance.

Mitigation will include a soil management procedure to include the following:

- Where relevant, soil handling on agricultural land to conserve the land use capability post-construction.
- Where possible undertake the work in the dry season where the opportunity for soil erosion (e.g. water and sedimentation) is limited.
- Where possible, works in periods of extreme rainfall will be limited, as far is it is practicable, to limit soil loss due to erosion.
- Dry season work to incorporate a combination of mitigation measures that also limit the potential for erosion generally to occur (see Soil Erosion).
- Following identification of medium to high importance soil resources during construction process, implementation of active revegetation of medium to high importance soil resources;
- Where there is a high potential for land to be used for arable cultivation; topsoil will be left in windrows for a maximum of 6 months along water pipeline route.
- Rehabilitation plan to be developed for ‘fly camps’.
- Develop erosion control plan, with specific attention on high erosion hazard areas that overlap with river valleys and luggas.

In addition, the make-up water pipeline will be inspected within the first two years following construction to identify areas of erosion and subsidence. An erosion and sediment control plan will be developed and implemented for areas requiring repair to mitigate sedimentation to nearby watercourses and protect soil quality.

Soil Erosion

Table 7.5-4 presents locations relating to Project infrastructure that have been identified as potentially prone to soil erosion. Recommended mitigation measures include installation of temporary erosion control measures, where required, prior to earth-moving activities and, where possible, undertaking works in watercourses during periods of low or no flow. If unavoidable, flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. An individual risk assessment will be completed on a case-by-case basis.

Table 7.5-4: Soil Erosion Risk Rating and Locations of Soils

Soil Reference Group	Erosion Risk Rating	Rationale	Locations identified as having potential for specific soils
Cambisols	Medium/ High	Erosion likely on slopes when surface is bare.	Water Pipeline RoW adjacent to the Turkwel Reservoir.
Fluvisols	Medium	Erosion potential in vicinity of rivers.	Turkwel and Malmalte River valleys along the Water Pipeline RoW.
Lixisols	Medium	Crust can develop leading to low rain infiltration, presenting an erosion risk from sudden overland flows and wind.	Turkwel River valley along water pipeline RoW.
Regosols	Low	Weakly developed soil structure and horizons makes these soils susceptible to erosion on high slopes.	All Project infrastructure will interact with Regosols, however they occur primarily in locations with low slope gradients for the risk rating is low.

Figure 7.5-3 to Figure 7.5-9 show the RUSLE output for erosion risk ratings spatially for the Project, which generally coincide with the Reference Group soil types described in Table 7.5-4 above. The figure demonstrates that for the majority of the Project, erosion rates are predominantly low, with some medium rate areas present along the water pipeline RoW. Where water pipeline RoW is in the vicinity of the Turkwel Dam there is an area of high erosion rate.

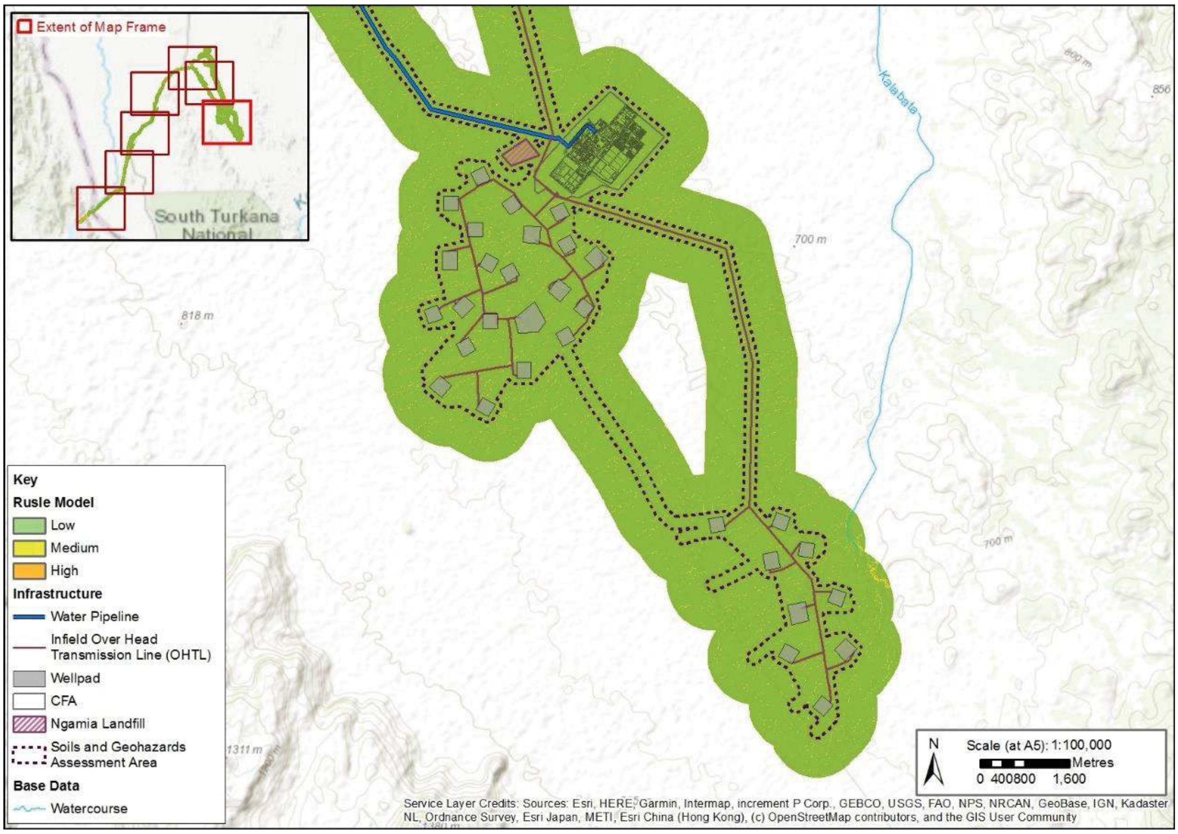

Figure 7.5-3: Soil Erosion Risk in the Upstream Oil & Gas Facilities (CFA, Wellpads, Landfill, Interconnecting Network RoW)

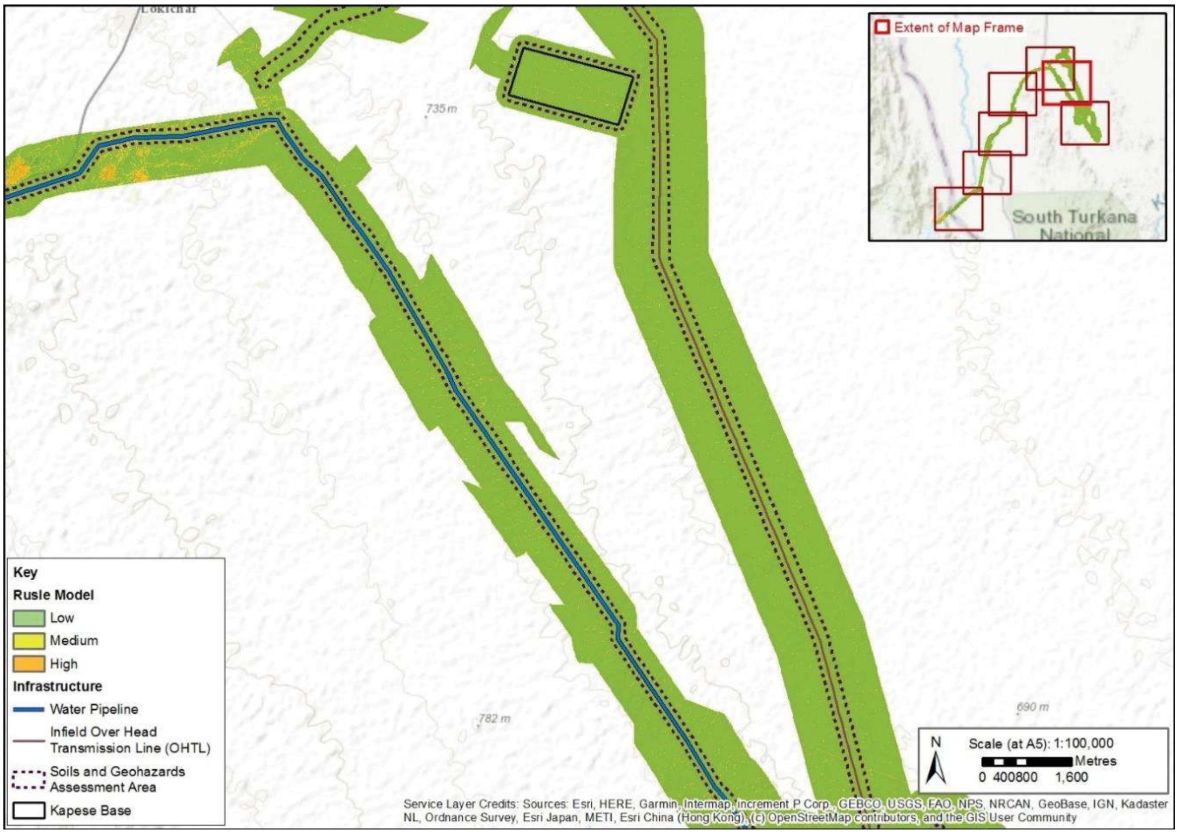

Figure 7.5-4: Soil Erosion Risk in the North Upstream Oil & Gas Facilities (Twiga Wellpad, Interconnecting Network RoW, Water Pipeline RoW).

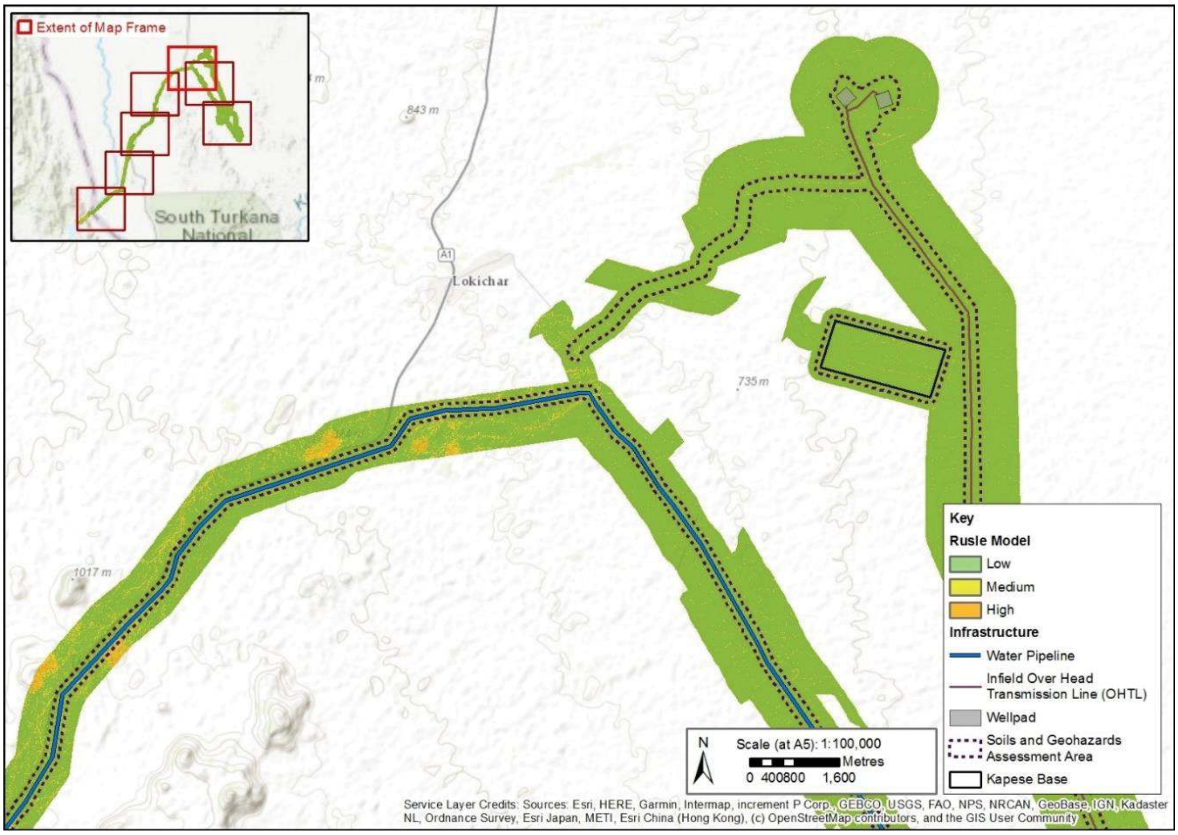

Figure 7.5-5: Soil Erosion Risk in the North Upstream Oil & Gas Facilities (Twiga Wellpad, Kapese Base, Interconnecting Network RoW, Water Pipeline RoW).

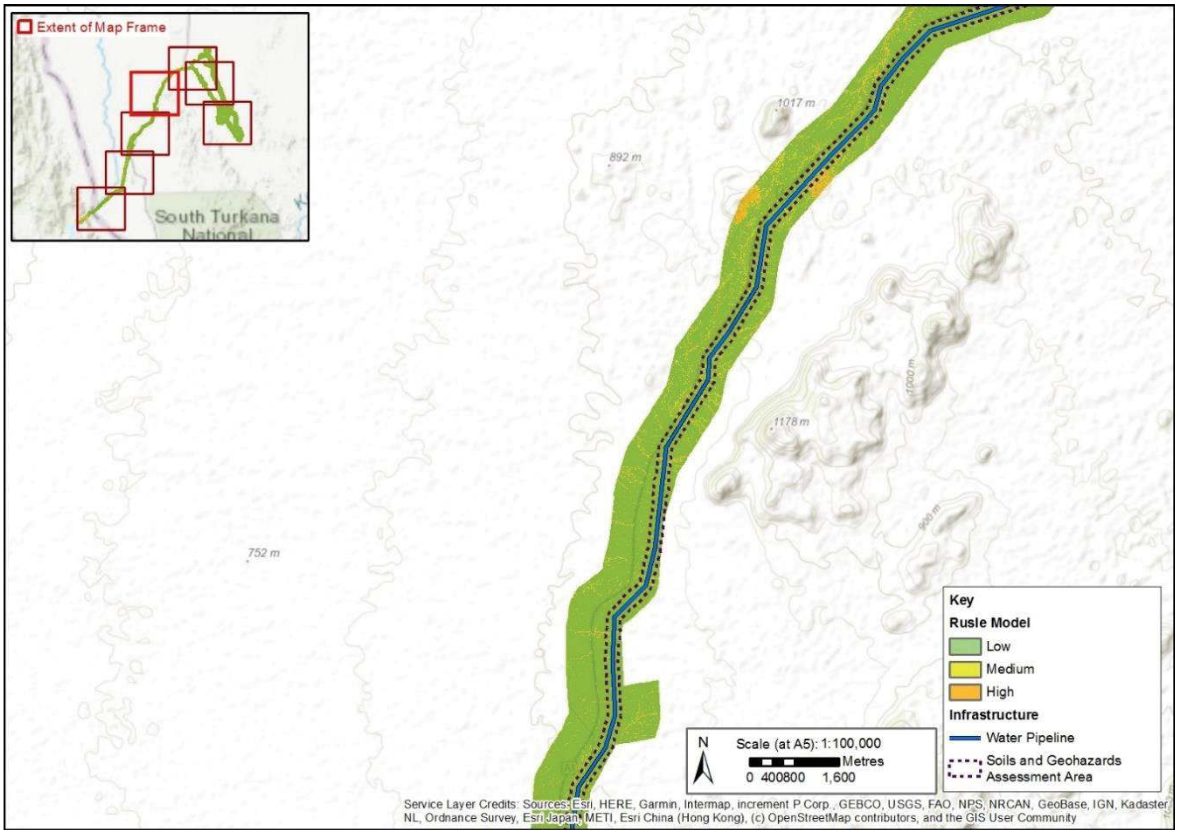

Figure 7.5-6: Soil Erosion Risk in the Northern Water Pipeline RoW

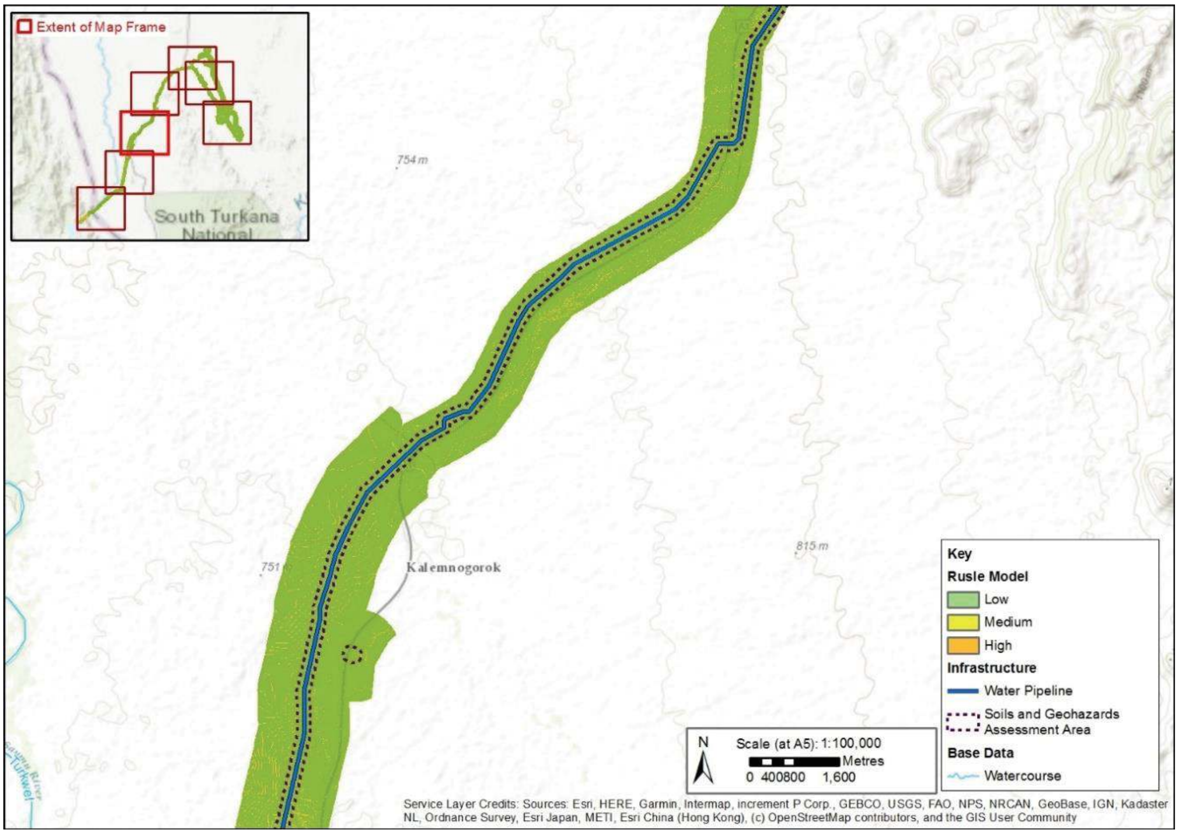

Figure 7.5-7: Soil Erosion Risk in the Central Water Pipeline RoW.

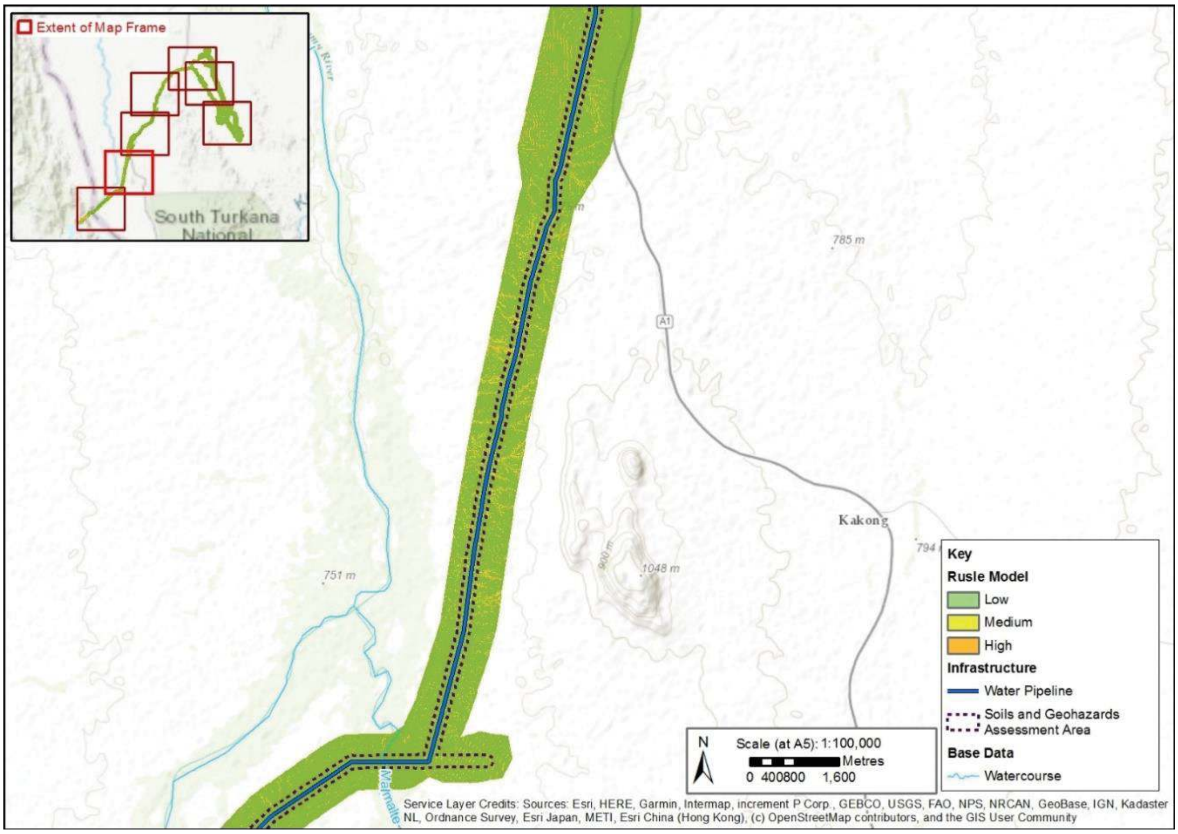

Figure 7.5-8: Soil Erosion Risk in the Southern Water Pipeline RoW.

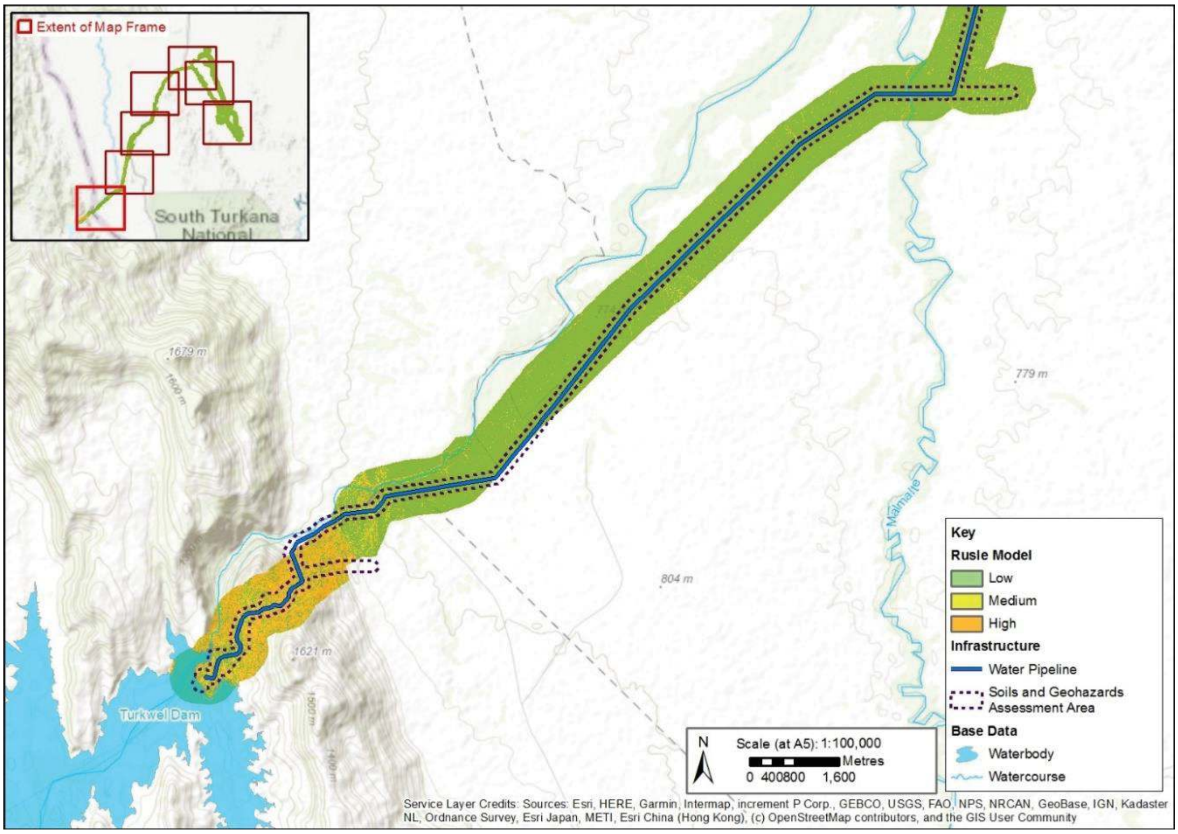

Figure 7.5-9: Soil Erosion Risk in the Southern Portion and Source of the Water Pipeline RoW.

Table 7.5-5: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Agricultural land potential: Cambisols and Fluvisols (High and medium, respectively)	Ground disturbance leading to increased exposure to erosion risk on the Water Pipeline RoW near the Turkwel Reservoir.	Medium – short-term - temporary	Moderate (Cambisols) and Minor (Fluvisols) (adverse)	Where relevant, soil handling on agricultural land to conserve the land use capability post-construction. Where possible undertake the work in the dry season where the opportunity for soil erosion (e.g. water and sedimentation) is limited. Where possible, works in periods of extreme rainfall will be limited, as far is it is practicable, to limit soil loss due to erosion. Dry season work limit the potential for erosion generally to occur. Following identification of medium to high importance soil resources during construction process, implementation of active revegetation of medium to high importance soil resources; Following construction where there is a high potential for arable land to occur; topsoil to be left in windrows for no longer than 6 months along water pipeline route. Rehabilitation plan to be developed for 'fly camps' Develop erosion control plan, with specific attention on high erosion hazard areas that overlap with river valleys and luggas. The make-up water pipeline will be inspected within the first two years following construction to identify areas of erosion and subsidence. An erosion and sediment control plan will be developed and implemented for areas requiring	Low – short-term – temporary	Minor (both) (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				repair to mitigate sedimentation to nearby watercourses and protect soil quality.		
	Ground disturbance leading to a short-term loss of agricultural land capability (including existing agricultural land and land that has the potential to be used for agriculture)	Low – short-term – temporary	Minor (adverse)	Soils management protocols described in the Construction Environmental Management Plan (CEMP).	Low – short-term – temporary	Minor (adverse)
	Topsoil handling and storage (admixing, organic carbon loss, salinity changes) – direct impact on quality	Low– short-term – temporary	Minor (adverse)	No additional measures	Low – short-term – temporary	Minor (adverse)

7.5.10.2 Operational Phase

For the operational phase soil resources impact assessment, the following has been taken into account:

- No additional direct soil disturbance will take place beyond the construction phase. Impacts associated with this have been assessed in the construction phase assessment; and
- As with the construction phase, some operational impact pathways are considered to be direct (i.e. topsoil quality degradation due to disturbance, storage and replacement).

Once a source of impact to soil quality has been removed or the construction process is over and rehabilitation is in place at the end of construction or operations, baseline conditions can return, so the impacts are temporary. Areas of permanent above-ground Project infrastructure where soils have been displaced will have long-term effects to pastoral land uses as described in Section 7.5.7.2. These impacts are addressed in the construction phase assessment.

During the operational phase there will negligible to low magnitude of impacts on soils as a result of compaction and rutting from heavy equipment traffic. This can reduce soil porosity and negatively impacting soil structure and water permeability in the rooting zone. This impact will be limited in extent and would be expected to recover over a short period of time following the application of the soil management plan. The impact is therefore considered to be of **Negligible** significance.

7.5.10.3 Decommissioning

As the operational phase of the Project nears its end, a decommissioning plan will be developed that will include measures to protect soil resources and mitigate the loss of agricultural land potential within the area of the Project. The decommissioning plan will include general and specific mitigation measures for erosion and sediment control, topsoil conservation, and the preservation of soil quality.

Prior to the planned ‘End of Project’, a Decommissioning Plan will be developed for agreement with the appropriate authorities.

When the Project is decommissioned, the following decommissioning philosophy will be adopted:

- All above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use;
- All decommissioning waste will be handled, stored and managed through the good practice outlined in the Waste Management section of the Decommissioning Plan.

7.5.11 Summary of Mitigation

In addition to the incorporated mitigation measures (Section 7.5.8), the following additional mitigation and monitoring is recommended to reduce the predicted impact significance to minor or below:

Construction Phase

- Revegetation of medium to high importance soil resources following construction where there is a high potential for arable land to occur;
- Soil management procedures and selection criteria will be defined in the CEMP will include:
  - Where relevant, soil handling on agricultural land to conserve the land use capability post-construction.
  - Where possible undertake the work in the dry season where the opportunity for soil erosion (e.g. water and sedimentation) is limited.

  - Where possible, works in periods of extreme rainfall will be limited, as far is it is practicable, to limit soil loss due to erosion.
  - Dry season work to incorporate a combination of mitigation measures that also limit the potential for erosion generally to occur (see Soil Erosion).
  - Following identification of medium to high importance soil resources during construction process, implementation of active revegetation of medium to high importance soil resources; Where there is a high potential for land to be used for arable cultivation; topsoil will be left in windrows for a maximum of 6 months along water pipeline route.
  - Rehabilitation plan to be developed for 'fly camps'.
- An erosion control plan will be prepared outlining soil conservation tactics for works during extreme rainfall events and extreme dry, windy events during construction of the Project area. Site-specific erosion control plans will be prepared as required during construction in mountainous/high relief portions of the make-up water pipeline route;
- Management of excavated/stored material and the installation of infrastructure to capture sediment in runoff will be put in place adjacent to watercourses to minimise erosion. The procedures being followed will be inspected and monitored throughout construction;
- Salvage topsoil in areas where it occurs in the direct soil disturbance footprint of the CFA, wellpads, landfill, roads and camps. Given the major soil types in these areas, it is expected that topsoil will be limited to the areas of the luggas.

Operational Phase

- The make-up water pipeline will be inspected within the first two years following construction to identify areas of erosion and subsidence. An erosion and sediment control plan will be developed and implemented for areas requiring repair to mitigate sedimentation to nearby watercourses and protect soil quality.

7.5.12 Summary of Residual Impacts

With mitigation that has been incorporated into the design, or will take place during pre-construction, construction or operational phases, it is considered that the sources of potential impacts to soil resources are manageable. Most impacts are also considered to be temporary, except where they are associated with physical changes to drainage, where these are identified, they will be monitored and rectified.

The residual impact significance on soils is classified as **Minor** or **Negligible**.

7.6 Landscape and Visual

7.6.1 Introduction

This section provides an assessment of the potential impacts of the Project on landscape and visual elements. There are two main parts to the assessment:

- Landscape impacts: which relate to the temporary or permanent impacts on the fabric, character and scenic quality of the landscape resulting from physical and perceptual changes (i.e. to landform, vegetation cover, or tranquillity of the landscape); and
- Visual impacts: which relate to changes in existing views due to Project infrastructure and activities, and the impacts of those changes on the current population (e.g. residents or visitors).

Potential impacts have been determined using a qualitative assessment methodology presented in Section 7.6.10. Where potential impacts have been identified, these are considered in turn and mitigation are set out where necessary to ensure that any potential impacts are reduced as far as practicable.

7.6.2 Area of Influence

The Project AoI is presented in Section 3.13. This has been used as a base to formulate a LVAA for the landscape and visual elements of the ESIA.

The LVAA comprises a 10 km buffer around aboveground Project facilities. The 10 km distance enables a comprehensive overview of the immediate landscape and visual context and covers receptors considered to have the potential to be affected by Project facilities.

Potential receptors located within the Project AoI have been identified as part of the baseline studies. Receptors that have been carried forward into the assessment are presented in Section 7.6.6.

7.6.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.6-1 have been used with reference to the information collated in the baseline to classify the selected receptors.

7.6.3.1 Landscape and Visual Receptor Importance

Table 7.6-1: Criteria for Determining Landscape Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ Landscape including protected or designated areas of international importance (e.g. World Heritage Sites).
High	■ Landscape including protected or designated areas of national importance (|National Reserves); and/or ■ Views for permanent residential receptor with open or limited views.
Medium	■ Landscape including designated areas of national or regional importance (e.g. Community Conservancies); and/or ■ Views for transient human or tourist receptor.
Low	■ Landscape including designated areas of local, limited or no known importance; and/or ■ Views for incidental/transient and amenity user.

7.6.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.6-2.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long-term, medium or short-term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period), where CFA/CPF construction will be within the first 36 months;
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself and all landscape and visual impacts are anticipated to be direct in nature.

The definitions applied to resulting significance categories for the purposes of this assessment are summarised as follows:

- Major: If adverse, impacts with this significance represent key factors in the decision-making process or the feasibility of the Project. They are generally, but not exclusively, associated with human health or features of international or national importance and/or resources/features that are unique, which, if lost, cannot be replaced or relocated.
- Moderate: If adverse, impacts with this significance may contribute to the decision-making process. These impacts are generally, but not exclusively, expected to be important at a regional or local scale.
- Minor: These impacts may be raised as local issues but are unlikely to be of importance in the decision-making process. Nevertheless, they are of relevance in the detailed design of the Project.
- Negligible: Impacts that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

7.6.4.1 Landscape Magnitude of Impact

Changes to the landscape attributes within each LCA were assessed and categorised individually using the criteria in Table 7.6-2 to determine the magnitude of impact on the landscape.

Table 7.6-2: Criteria for Assessing Magnitude of Landscape Impact

Magnitude of Impact	Description Criteria		
	Adverse	Beneficial	Geographical Extent
High	Loss of resource/receptor, loss of quality and integrity of the resource/receptor, severe damage to key characteristics, features or elements. Major loss or alteration to the landscape.	Large scale or major improvement to resource/ receptor quality, extensive restoration or enhancement.	Very extensive or complete impact on landscape character area.
Medium	Partial loss of resource/ receptor, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements. Notable loss or alteration to the landscape character.	Some benefit to key characteristics, features or parameters describing resource/ receptor quality.	Affecting a substantial proportion of the landscape character area.
Low	Some measurable change in/ damage to attributes, quality or vulnerability. Minor loss or alteration to the landscape character.	Minor benefit to, or addition of, one or more key characteristics, features or parameters describing resource/ receptor quality.	Impacted by the immediate setting of the Project component site.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing resource/ receptor quality. No or very minor loss or alteration to the landscape character.		Typically, no major changes to key landscape attributes.

7.6.4.2 Visual Magnitude of Impact

The overall impacts on view composition, prominence and distance are calculated using the criteria in Table 7.6-3. The magnitude of change is based on a qualitative assessment by Golder and does not necessarily reflect the individual opinions or perception of the viewers within the communities who may be disposed or predisposed to the Project, altering their tolerance to visual change.

Table 7.6-3: Criteria for Assessing Magnitude of Visual Impact

Magnitude of Impact	Description Criteria[(a)]	
	Change to the composition and quality of the view	Prominence of the development
High	Major change to all attributes.	The development is dominant.
Medium	Moderate change to all attributes or major change to some attributes.	The development is prominent.
Low	Low change to all attributes or moderate change to some attributes.	The development is discernible.
Negligible	Negligible change to attributes.	The development is not visible or barely discernible.

(a) Description criteria, including terminology used in Table 7.6-4, are described in Section 7.6.4

7.6.5 Key Guidance and Standards

The Kenyan policy and legislation documents presented in Section 2.2 and the international guidance and standards presented in Section 2.3 are relevant to this assessment. The following are of particular relevance:

- Kenya's Environmental (Impact Assessment and Audit) Regulations (2003), which identifies the following landscape issues which have been considered in the making of this landscape and visual impact assessment:
  - Views opened up or closed;
  - Visual impacts (features, removal of vegetation, etc.);
  - Compatibility with surrounding area; and
  - Amenity opened up or closed, e.g. recreation possibilities.
- The IFC PS3: Resource Efficiency and Pollution Prevention (2012) highlights the need to reduce pollution from new development. The term is deemed to include "*potential visual impacts, including the impacts of lighting*".
- Landscape Institute with the Institute of Environmental Management and Assessment. 2013[10]. *Guidelines for Landscape and Visual Impact Assessment, Third Edition*.

7.6.6 Receptors of Interest and Importance

As presented in the Landscape and Visual Baseline (Section 6.11), a number of primary landscape and visual receptors have been identified as being potentially susceptible to changes in the landscape and visual setting.

7.6.6.1 Landscape Receptors

Table 7.6-4 presents landscape features considered to be of particular importance due to their respective designations, importance for local communities and tourism, and proximity to proposed Project infrastructure. The table presents the assigned landscape character areas of these features and their importance as receptors.

Figure 7.6-1 presents the key landscape receptors and their location in relation to Project facilities.

[10] In the absence of international guidance, the proposed methodology employed for this assessment is based primarily on this current UK guidance

Table 7.6-4: Landscape Receptors and Importance

Receptor	Importance	Comment
South Turkana NR	High	Protected area is a designated reserve of national importance. Reserve comprises LCA 2 (dense bushland) and LCA 3 (rocky habitat/stunted bushland). The proposed make-up water pipeline passes 7.3 km to the east of the reserve.
Nasolot NR	High	Protected area is a designated reserve of national importance. Reserve comprises LCA 2 (dense bushland), LCA 3 (rocky habitat/stunted bushland) and LCA 4 (alluvial woodland). The proposed make-up water pipeline passes through the northern extent of the reserve and, following construction, will be buried throughout.
Pellow Community Conservancy	Medium	A community conservancy is considered to be of regional importance. Conservancy comprises LCA 2 (dense bushland), LCA 3 (rocky habitat/stunted bushland) and LCA 4 (alluvial woodland). The proposed make-up water pipeline passes through the northern extent of the conservancy and, following construction, will be buried throughout.
LCA 1 – Semi-desert	Low	There are no landscape designations within this LCA. The semi-desert landscape is relatively commonplace across the LVAA, with few distinctive elements of notable quality.
LCA 2 – Dense bushland	Medium	The LCA falls partially within the South Turkana NR, Nasolot NR and Pellow Community Conservancy. The dense bushland landscape is relatively commonplace across the LVAA, with few distinctive elements of notable quality.
LCA 3 – Rocky Habitat/Stunted Bushland	Medium	The dense bushland landscape is generally situated at the borders of the LVAA and signifies higher relief/altitude areas. The LCA has few distinctive elements of notable quality. The LCA falls partially within the South Turkana NR, Nasolot NR and Pellow Community Conservancy.
LCA 4 – Alluvial woodland (riparian)	High	The riparian landscape comprises a fundamental aspect of the LVAA and is an important resource for human activity and ecological value. The LCA is therefore vulnerable to changes to landscape features and characteristics. The LCA falls partially within the Nasolot NR and Pellow Community Conservancy.

The Turkwel Gorge Reservoir and Dam, from which the make-up water pipeline will be abstracted, has been scoped out as a receptor as it will not be significantly impacted by the Project from a landscape or visual perspective.

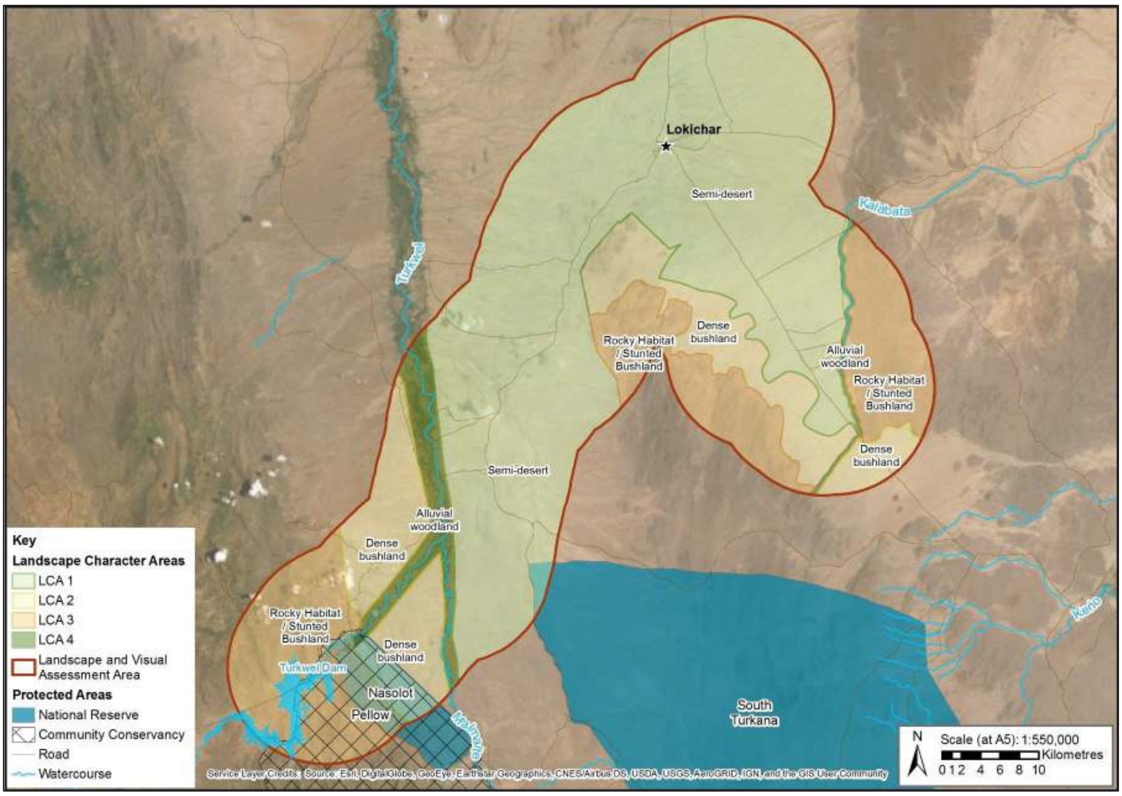

Figure 7.6-1: Landscape Receptors of Importance

7.6.6.2 Visual Receptors

Receptors included in the assessment, where present, are as follows:

- Permanent human receptors (high importance) – residential settlements indicative of PAP; and
- Transient human receptors (high importance) – due to the prevalence of nomadic pastoralism in the region and the associated transience of settlement, sensitive receptors cannot be easily defined.

Thirty-one viewpoints (18 near the TAN oilfields and 13 along the water pipeline) were identified to cover the LVAA and to provide a representative sample of the typical views experienced by the local receptors/populations. These viewpoints are presented in Table 7.6-5 along with their assigned importance and on Figure 7.6-2.

Table 7.6-5: Visual Receptors, Importance and Setting

Receptor	Receptor Representation	Importance	Setting
PL-1 – view of Twiga	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Twiga wellpads. Viewpoint is located 120 m from TW-04 wellpad.
PL-2 – view of Twiga	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Twiga wellpads. Viewpoint is located 1,380 m from TW-04 wellpad.
PL-3 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Ngamia wellpads and CFA/CPF. Viewpoint is located 190 m from NG-03 wellpad.
PL-4 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Ngamia wellpads. Viewpoint is located 240 m from NG-02 wellpad.
PL-5 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Ngamia wellpads. Viewpoint is located 130 m from NG-24 wellpad.
PL-6 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Ngamia lugga to Ngamia wellpads. Viewpoint is located 300 m from NG-11 wellpad.
PL-7 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Ngamia lugga to Ngamia wellpads. Viewpoint is located 140 m from NG-11 wellpad.

Receptor	Receptor Representation	Importance	Setting
PL-8 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Ngamia lugga to Ngamia wellpads. Viewpoint is located 220 m from NG-01 wellpad.
PL-9 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Ngamia lugga to Ngamia wellpads. Viewpoint is located 120 m from NG-16 wellpad.
PL-10 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Ngamia wellpads. Viewpoint is located 650 m from NG-10 wellpad.
PL-11 – view of Ngamia	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Ngamia lugga to Ngamia wellpads. Viewpoint is located 150 m from NG-16 wellpad.
PL-12 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) to Amosing wellpads. Viewpoint is located 1,150 m from AM-19 wellpad.
PL-13 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Amosing lugga to Amosing wellpads. Viewpoint is located 600 m from AM-03 wellpad.
PL-14 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Amosing lugga to Amosing wellpads. Viewpoint is located 840 m from AM-03 wellpad.
PL-15 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 and Amosing lugga to Amosing wellpads. Viewpoint is located 350 m from AM-01 wellpad.
PL-16 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to Amosing lugga to Amosing wellpads. Viewpoint is located 760 m from AM-10 wellpad.
PL-17 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 to Amosing wellpads. Viewpoint is located 180 m from AM-09 wellpad.

Receptor	Receptor Representation	Importance	Setting
PL-18 – view of Amosing	Residential users (permanent settlements – nomadic view)	High	Represents views from settlements (homesteads) adjacent to C46 to Amosing wellpads. Viewpoint is located 630 m from AM-09 wellpad.
PL-a to PL-k	Transient users (nomadic view)	High	Represents views from transient pastoralists. Viewpoint is located 1,500 m from make-up water pipeline/C40 road.
PL-i	Transient users (nomadic view)	High	Represents views from transient pastoralists. 1,530 m from the C40 road/4,950 m from Ngamia to Twiga OHTL.
PL-m	Transient users (nomadic view)	High	Represents views from transient pastoralists adjacent to the Malmalte River. Adjacent to the make-up water pipeline.

**Note: PL - Photo Location.*

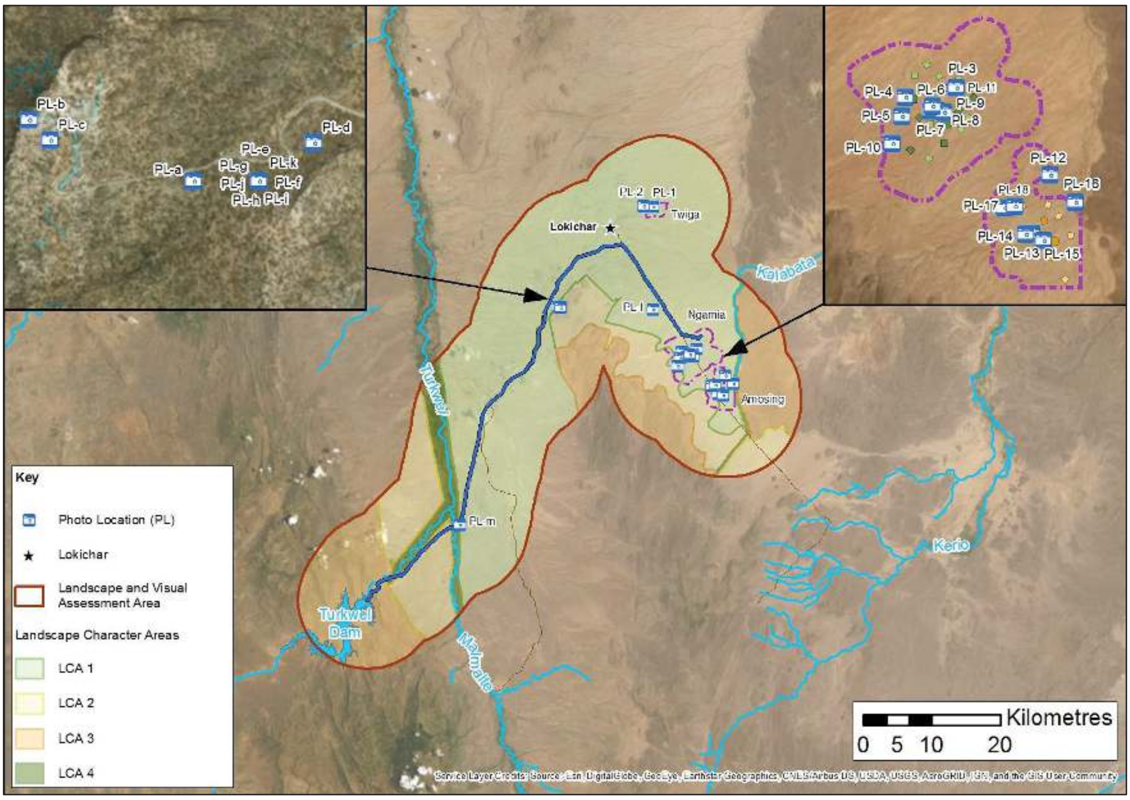

Figure 7.6-2: Project Viewpoints

7.6.7 Sources of Impacts

Potential sources of impact of a range of magnitudes will occur throughout the life of the Project are set out below by Project phase.

7.6.7.1 Construction Phase

Based on the Project Description and the understanding of the baseline landscape and visual conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to landscape and visual receptors during the construction phase. The potential sources of impact and routes by which they could impact landscape and visual receptors are as follows:

- Works associated with the construction of wellpads:
  - Temporary flaring at wellpads during construction; and
  - Initial well drilling.
- Works associated with the construction of OHTLs (including large-scale plant and machinery e.g. cranes);
- Works associated with the construction of the CFA and CPF (including large-scale plant and machinery e.g. cranes);
- Works associated with the construction of below ground project facilities (make-up water pipeline, interconnecting flowlines, landfill);
- Works associated with the construction of temporary infrastructure (including temporary access roads, camps, laydown areas);
- Mobilisation of plant, delivery of materials and supplies, transportation of construction personnel by vehicles and physical movement of construction workers;
- Site activity during construction, including dust plumes and lighting emissions associated with construction works;
- Clearance/removal of vegetation and soils (screening elements) during construction; and
- Material and construction waste generation, storage/stockpiles and disposal.

7.6.7.2 Operational Phase

Based on the Project Description and the understanding of the baseline landscape and visual conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to landscape and visual receptors during the operation phase. The potential sources of impact and routes by which they could impact landscape and visual receptors are as follows:

- Presence and operation of wellpads and supporting infrastructure;
- Presence and operation of OHTLs (both near Turkwel and the TAN oilfields);
- Presence and operation of CFA (CPF) and supporting infrastructure, including:
  - Routine and continuous flaring (and presence of flare stack) at the CPF; and
  - Flue gas stack at the IWMF in the CFA.
- Presence and operation of the landfill;

- Site activity during operation, including dust plumes and lighting emissions; and
- Mobilisation of plant, delivery of materials and supplies and transportation of operational and maintenance personnel by vehicles.

7.6.7.3 Climate Change

Climate change is not considered relevant to this section of the ESIA.

7.6.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.6.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on landscape and visual elements:

- The section of the make-up water pipeline that passes under the Malmalte River will be installed by HDD and the buried section will originate outside the riparian corridor. By using HDD rather than cut-and-fill, the construction works will not involve the clearance or excavation of ground and vegetation within the riparian corridor and subsequent change to the landscape character;
- Reducing the height of the flare at the CPF (stack height reduction from 60 m to 30 m during FEED review process);
- Route selection to avoid protected and designated areas where possible;
- Physical disturbance areas will be limited to within the Project facilities and RoW areas;
- The water pipeline and infield flowlines will be buried below the surface;
- Where practicable, linear Project infrastructure, including the water pipeline and OHTLs follow existing infrastructure or transport routes, limiting impacts on unspoilt landscape areas;
- Construction activities will be sequentially staggered and therefore will not take place concurrently at the same location, where the construction of the CFA/CPF will be within the first 36 months; and
- Laydown areas at each of the wellpad sites and at the CFA will be located within the footprint of the facility; there will be no additional site clearance required outside the facility footprint.

7.6.8.2 Good International Industry Practice

In addition to the mitigation specified within the Project description, this section presents accepted good practice that will also be implemented in order to remove or reduce the magnitude of potential impacts.

Construction Phase

- All temporary land take associated with the construction of the Project facilities and roads will be left to revert to natural condition and returned to communities following construction;
- Prompt removal of materials that have a potential to produce dust (including spoil), unless being re-used on site;

- Where practical, trucks transporting dusty material associated with the project will be covered to prevent escape of materials during transport;
- Daily site inspections will be undertaken by the clerk of works when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions;
- A permitted water supply will be available for on the site for dust/particulate matter suppression/mitigation, using non-potable water where possible and deemed appropriate; and
- Open burning of waste materials will be prohibited.

Operations Phase

- Lighting will be limited to within perimeter fencing of Project facilities (i.e. not on access roads).

All Project Phases

- Speed limits will be adhered to on all roads; and
- Lighting will be reduced to the practical minimum, without impacting safety and security. Where feasible, the light will be directed inwards the facilities and will be of a warm/neutral colour so as to limit nuisance to the surrounding communities and to avoid attracting animals.

7.6.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were captured during the EOPS and LLCOP consultation meetings and should only be use as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- Concern that light from the Project might affect communities;
- Concern that dust associated with the Project might affect communities;
- Concern that project activities might cause an impact on local scenery and request of information on mitigations in place to address this issue; and
- Visual impacts associated with the siting of Project facilities.

7.6.10 Impact Classification

Taking into account the baseline landscape and visual setting (Section 6.11), the relevant incorporated environmental measures (Section 7.6.8), and the potential sources of impact (Section 7.6.7) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

The following methodology was used to evaluate the impacts on the landscape:

- Overlaying the infrastructure footprints on the LCA plan and aerial photographs to estimate the physical extent of the changes to the landscape attributes within the LCAs;
- Preparing a computer-generated model of the main Project components to assess the permanent changes to landform and land cover; and
- Comparing the main Project components with observations/judgements made during the baseline study.

The following methodology was used to evaluate visual impacts:

- Generating ZTV mapping and analysis to predict the visual envelope for indicative heights of infrastructure, to inform the baseline data gathering;
- Generating simplistic computer-generated visualisations to provide an indication of the views of the project development from locations which represent typical views from settlements, roads, and tourist destinations; and
- Comparing the main project components with observations/judgements made during the baseline study.

Impacts on viewers were assessed in relation to change to the composition and quality of the view, the prominence of the development and the distance between the viewer and the development.

The Composition and Quality of the View

A view comprises a number of attributes which collectively contribute to the composition and scenic quality of the view. The assessment considers changes to these attributes (which include scale, colour, texture, form and pattern) to determine the overall impacts on the view composition.

Prominence of the Development

The overall prominence of the site components is measured in terms of the extent or proportion of the viewer's field of vision occupied by the Project. There is usually a strong correlation between prominence and distance.

Distance between the Viewer and the Development

There is usually a correlation between viewer distance and magnitude of change (i.e. the greater the distance, the less the visual impact), though occasionally distant viewers may be more adversely affected than closer viewers whose views are screened by intervening landform and/or vegetation.

7.6.10.1 Construction

The impact classification process focuses on the potential construction-related impacts to landscape and visual elements that could result in significant impacts. As such some potential impacts can be "*scoped out*" where there is insufficient linkage between the source of impact and receptors, or the magnitude of this impact would be negligible when taking account of incorporated environmental measures.

The following bullets provide a qualitative evaluation of landscape and/ or visual impacts that are not considered for further impact classification:

- Due to its relative distance from the Project facilities and the associated avoidance of direct landscape character change, construction related landscape and visual impacts on South Turkana NR are considered to be **Negligible**.
- Due to the temporary nature of the construction activities, landscape and visual impacts to transient receptors are considered to be **Negligible**.
- Due to the relatively short time period of construction and lack of significant visual impact for the laying of below-ground infrastructure, visual impacts associated within construction activities for and along the make-up water pipeline and in field flowlines are considered to be **Negligible**.

The following potential sources of impact are the focus of further construction impact classification:

- Works associated with the construction of wellpads, including temporary flaring at wellpads during construction and initial well drilling potentially impacting the landscape character and visual elements within the vicinity of the Project facilities.

- Works associated with the construction of OHTLs (including large-scale plant and machinery e.g. cranes) will impact the landscape character and visual elements within the vicinity of the Project facilities.
- Works associated with the construction of the CFA and CPF (including large-scale plant and machinery e.g. cranes) potentially impacting the landscape character and visual elements within the vicinity of Project facilities.
- Works associated with the construction of below ground Project facilities (make-up water pipeline, interconnecting flowlines, landfill) and temporary infrastructure (including temporary access roads, camps, laydown areas) potentially impacting the landscape character along the length of the water pipeline and near the TAN oilfields.
- Clearance/removal of vegetation and soils during construction potentially impacting the visual elements within the vicinity of the Project facilities/activities.
- Site activity during construction will generate dust plumes, lighting emissions, material and construction waste storage/stockpiles, potentially impacting visual elements within the vicinity of the Project facilities/activities. This includes impacts from the mobilisation of plant, delivery of materials and supplies, transportation of construction personnel by vehicles and physical movement of construction workers.

The impact assessment is discussed in more detail in the sub-sections below. The construction phase impact assessment with respect to landscape and visual is presented in Table 7.6-6. Any additional mitigation is also presented in that table.

Summary of Impacts on the Landscape

The following impacts require no additional measures beyond those described in Section 7.6.8, with no change in impact significance pre and post mitigation, and are therefore not considered further in Table 7.6-8:

- Construction activities within the TAN oilfields relate to the installation of infrastructure on the 33 wellpads, construction of the CFA (and the CPF) as well as the OHTLs, occurring throughout the 36 to38-month construction period. This change to the existing landscape character would be relatively short-term, and partially reversible for temporary construction sites:
  - For LCA 2 (dense bushland) and LCA 3 (rocky habitat/stunted bushland), due to the limited value of these character areas outside of the protected areas, predicted residual impacts during construction will be **Minor**.
  - Similarly, **Minor** residual impacts are predicted for LCA 1 (semi-desert) as a result of construction works associated with both above-ground and below-ground Project infrastructure.
  - For LCA 4 (alluvial woodland), there will be limited construction related impacts due to inherent design measures, including the use of HDD for the Malmalte River crossing avoiding extensive tree clearance and the relatively small area affected by the Project infrastructure. Therefore, the predicted residual impacts during construction on LCA 4 will also be **Minor**.

The make-up water pipeline will pass through two protected areas; Nasolot NR and Pellow Community Conservancy. It is understood that the immediate area where the water pipeline passes through the protected areas is a modified habitat of very poor vegetation class condition and has a high level of altered land use.

Construction works associated with water pipeline and associated infrastructure near the Nasolot NR and Pellow Community Conservancy will be limited to the 27 m RoW for the make-up water pipeline (including laydown areas), and construction camp use existing facilities at Turkwel, meaning that there will not be a change to the wider landscape area associated with loss or damage to key characteristics, features or elements during the construction period. As these are protected areas (high importance), the Medium magnitude impact translates to a **Moderate** significance. However, with mitigation implemented by the EPC contractor of no night-time working during construction within 100 m of the Nasolot NR or Pellow Community Conservancy unless pre-agreed with TKBV and supervised by the Project BCoW plus a communication plan to ensure protected areas administration and users are informed of timings of construction, the predicted residual impacts during construction on protected areas will be of **Minor** significance.

Summary of Significant Visual Impacts

A number of permanent residences (homesteads) are located within close proximity to the Project facilities (particularly within the TAN oilfields), and receptors at these locations are of high importance. During the construction of the wellpads, CFA (CPF) and OHTL, full views of the infrastructure will be possible from a number of these settlements.

The facilities outline will break the skyline in many areas, as the surrounding landscape has particularly flat ground. Existing vegetation within luggas offers some natural screening in certain areas; however, work within the RoW will result in the clearance/removal of this vegetation. Ultimately, this will mean that as taller infrastructure elements are progressively constructed, the extent of the area from which the development will be seen will progressively increase. In addition, these activities would temporarily introduce further large-scale plant and machinery including cranes (required to construct the tallest structures) and drilling rigs at the wellpads (three rigs, one at each wellpad). Therefore, without mitigation in place, PAP within close proximity to the TAN oilfields may be impacted by infrastructure development during construction, in particular works associated with the construction of wellpads (temporary flaring at wellpads and initial well drilling), the CFA (and CPF) and the OHTL. Without mitigation this will cause a medium impact, which translates to a **Moderate** significance.

Appropriate mitigation measures implemented by the EPC contractor will include natural screening where possible as defined in the BMP and if receptors are located adjacent or in close proximity to proposed Project facilities. This will reduce the significance to **Minor**. In addition, a Grievance Mechanism will be implemented to record and follow up any construction-related complaints.

By maximising the retention and preservation of existing vegetation outside the fence-line, visual impacts associated with the clearance/removal of vegetation (screening elements) and soils during construction can be reduced from **Moderate** to **Minor**.

Site activity during construction will also result in the generation of dust plumes, lighting emissions, and material and waste storage/stockpiles, which could present a visual impact. In addition, there will be mobilisation of plant, transportation of construction personnel by vehicles and physical movement of construction workers. However, in addition to incorporated measures of dust suppression techniques to reduce airborne dust (as outlined in theCEMP))), mitigation can be applied to minimise and control lighting (with restricted lighting heights), and vegetating stockpiles of material remaining on site post-construction, residual visual impacts associated with these activities change from a low impact magnitude and a **Minor** significance to **Negligible** significance.

Table 7.6-6: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Landscape						
Nasolot NR (high)	Works associated with the construction of below ground project facilities (make-up water pipeline) and temporary infrastructure (including temporary access roads, camps, laydown areas)	Medium (temporary, short-term)	Moderate (adverse)	No night-time working (dusk until dawn) during construction in areas within 100m of the Nasolot NR or Pellow Community Conservancy unless pre-agreed with TKBV and supervised by the Project BCoW. The EPC contractor will work with TKBV to produce and implement a Communication plan to ensure protected areas administration and users are informed of timings of construction.	Low (temporary, short-term)	Minor (adverse)
Pellow Community Conservancy (medium)		Low (temporary, short-term)	Moderate (adverse)		Low (temporary, short-term)	Minor (adverse)
Visual						
Permanent human receptors (settlements – nomadic view) (high)	Works associated with the construction activities of wellpads (temporary flaring at wellpads and initial well drilling) and associated infrastructure (e.g. access roads) may result in temporary impacts such as plant mobilisation, transport, material stockpiles and lighting emissions.	Medium (temporary, short-term)	Moderate (adverse)	Maintain natural screening where possible as defined in the BMP. EPC contractor will work with TKBV to Implement a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities that could contribute to visual impacts.	Medium (temporary, short-term)	Minor (adverse)
	Works associated with the construction of the CFA (and CPF) and	Medium (temporary, short-term)	Moderate (adverse)		Medium (temporary, short-term)	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	associated infrastructure (e.g. access roads) may result in temporary impacts associated with construction works such as plant mobilisation, transport, material stockpiles and lighting emissions.					
	Works associated with the construction of the OHTL	Medium (temporary, short-term)	Moderate (adverse)		Medium (temporary, short-term)	Minor (adverse)
	Clearance/ removal of vegetation (screening elements) and soils during construction	Medium (temporary, short-term)	Moderate (adverse)	Maximise the retention and preservation of existing vegetation outside the fence-line in the AoI (particularly large trees), acting as natural screening of Project facilities. Measures defined in the BMP.	Low (temporary, short-term)	Minor (adverse)
	Site activity and plant movement during construction (dust plumes, lighting emissions, material and waste storage/ stockpiles)	Low (temporary, short-term)	Minor (adverse)	Vegetating stockpiles (through mixing of chippings and mulch of selected species) of material to remain on site post-construction. Dust suppression techniques to reduce airborne dust as outlined in a CEMP Use of lighting will be minimised and light spill controlled where possible, with restricted lighting heights. Floodlighting will be installed with cowls to minimise light spillage, as outlined in the CEMP.	Low (temporary, short-term)	Negligible

7.6.10.2 Operational Phase

The following bullet provides qualitative evaluation of landscape impacts which are not considered further for impact classification:

- Post-construction the make-up water pipeline will be buried and there will be no aboveground features of significance along its route. In addition, the RoW will be allowed to naturally revegetate except from trees or seeded in sloped areas, and thus the landscape will ultimately be restored to its baseline condition. Therefore, operational impacts along this part of the LVAA, associated with the protected areas (Nasolot NR and Pellow Community Conservancy), LCA 3 (rocky habitat/stunted bushland) and LCA 4 (alluvial woodland (riparian)), are considered of **Negligible** significance.

The following potential sources of impact are the focus of this operations impact classification:

- Visual impacts relating to the siting of above ground wellpads and supporting infrastructure during the operational lifetime of the Project potentially impacting the landscape character and visual elements within the vicinity of the Project facilities.
- Visual impacts relating to the siting of OHTLs (and associated pylons) both near Turkwel and around the TAN oilfields during the operational lifetime of the Project potentially impacting the landscape character and visual elements within the vicinity of the Project facilities.
- Visual impacts relating to the siting of above ground CFA, including elevated structures (ground flare at CPF and flue gas stack at IWMF), and supporting infrastructure during the operational lifetime of the Project potentially impacting the landscape character and visual elements within the vicinity of the Project facilities.
- Visual impacts relating to site activity during operations will generate dust plumes and lighting emissions, potentially impacting visual elements within the vicinity of the Project facilities/activities. This includes impacts from the mobilisation of plant, delivery of materials and supplies, transportation of operations and maintenance personnel by vehicles and physical movement of workers.

The impact assessment is discussed in more detail in the sub-sections below. The operational phase impact assessment with respect to landscape and visual is presented in Table 7.6-8. Any additional mitigation is also presented in that table.

Summary of Impacts on the Landscape

The following impacts require no additional measures beyond those described in Section 7.6.8, with no change in impact significance pre and post mitigation, and are therefore not considered further in Table 7.6-8:

- The introduction and operation of the aboveground Project facilities would be highly contrasting with the existing rural, pastoral landscape character. Currently, there is limited industrial development within the LVAA, with the exception of EOPS infrastructure. The scale of the proposed industrial development would result in a relatively comprehensive change within a limited geographical area of the wider LCA 1 (semi-desert) and LCA 2 (dense bushland) over a long-term period. However, as the two LCA's comprise landscapes with a low or medium quality and rarity, local scale and limited potential for substitution/replacement, **Minor** residual impacts are anticipated.

Summary of Significant Visual Impacts

The following impacts require no additional measures beyond those described in Section 7.6.8 and are therefore not considered further in Table 7.6-8:

- Altered views as a result of Project facilities and operations will also be experienced by a large number of pastoralists/herders roaming the surrounding land for grazing and migration. Based on the same mitigations presented above for reducing operational related impacts on permanent receptors, residual impacts on transient users will be **Minor** for all sources.

Post-construction, visual impacts from the wellpads will be limited, with no operational infrastructure or machinery of significant height which extends above the existing tree canopy (see Table 7.6-7).

Table 7.6-7: Height of Structures Associated with Project Facilities

Facility	Structure	Height (m)[(a)]
Wellpad	Diesel and demulsifier shelters	4.5
CFA	Flue gas stack (IWMF)	15
CPF	Flare	30
OHTL	Pylons	21

(a) Fundamental height parameters for Project facilities, based on the maximum height of structures within the facility

The magnitude of impact is classified as medium, with a **Moderate** significance. Landscaping, including earth bunds will also be promoted around wellpads and, where appropriate, the planting of endemic natural vegetation will be provided to act as screening of operational facilities at the wellpad. TKBV will maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities. Where impacts on receptor are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under the LRP. With the implementation of these additional mitigation measures, residual impacts can be reduced to from moderate to **Minor**.

In contrast, the CFA (particularly the CPF) and the OHTL will present more significant visual impacts during the operational lifetime of the Project, as illustrated by Figure 7.6-3 and Figure 7.6-4[11]. The OHTL pylons will reach heights of up to 21 m, which is significantly greater than the canopy level of the existing lugga vegetation. A number of permanent settlements located within the AoI therefore have the potential to be visually impacted by the OHTL infrastructure, with temporary (for the Project lifetime) and medium-term changes to local views. No additional mitigation is proposed resulting in a medium magnitude and **Moderate** significance.

The CFA will contain the most elevated and extensive Project facilities during operation. Within the CFA, the IWMF will contain the 15 m flue gas stack. In addition, the flare at the CPF will be 30 m in height and 10 m in diameter and will present a significant visual feature to surrounding PAP. Additional mitigation around the CFA, similar to that found at the TAN wellpads, will be achieved via landscaping (earth bunds), planting of endemic, natural vegetation to act as screening and soften the visual impact of Project infrastructure. No additional mitigation is proposed resulting in a medium magnitude and **Moderate** significance.

As detailed above, TKBV will maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities and ensure landscaping (earth bunds), planting of vegetation, material selection where possible. In addition, if receptors are located adjacent or in close proximity to proposed Project facilities, then where appropriate, the receptor may be considered under a LRP. This will reduce the significance to **Minor**.

Site activity during operation, including operations, maintenance and vehicle movement, will result in the generation of dust plumes and lighting emissions (limited existing artificial lighting within the LVAA), which could present a visual impact. However, this will be considerably less than during the construction phase. By implementing dust suppression techniques to reduce airborne dust, minimising and controlling lighting (with restricted lighting heights), will reduce a low impact with **Minor** significance to a **Negligible** residual significance.

[11] It should be noted that these outputs are based solely on the existing terrain models, and do not take into account natural vegetative screening, which is present within the TAN areas.

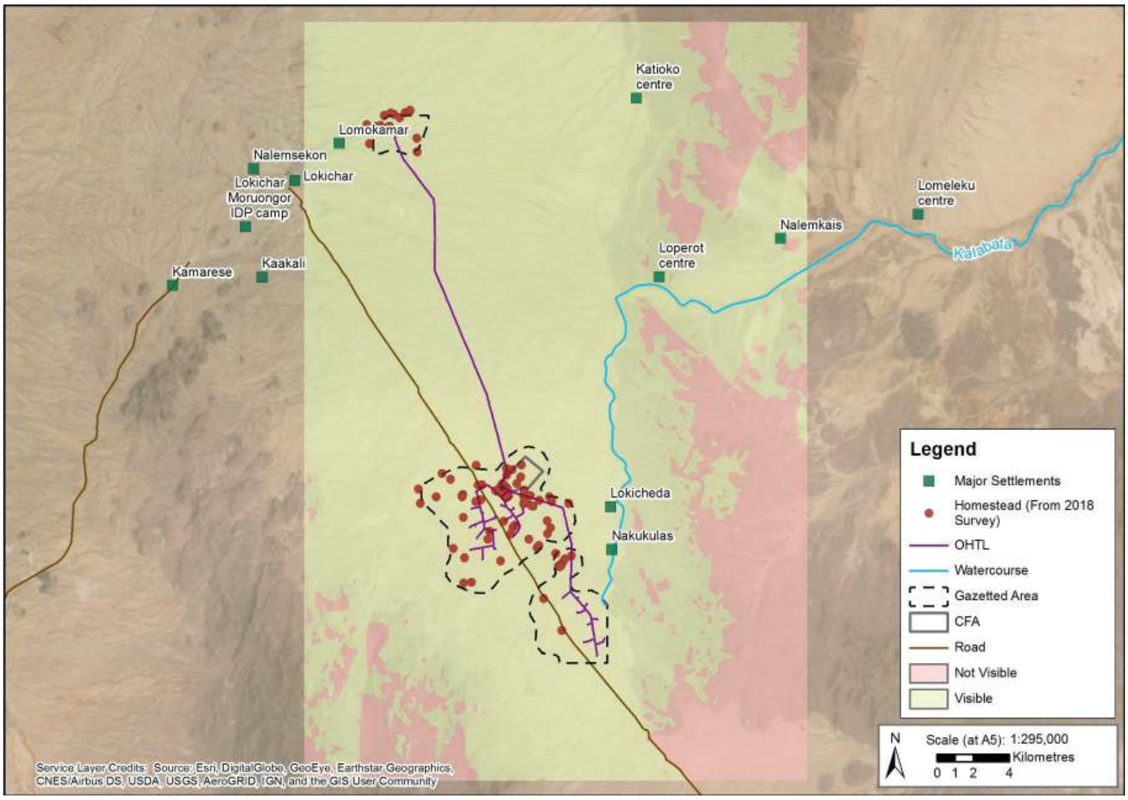

Figure 7.6-3: OHTL Zone of Theoretical Visibility

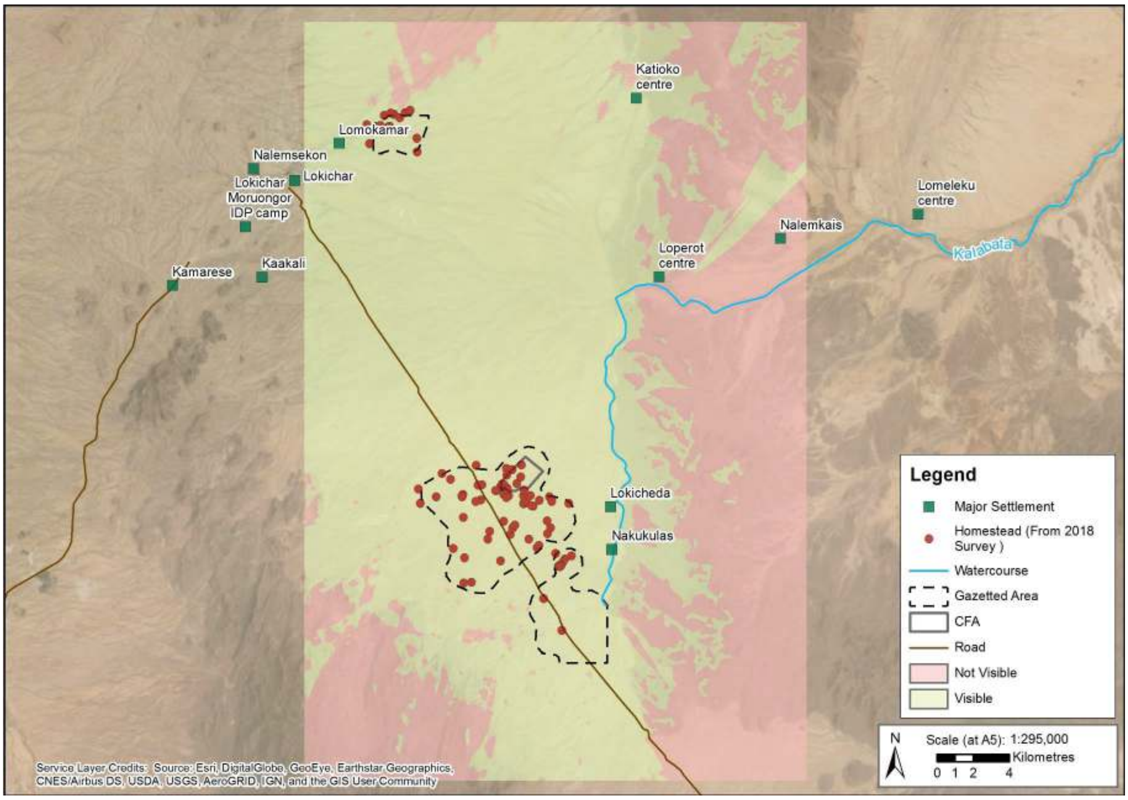

Figure 7.6-4: CFA Zone of Theoretical Visibility

Table 7.6-8: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Visual						
Permanent human receptors (settlements – nomadic view) (high)	Location of above ground wellpads and supporting infrastructure	Medium (temporary, medium-term)	Moderate (adverse)	Where practical, landscaping, including earth bunds around wellpads, will be established. Subject to site specific conditions, including vegetation type and density and where appropriate, planting of endemic, natural vegetation shall be provided to act as screening and soften visual impact of Project infrastructure. TKBV will maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities. Where impacts on receptors are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under an LRP.	Low (temporary, medium-term)	Minor (adverse)
	Location of above ground OHTL	Medium (temporary, long-term)	Moderate (adverse)	TKBV will maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities., plus ensure landscaping (earth bunds), planting of vegetation, material selection where possible (as above). Where impacts on receptors are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under an LRP.	Medium (temporary, long-term)	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Location of above ground CFA (CPF) and supporting infrastructure (flaring at CPF and flue gas stack at IWMF)	Medium (temporary, medium-term)	Moderate (adverse)	TKBV will maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities, plus ensure landscaping (earth bunds), planting of vegetation, material selection where possible (as above). Where impacts on receptors are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under an LRP.	Medium (temporary, medium-term)	Minor (adverse)
	Site activity and plant movement during operations (dust plumes, lighting emissions)	Low (temporary, medium-term)	Minor (adverse)	TKBV will maintain a Grievance Management Procedure, dust suppression and light spill control (as above).	Low (temporary, medium-term)	Negligible

7.6.10.3 Decommissioning

Decommissioning refers to the dismantling, decontamination and removal of process equipment and facility structures and any appropriate remediation.

Five years prior to the planned 'End of Project', a Decommissioning Plan will be developed for agreement with the appropriate authorities.

The likely decommissioning activities would be focused on:

- Production and injection wells with corresponding wellpads;
- The interconnecting network;
- Surface facilities in the CFA; and
- Other outfield infrastructure.

Assuming there is no other use for infield and outfield facilities, all structures including production, processing, treatment, storage, pumping, power, and related infrastructure facilities will be dismantled for recycling, sold for scrap, or disposed of properly. The areas impacted by Project facilities will be returned to their original (baseline) condition on decommissioning.

It is assumed that the OHTL will not be decommissioned post-operation and will be transferred to an alternative operator, and as such, will be the only potential permanent and long-term impact associated with the Project on the identified receptors.

7.6.11 Summary of Mitigation

As identified in Table 7.6-6 and Table 7.6-8, additional mitigations are required to mitigate landscape and visual impacts from the Project, on top of the incorporated measures identified in Section 7.6.8.

Additional measures during construction will include:

- Vegetating stockpiles (through mixing of chippings and mulch of selected species) of material remaining on site for a significant amount of time to merge with the surroundings as much as practicable;
- Maximise the retention and preservation of existing vegetation outside the fence-line in the AoI (particularly large trees), acting as natural screening of Project facilities; and
- No night-time working, in areas within 100 m of National Reserves or Community Conservancies unless agreed and supervised by the Project BCoW.

Additional measures during operations will include:

- Where practical, landscaping, including earth bunds around wellpads will be established around wellpads will be established. Maximise the retention and preservation of existing vegetation in the AoI (particularly large trees), acting as natural screening of Project facilities;
- Subject to site specific conditions, including vegetation type and density and where appropriate, planting of endemic naturalistic vegetation shall be provided to act as screening and soften visual impact of Project infrastructure;

- Where possible and subject to specific conditions, material selection will be designed to blend in with the existing landscape. -
- Use of lighting will be minimised and light spill controlled where possible, with restrict lighting heights. Floodlighting will be installed with cowls to minimise light spillage.

Additional measures during all phases will include:

- TKBV will develop and implement a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities; and
- Where appropriate, the receptor may be considered under a LRP.

7.6.12 Summary of Residual Impacts

The Project has the potential to impact landscape and visual receptors during both the construction of Project facilities and the operations of above ground features. Overall, with incorporated environmental measures in the design and the additional mitigation presented above, residual impacts to identified landscape and visual receptors will be **Minor** or **Negligible**.

7.7 Biodiversity, Ecology and Protected Areas

7.7.1 Introduction

The Project aims to ensure that biodiversity and ecosystem functions are not degraded or significantly impacted as a result of the Project's development, operation and decommissioning. Key to this commitment is securing the long-term survival of species and habitats that occur in the Project's AoI.

7.7.2 Area of Influence

The biodiversity assessment uses the biophysical AoI presented in Section 3.0, which comprises the areas of potential direct and indirect effects during operations and construction of the Project, based on analysis completed in the ESIA.

Primary data sources used to support this assessment included land cover mapping and classification for the AoI and a seasonal field sampling programme. The field sampling programme includes vegetation and flora, invertebrates, herpetofauna, birds, mammals and fish in representative locations. The baseline is presented in Section 6.0 of this ESIA.

7.7.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.7-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.7-1: Criteria for Determining Importance of Biodiversity Receptors

Receptor Importance	Criteria for Receptor Importance
Very high	■ International importance; ■ Receptor with a high quality and rarity, regional or national scale and limited potential for substitution/replacement. ■ Critical habitat triggers: ▪ Criterion 1: CR and/or EN species; ▪ Criterion 2: Endemic or restricted-range species; ▪ Criterion 3: Migratory or congregatory species; ▪ Criterion 4: Highly threatened and/or unique ecosystems; and ▪ Criterion 5: Key evolutionary processes. ■ Natural habitats as defined by IFC PS6: areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition (IFC, 2012).
High	■ National importance; ■ Receptor with a high level of biotic integrity, uniqueness or restricted range; and/or ■ Receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement.
Medium	■ Regional importance; ■ Receptor with a medium quality and rarity, local scale and limited potential for substitution/replacement; and/or ■ Receptor with a low quality and rarity, regional or national scale and limited potential for substitution/replacement.

Receptor Importance	Criteria for Receptor Importance
Low	■ Local, limited or no known importance; ■ Receptor with a low quality and rarity, local scale; and/or ■ Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character.

7.7.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.7-2.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period). The CFA/CPF will be constructed within the first 36 months;
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project.

Table 7.7-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Loss of resource/receptor, loss of quality and integrity of the resource/receptor, severe damage to key characteristics, features or elements (e.g. loss of natural or critical habitat).	Large scale or major improvement to resource/receptor quality, extensive restoration or enhancement.
Medium	Partial loss of resource/receptor, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements.	Some benefit to key characteristics, features or parameters describing resource/receptor quality.

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
Low	Some measurable change in/damage to attributes, quality or vulnerability.	Minor benefit to, or addition of, one or more key characteristics, features or parameters describing resource/ receptor quality.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing resource/receptor quality.	

7.7.5 Key Guidance and Standards

The biodiversity impact assessment has been completed in accordance with Kenyan legislation and to comply with international guidance and best practice, the IFC PSs and obligations from international conventions to which Kenya is a signatory.

7.7.6 Receptors of Interest and Importance

This assessment divides receptors into the following categories:

- Habitat receptors; and
- Species receptors.

Table 7.7-3 presents the assigned importance for these receptors following the criteria presented in Section 7.7.3.

7.7.6.1 Habitat Receptors

Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment (IFC GN6, 2019).

For the purposes of this assessment, habitat receptors, or ecosystems of concern, were identified according to the following attributes:

- Critical habitats as per the IFC PS6 (2012a[12]) criteria including:
  - Areas that meet the criteria of the IUCN's Protected Area Categories Ia, Ib and II;
  - KBAs which encompass IBAs, RAMSAR sites and WWF Ecoregions; and
  - Natural or modified habitats as defined by IFC PS6 (IFC GN6, 2012).

7.7.6.2 Species Receptors

Species receptors were divided into the following categories:

- Critical habitat trigger species – species that qualify for critical habitat status based on the criteria and thresholds identified in IFC PS6 (WBG, 2012a) or species that were deemed to qualify for critical habitat status based upon consultation with relevant specialists; and
- SoCC - this includes species that are listed either nationally or internationally as being of conservation concern that do not meet the IFC PS6 criteria for critical habitat status.

[12] The impact assessment scope and methodology were established prior to the 2019 revision to IFC GN6. The assessment was therefore conducted in accordance with the 2012 guidance.

The assessment of whether individual species qualify for critical habitat status was assessed in consultation with external experts and the process is described in more detail in Annex I.

Table 7.7-3: Receptors and Importance

Receptor	Importance	Comment
Habitat Receptors		
Nasolot and South Turkana (NRs)	Very high	Nationally designated protected areas, IUCN protected area category II[13].
Pellow Community Conservancy	Very high	Adjoining Nasolot NR and provides habitat for several critical habitat trigger species.
Faidherbia - Celtis riparian forest community along the Malmalte and Turkwel Rivers	High	Identified as natural habitat based on IFC PS6 criteria and critical habitat for several species.
Turkwel and Malmalte Rivers	Very high	Critical habitat for range restricted fish species.
Rocky ridges separating core Project area (Ngamia & Amosing) from Turkwel & Malmalte Rivers as well as rocky ridges to the east and south-east of Ngamia and Amosing	Very high	Critical habitat for several critical habitat trigger species.
Northern Acacia-Commiphora bushlands and thickets associated with the WWF Ecoregion	Moderate	Extensively degraded throughout the AoI due primarily to extensive overgrazing. Identified as modified habitat in terms of IFC PS6 criteria.
Species Receptors		
Euphorbia turkanensis	Very high	Range restricted plant species only known from the AoI, triggers critical habitat in terms of IFC PS6 Criterion 2 (IFC GN6, 2012)
Elephants	Very high	Listed as EN in the KWCMA (2013) – critical habitat trigger species based on IFC PS6 Criterion 1 and Criterion 3 (IFC GN6, 2012).
Leopard and striped hyaena	Very high	Both species are listed as EN in the KWCMA (2013) – critical habitat triggers based on IFC PS6 Criterion 1 (IFC GN6, 2012).
Vultures[14] (3 species have been confirmed as present in the AoI namely Lappet-faced, Rüppell's and African White-backed)	Very high	■ African White-backed Vulture is listed as CR by the IUCN (2019). Qualifies for critical habitat status based on IFC PS6 Criterion 1; ■ Rüppell's Vulture is listed as CR by the IUCN (2019). Qualifies for critical habitat status based on IFC PS6 Criterion 1; and

[13] Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities (Dudley, 2008).

[14] In addition to the 3 vulture species confirmed as present in the AoI, records of other species and the continued presence of wild ungulates in places such as the Nasolot NR and South Turkana NR suggests a high likelihood of occurrence of other species e.g. the White- headed vulture (listed as VU in Kenya and CR by the IUCN).

Receptor	Importance	Comment
		■ Lappet-faced Vulture is listed as EN by the IUCN (2019) and qualifies as a critical habitat trigger based on IFC PS6 Criterion 1.
Turkana toad	Very high	Range-restricted amphibian species that triggers critical habitat in terms of IFC PS6 Criterion 2.
Ground beetle (*Omophron* sp)	Very high	Previously undescribed beetle species only known from the AoI. Qualifies as critical habitat trigger in terms of IFC PS6 Criterion 2.
Fish	Very high	Two range-restricted fish species that qualify as critical habitat triggers in terms of IFC PS6 Criterion 2 were recorded in the Turkwel River namely: ■ *Haplochromis turkanae; and* ■ *Haplochromis macconneli.*
Plant SoCC (non-critical habitat trigger species)	High	Three range restricted plant species recorded during the baseline surveys namely: ■ *Blepharis turkanae* – range restricted plant species only known from Turkana County, recorded east of Project area, not recorded within the AoI therefore no critical habitat could be designated within AoI; ■ *Neuracanthus kenyensis* – range restricted to northern Kenya but does not reach threshold for critical habitat in terms of IFC PS6 Criteria 2; and ■ *Xerophyta schnizleinia* – range restricted plant species known to occur in northern Kenya but does not reach threshold for critical habitat in terms of IFC PS6 Criteria 2.
Bird SoCC (non-critical habitat trigger species[15])	High	■ Steppe Eagle – listed as EN by IUCN (2019) but population does not meet threshold for critical habitat based on IFC PS6 Criteria 1; ■ Lesser Kestrel – listed as VU by KWCMA (2013); and ■ Tawny Eagle – listed as VU by IUCN (2019).
Mammal SoCC (non-critical habitat trigger species)	Moderate	■ Lesser Kudu – listed as VU by KWCMA (2013) and NT by IUCN (2019). Confirmed as present along the Malmalte River, also known to occur in Nasolot NR and South Turkana NR; and ■ Cape Buffalo – listed as NT by the IUCN (2019) and known to occur in Nasolot NR, South Turkana NR and along the Malmalte River.
Herpetofauna SoCC (non-critical habitat trigger species)	Moderate	Three nationally protected (KWCMA, 2013) reptile species are known to occur in the AoI namely: ■ Kenyan sand boa; ■ Puff Adder; and ■ Rock Monitor.

[15] Species are listed either nationally or internationally as being of conservation concern but that do not meet the IFC PS6 Critical Habitat thresholds.

7.7.7 Sources of Impacts

Potential sources of impact of a range of magnitudes will occur throughout the life of the Project and are set out below by Project phase.

7.7.7.1 Construction Phase

Direct impacts on habitat and species receptors:

- The temporary and/or permanent land take required to accommodate and construct Project facilities;
- Temporary or permanent loss of habitat for critical habitat trigger species associated with Project facilities;
- Construction camp land take and disturbance;
- Temporary habitat severance during construction of linear infrastructure components;
- Temporary drawdown of groundwater in the Kalabata River whilst construction of make-up water pipeline is underway (duration of abstraction expected to last from 18 months);
- Clearing of vegetation prior to construction;
- Temporary changes to surface water regimes;
- Waste generated from the Project activities, including solids and liquids e.g. hydro-test water; and
- The introduction and spread of invasive plants, pests and diseases.

Indirect construction impacts resulting from the Project including:

- Light pollution attracting insects out of surrounding areas and contributing to shifts in predator – prey dynamics;
- Increases in air emissions and dust deposition during construction;
- Sensory disturbance (light and noise);
- Population influx to nearby settlements during construction, and subsequent increases to natural resource harvest, charcoal production, further escalation of human-elephant conflict, ivory poaching, bushmeat hunting, fishing and grazing/browsing pressure on vegetation communities and habitats; and
- Increased access for people and vehicles along permanent service tracks, RoW and roads.

7.7.7.2 Operational Phase

- Deposition of dust on vegetation from increased traffic and Project activities;
- Sensory disturbance (light and noise) from operational activities;
- Light pollution attracting insects out of surrounding areas and contributing to shifts in predator – prey dynamics;
- Injury/mortality of individuals and/or local populations of birds, volant mammals and invertebrates due to the presence of flares;
- Impacts on birds associated with infield OHTL (electrocution or direct impacts with lines);
- Impacts on birds associated with none- infield OHTLs (electrocution or direct impacts with lines) developed outside of the infield areas and along the water pipeline route by the relevant Kenyan electricity company, which are an associated development;

- Increased access for people and vehicles along permanent service tracks and roads; and
- Access to permanent water sources. Water storage areas on the well-pads could attract fauna, both in a beneficial sense, and detrimentally (if they drown, or are poisoned).

7.7.7.3 Climate Change

Climate change predictions with respect to meteorological data can be highly variable. The uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Niño events. Most climate predictions suggest there will be an increase in temperature and rainfall, and of extreme weather events (i.e. rainfall intensity and droughts).

Due to this uncertainty, impacts directly attributed to climate change are not assessed in this chapter, but the climate change management plan will look into linkages between impacts of climate change on physical sciences and biodiversity receptors.

7.7.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.7.8.1 Design Measures

The following design measures will provide inherent mitigation to selected impacts:

- Abstraction of make-up water from Turkwel Dam headrace instead of the Turkwel River mitigates the impact of reduced instream flow within the river;
- Burying of make-up water pipeline to mitigate habitat fragmentation;
- Burying of infield flowline network mitigates impact of habitat fragmentation;
- The use of an enclosed ground flare will mitigate noise and light impacts as well as threats to birds associated with flaring;
- The use of HDD for the make-up water pipeline crossing of the Malmalte River will mitigate the impact of clearing large tracts of riparian vegetation and will also mitigate potential impacts associated with the trenching of the pipeline through the Malmalte River;
- Well-pads are designed so that all clean rainwater runs to an external ditch that runs around the perimeter. Sumps are provided for collection of contaminated water;
- The three-casing policy for wells reduces the potential risks associated with uncontrolled hydrocarbon release;
- An artificial geosynthetic clay layer will be installed at the landfill site in order to mitigate the risk of groundwater contamination;
- Roads will be designed to manage runoff and discharge it at equivalent rates to pre-construction, while maintaining quality in line with Kenyan water standards;
- Routing of make-up water pipeline to avoid sensitive rocky ridge habitats;

- Existing roads will be used where possible – avoiding the construction of new roads where existing ones can be used (with or without upgrade) reduces the requirement for unnecessary earth movement and land take;
- The use of HDPE liners for storage of waste on well-pads mitigates the risk of groundwater and soil contamination; and
- The chemical storage and pigging areas are provided with a kerbed concrete area to contain any spillages.

7.7.8.2 Good International Industry Practice

The following measures included in the Project design are considered to be GIIP and will mitigate selected potential impacts:

- Education of staff about company environmental policies and procedures including ongoing training and auditing of effectiveness; and
- During construction, well-pads will have a bunded diesel storage area. The bunds will be lined to prevent soil contamination and will be designed to retain the larger of 110% of the volume or 25% of the combined tank volume of the diesel stored.

7.7.8.3 Considerations from Stakeholder Engagement (TBC)

The following list of issues were captured during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations:

- Concern on use of (invasive) species to reforest the environment;
- Concerns about savannah grasslands and the need to protect these areas to avoid people moving to other territories that might lead to conflict;
- Question on restoration of trees in Lokichar-Amosing Road;
- Request for information on natural reforestation given that area is semi-arid. Multiple requests for information on how the Project will restore disturbed areas (clearing of bushes and shrubs);
- Concerns that Project construction activities might introduce invasive species;
- Question on mitigation measures to protect wildlife from accidents during Project construction; and
- Concerns on migratory routes/wildlife corridors and critical habitats.

7.7.9 Impact Classification

Taking into account the biodiversity baseline conditions (Section 6.0), the relevant incorporated environmental measures (Section 7.7.8), and the potential sources of impact (Section 7.7.8) determined from the Project description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section. A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.7.4. Direct (within, and immediately adjacent to the Project footprint) and other non-footprint direct impacts (for example, sensory disturbance and edge impacts) were superimposed on the habitat mapping in GIS to evaluate the magnitude and extent of impacts on habitats.

Indicators used to assess impacts to habitat receptors were changes in:

- Extent;
- Condition;
- Regional representativeness; and
- Landscape connectivity.

Loss of habitat due to direct disturbance associated with the Project was quantified by overlaying the current, baseline extent of the habitat with the Project footprint. Additional, indirect impacts to habitat receptors were estimated by applying the results of other technical discipline impact analysis to indicate possible changes in habitat quantity and/or quality caused by non-footprint direct impacts, fragmentation, sensory disturbance (light and noise), and air emissions and dust. The majority of these impacts are wholly temporal in nature. The transient nature of these impacts reduces the magnitude to receptors.

Indicators used to assess impacts to species receptors were:

- No loss of habitat for critical habitat species;
- No mortality of individuals; survival and the subsequent ability to reproduce;
- Maintenance of species' functional habitat connectivity;
- Vegetation restoration and establishment efficacy post construction; monitoring to review the timely restoration of floral species composition and the potential introduction of invasive species; and
- Measurable changes in habitat quality and quantity from baseline.

The analysis focuses on assessing potential Project impacts relative to baseline conditions.

Potential changes in survival and reproduction were assessed qualitatively by considering potential disturbances (that is, severance, (temporary and permanent) traffic, light and noise). These disturbances were considered with relation to known or inferred impacts to the survival and reproduction of species for which data on these types of impacts are available as presented in published literature and in consultation with experts. Changes in habitat connectivity were assessed by identifying potential barriers, including sensory barriers, to movement and species mobility.

Habitat loss was quantified by overlaying known species distribution data with the proposed Project footprint. At the species level, the concept of a self-sustaining[16] population was used as a benchmark when describing the magnitude of an impact.

7.7.9.1 Construction Phase

During the construction phase the EPC contractor shall appoint a BCoW to ensure compliance with relevant mitigation measures. The BCoW will be responsible for implementation of biodiversity-related management controls and to have "*stop work*" authority if any unexpected very high or high-value receptors are encountered so that the appropriate management procedures can be implemented or if appropriate mitigation is not being implemented for expected receptors.

The construction phase impact assessment, with respect to biodiversity, is presented in Table 7.7-4.

[16] A self-sustaining population is one that will be maintained into the future with a low risk of extirpation (local extinction). Long-term population persistence is the outcome of maintaining viable populations and maintaining or achieving self-sustaining populations is frequently applied as a conservation target by conservation biologists and resource managers (Fahrig 2001; Nicholson *et al*. 2006; Ruggiero *et al*. 1994; With and Crist 1995). Self-sustaining populations are not populations at the brink of extirpation; they are healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Fahrig 2001).

7.7.9.1.1 Habitat Receptors

Protected Areas and Community Conservancies

Protected areas that are classified as IUCN Protected Area Categories Ia, Ib and II qualify as critical habitat in terms of IFC PS6 (IFC GN6, 2012). Two IUCN Protected Area Category II reserves are situated within the Project AoI, namely Nasolot NR and South Turkana NR (Figure 7.7-1). Pellow Community Conservancy adjoins Nasolot NR and provides habitat for some of the same critical habitat trigger species and together with Masol Community Conservancy provides connectivity between Nasolot NR and South Turkana NR (Figure 7.7-2). The Masol Community Conservancy was not included in the scope of this assessment as it falls outside of the Project AoI, however as mentioned above it does form part of the larger biodiversity landscape.

Of these reserves and conservancies, only approximately 4.8 km of the Nasolot NR will be physically crossed by the Project RoW. South Turkana and Pellow will not be impinged upon by the Project RoW, but may be subject to indirect impacts, such as sensory disturbance of fauna due to light and noise. As these reserves and the community conservancy provide habitat for several critical habitat trigger species, including elephants, leopards, striped hyaena as well as other SoCC, they are all assigned a very high importance.

Potential impacts on Nasolot NR include the temporary land take required to accommodate construction of the water pipeline and its associated infrastructure (e.g. cable-crane system), and the establishment of a permanent RoW for the pipeline. The significance of potential impacts on the Nasolot NR was rated as **Moderate** prior to mitigation given that the footprint of the proposed pipeline RoW already supports infrastructure associated with the Turkwel Dam hydroelectric scheme and that the area is extensively degraded and developed from the construction and operation of that scheme (Figure 7.7-1).

Implementation of the mitigation shall include:

- Development and implementation of a BMP. The BMP will set out all the mitigations and management controls defined in the ESIA in a clear, implementable and auditable manner. With regards to developments in protected areas the BMP should include;
  - Development and implementation of a vegetation rehabilitation plan for the construction RoW; and
  - Development and implementation of an Invasive Species Management Plan (ISMP).
  - Production of a Management Plan for Nasolot NR.
- Demarcation of the following reserve boundaries on construction plans (and for Nasolot NR, also on the ground):
  - Nasolot NR;
  - South Turkana NR; and
  - Pellow Community Conservancy.
- During environmental inductions EPC staff should be educated on procedures and policies associated with environmentally significant areas;
- The Project footprint within the reserve should be minimised and areas beyond the footprint should be identified as *No-Go* areas;
- The pipeline construction camp should not be developed within the protected areas or community conservancy; and

- Development and implementation of Wildlife Rescue Procedures for animals trapped within open trench e.g. the use of crawl boards and daily inspections of the trench prior to works commencing.

Successful implementation of this mitigation will reduce the significance of the impact to **Minor** (Table 7.7-4)

The potential significance of impacts on South Turkana NR and Pellow Community Conservancy were rated as **Moderate** prior to mitigation (Table 7.7-4). This was attributed to the indirect and temporary nature of the impacts. Post mitigation, the significance of potential impacts was reduced to **Minor** (Table 7.7-4).

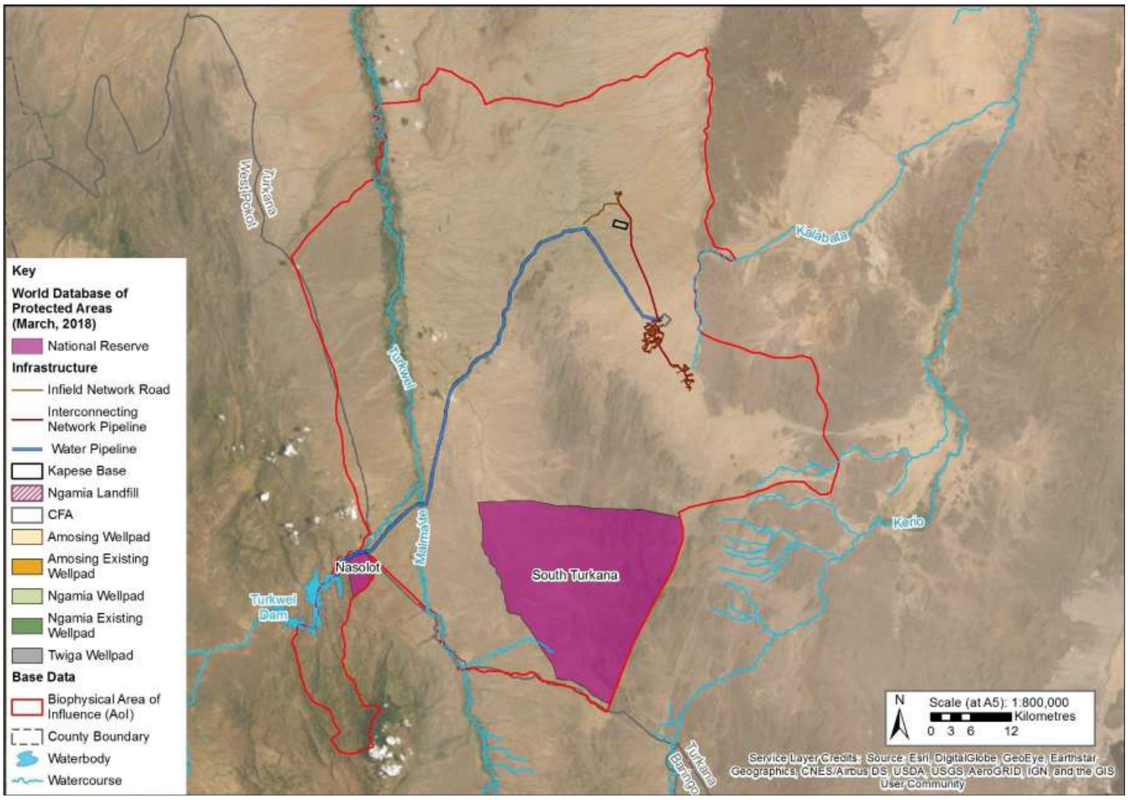

Figure 7.7-1: National Reserves Classified as IUCN Protected Area Categories Ia, Ib or II Located Within the Project AoI

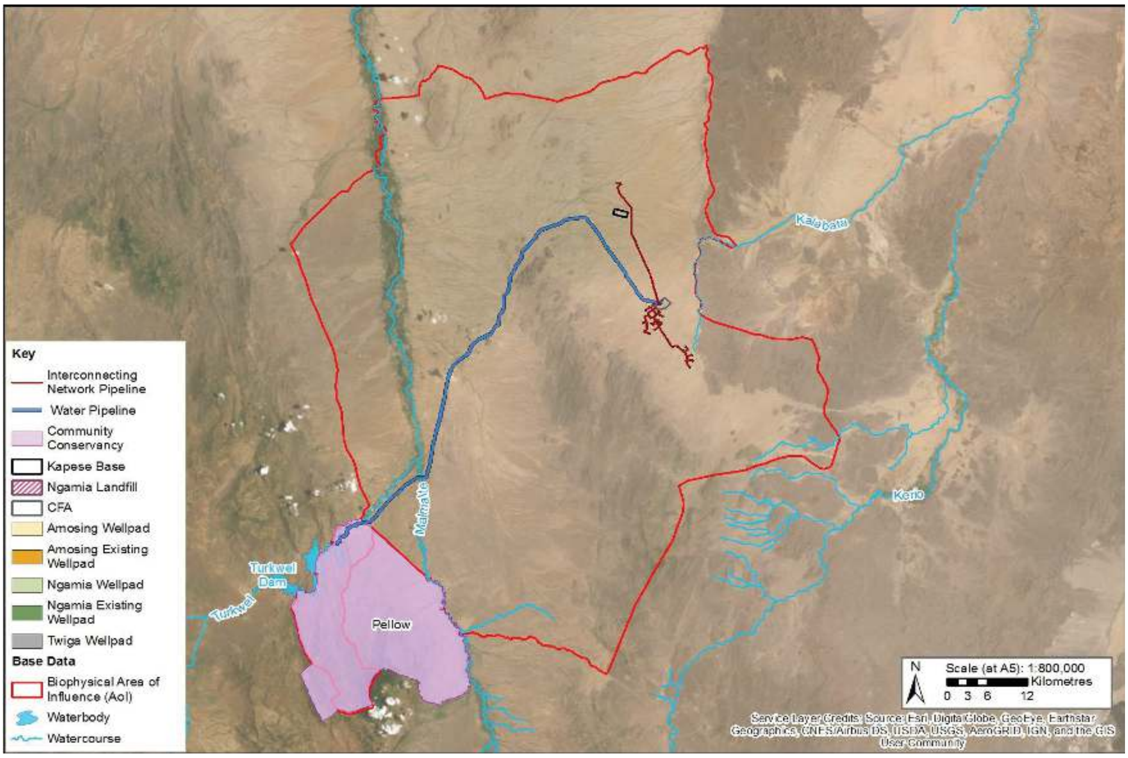

Figure 7.7-2: Location of the Pellow Community Conservancy Within the Project AoI

Natural Versus Modified Habitats

The IFC describe natural habitats as areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition (IFC GN6, 2012). In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity, where feasible (IFC GN6, 2012). The IFC stipulates that the determination of natural habitat will be made using credible scientific analysis of best available information (IFC GN6, 2012). The methodology used in provided in Annex I.

With a single exception, vegetation communities throughout the Project footprint are classified as modified (Figure 7.7-3). The only exception is the Faidherbia - Celtis riparian forest community along the Malmalte River, which was identified as natural habitat. The Project incorporated environmental measures include the use of 1.2 km of HDD under the Malmalte River and thus direct impacts on the Faidherbia - Celtis riparian forest community immediately adjacent to the river will be avoided. However, some impacts remain including the clearing of natural vegetation to the west of the river, increased degradation of the area to the west of the Malmalte River due to the provision of improved access routes to the area, sensory disturbance of fauna during construction, and the potential introduction of alien invasive plant species.

Implementation of the mitigation should include:

- Development and implementation of a Rehabilitation Plan and ISMP for the RoW;
- Development and implementation of a BMP;
- Demarcation of riparian vegetation communities as environmentally significant areas on construction plans and on the ground;
- EPC staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas;
- EPC engagement with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in environmentally significant areas which will require demarcation as *No-Go* areas.
- Development and implementation of Influx Management Plan to include particular actions around access to Malmalte;
- Development and implementation of wildlife rescue procedures for animals trapped within open trenches e.g. the use of crawl boards; daily inspections prior to works commencing; and
- Inclusion of 100 m setback distances beyond the riparian vegetation boundary for the drill rig and pipe stringing.

The significance of these impacts on the Faidherbia - Celtis riparian forest community was rated as **Moderate** pre-mitigation (Table 7.7-4). Implementation of the mitigation measures reduce the significance of the impact to **Minor** (Table 7.7-4).

Rocky Ridges

The rocky ridge habitats that separate the core Project area (Ngamia and Amosing) from the Turkwel and Malmalte Rivers, and the rocky habitats to the east and south-east of Ngamia and Amosing, were identified as critical habitat for several species (leopard, striped hyaena, lappet, white-backed and Rüppell's vultures). These areas were therefore assigned a very high importance (Table 7.7-3). During the Project design phase, it was decided to route the water pipeline to avoid direct impacts on these habitats. These habitats are mostly situated beyond the direct Project footprint and are, therefore, only subject to indirect impacts, including the potential for sensory disturbance of fauna due to lights and noise (Table 7.7-4).

Mitigation measures must include:

- Education of staff during environmental inductions on company policies and procedures associated with environmentally significant areas; and
- Environmentally significant areas will be identified as *No-Go* areas for EPC staff.

The significance of this impact, pre-mitigation, was rated as **Moderate** due to the indirect nature and short duration of the impact and decreased to **Minor** after mitigation (Table 7.7-4).

Northern Acacia-Commiphora Bushland and Thicket

The Project AoI lies largely within the Northern Acacia-Commiphora bushlands and thicket ecoregion. This ecoregion occurs mostly in Kenya and is threatened by increasing human density contributing to unsustainable water usage, frequent burning, and overgrazing by livestock (WWF, 2019). Much of the habitat within the Project footprint, representative of this ecoregion, is degraded due to overgrazing and erosion, and is also under competitive pressure from non-native and invasive species. Therefore, it was assigned a moderate importance (Table 7.7-3). Potential impacts on this ecoregion within the AoI include temporary and permanent land take required to accommodate and construct Project facilities. The significance of this impact was rated as **Moderate** prior to implementation of mitigation (Table 7.7-4).

Mitigation measures shall include:

- Land take to be limited to direct Project footprint and areas beyond the Project footprint to be identified as *No-Go* areas for EPC staff;
- Development and implementation of an ISMP; and
- Inclusion of a Rehabilitation Plan for the Northern Acacia-Commiphora bushland and thicket ecoregion within the Project BMP.

Implementation of mitigation measures reduced the significance of this impact to **Minor** (Table 7.7-4).

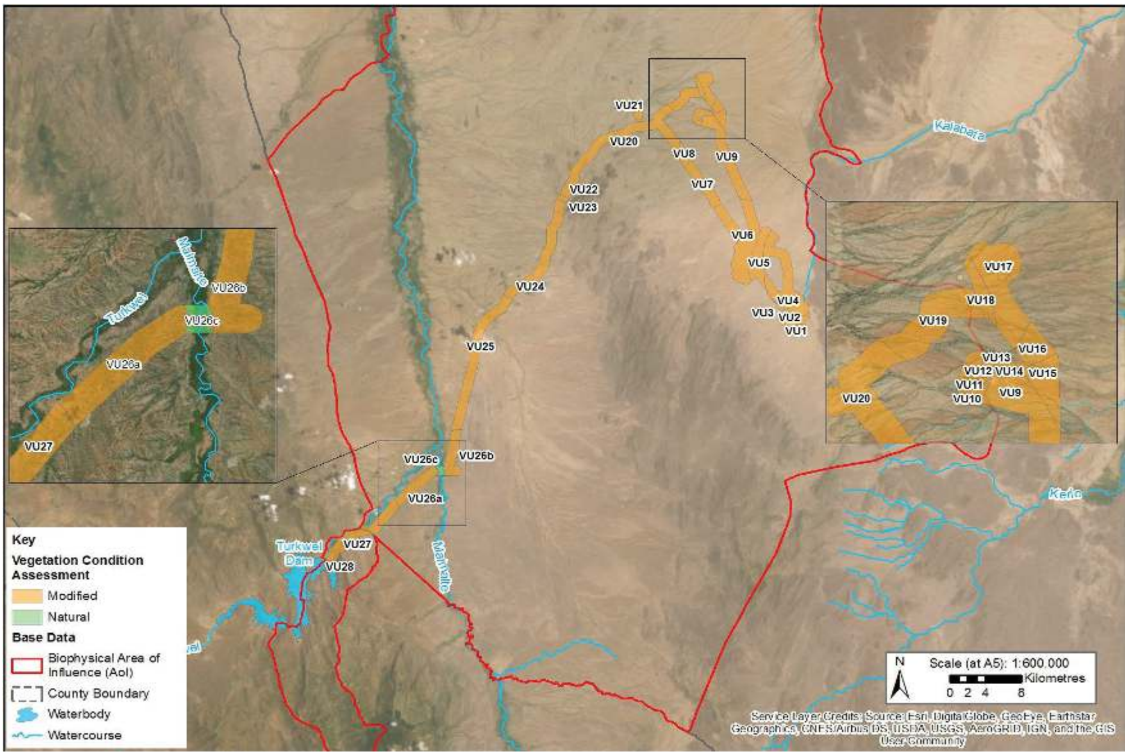

Figure 7.7-3: Vegetation Condition Assessment Conducted for the Project Footprint Showing areas of Natural and Modified Habitat

7.7.9.1.2 Species Receptors

The assessment of species receptors was divided into two categories, namely:

- Critical habitat trigger species – species that meet the numeric thresholds for critical habitat, based on the first four critical habitat criteria (i.e., CR/EN species; endemic/restricted-range species; migratory/ congregatory species; and
- SoCC - this includes species that are listed either nationally or internationally as being of conservation concern, but do not meet the IFC PS6 criteria for critical habitat status.

Euphorbia turkanensis

Euphorbia turkanensis is a range-restricted plant species that is only known from the AoI and triggers critical habitat status in terms of IFC PS6 Criterion 2 (IFC GN6, 2012). During the baseline assessment, *E. turkanensis* colonies were recorded at various locations, and in various land-use types, along the make-up water pipeline RoW. Based on this, a critical habitat map for *E. turkanensis* was compiled (Figure 7.7-4). The critical habitat for this species includes the portion of the water pipeline from south of Lokichar to the Malmalte River (Figure 7.7-4). Without mitigation, the clearing of vegetation along the pipeline RoW could have a **Major** impact on the population of this plant species (Table 7.7-4).

Mitigation measures must include:

- Compilation and implementation of a *E. turkanensis* management plan, in the Project BMP, that covers the following:
  - Mapping of *E. turkanensis* colonies within the make-up water pipeline RoW to understand presence prior to any vegetation clearing;
  - Identification of *E. turkanensis* colonies within 250 m to the north and west of the make-up water pipeline RoW (based on the prevailing wind direction) to understand the extent of potential deposited dust impacts;
  - Identification of *E. turkanensis* colonies within the RoW that will need to be translocated (via a temporary nursery) or have cuttings propagated and those that can be preserved *in situ.* Only *E.turkanensis* directly within the pipeline RoW will need to be translocated, all other colonies will be preserved and monitored *in situ*;
  - *E. turkanensis* colonies that are to be preserved *in situ* should be clearly demarcated on the ground and protected by visible barriers;
  - Ongoing monitoring of *E.turkanensis* communities preserved *in situ* to monitor their response and hardiness to construction dust impacts. If signs of stress are noted, additional mitigation will be implemented
  - Establishment of a nursery for temporary maintenance of translocated *E. turkanensis* or propagation of cuttings;
  - Replanting of *E. turkanensis* within the RoW after completion of construction and rehabilitation; and
  - Monitoring of translocated of *E. turkanensis* colonies to assess reestablishment success.
- Education of EPC staff during environmental inductions as to company policies and procedures related to environmentally significant areas and SoCC.

The significance of impacts on *E. turkanensis* was rated as **Minor** post mitigation (Table 7.7-4).

Plant Species of Conservation Concern

Of the remaining plant SoCC recorded during the baseline surveys, *Blepharis turkanae* was not recorded within the AoI. Based on consultation with the external vegetation specialist (John Kimeu, NMK) it is not expected to occur in the AoI. The remaining plant SoCC (i.e., *Neuracanthus kenyensis* and *Xerophyta schnizleinia*) do not meet the threshold for critical habitat status, and neither were recorded within the Project footprint although they have been recorded in the AoI. Based on the low likelihood that any of the remaining SoCC occur within the direct Project footprint, the significance of vegetation clearing required to accommodate and construct Project facilities was rated as **Minor** both pre- and post-mitigation (Table 7.7-4).

Mitigation measures must include pre-vegetation clearing checks to be conducted by the BCoW in order to verify the absence of plant SoCC.

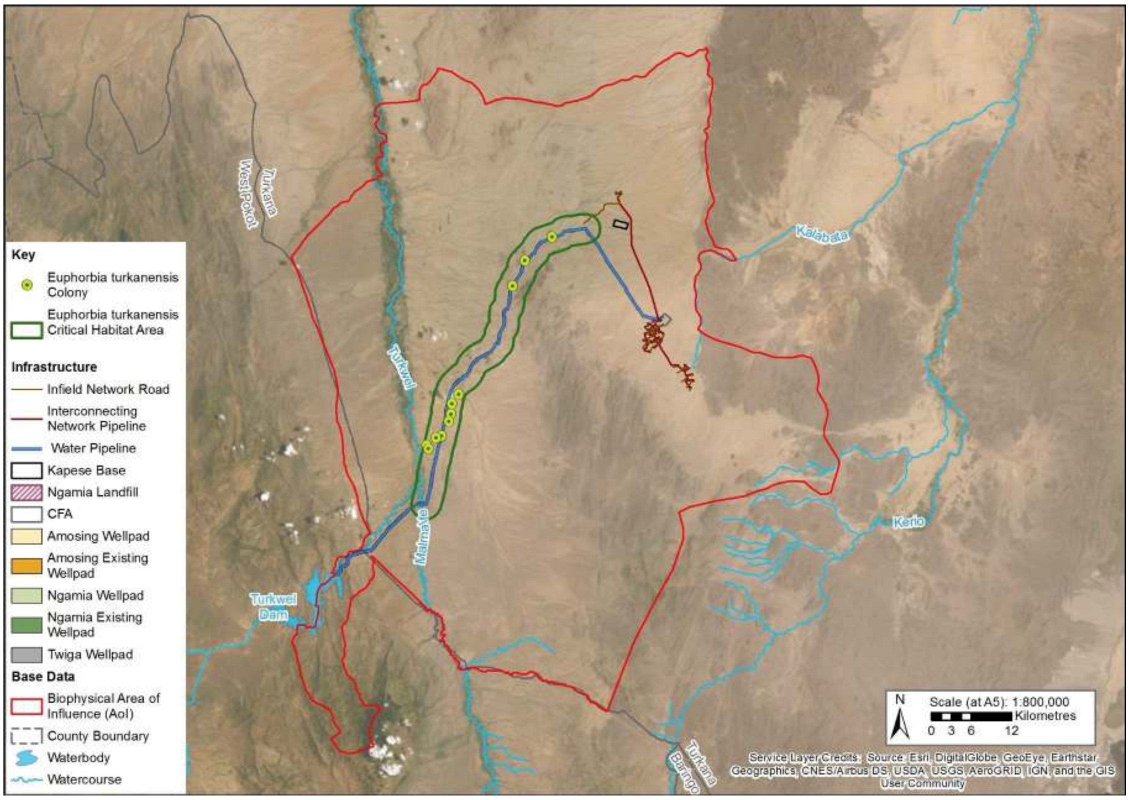

Figure 7.7-4: Location of Known *E. turkanensis* Colonies as well as Critical Habitat Associated with the Water Pipeline RoW

Elephants

The elephants that populate the AoI form part of the Nasolot - Kamnarok population that extends from the Kerio Valley in the south, to South Turkana and Nasolot NRs in the north. This area includes four protected areas, namely South Turkana, Nasolot, Kerio Valley and Kamnarok National Reserves, and is the largest elephant population in western Kenya (Chase *et al*., 2016). The commercial ivory trade is active in the area, and the Nasolot – Kamnarok elephant population is severely threatened (Omondi *et al* (2002). The results of the Great Elephant Census (Chase *et al*., 2016) also pointed to excessive mortality rates recorded in the area. Elephant are listed as EN in KWCMA (2013), therefore, the species is automatically a candidate for critical habitat status; however, it is unclear whether it meets the threshold for inclusion under IFC PS6 Criterion 1. The decision to include elephants as a critical habitat trigger was reached in consultation with the external specialist B. Agwanda (NMK) and was based on the following factors:

- The isolated nature of the Nasolot - Kamnarok elephant population;
- The severe threat faced by this population; and
- The likelihood that elephants will be upgraded to EN or CR status by the IUCN over the course of the Project lifespan.

A critical habitat map for elephants in the AoI was compiled primarily based on data collected from four elephants fitted with GPS collars in December 2017 (Ihwagi et al., 2018). Maps showing the movements of those elephants between Nasolot and South Turkana were digitised and used as a basis to define the critical habitat map within the area Figure 7.7-5). Elephant critical habitat is situated mostly in the south of the Project AoI but extends northwards along the Malmalte and Turkwel Rivers (Figure 7.7-5). The elephant critical habitat is traversed by the water pipeline RoW, both to the east and the west of the Malmalte River (Figure 7.7-5). Potential impacts on elephants are primarily associated with construction of the make-up water pipeline, and include:

- Sensory disturbance due to noise and the presence of humans;
- Temporary loss of critical habitat during pipeline construction;
- Temporary habitat severance during pipeline construction; and
- Increased conflict due to increased human density in the AoI and improved access to critical habitat areas (Table 7.7-4).

The significance of construction impacts on elephants was rated as **Major** prior to mitigation (Table 7.7-4). Mitigation measures include construction of the portion of the make-up water pipeline in the vicinity of the Malmalte River during the period from January to April, when most of the elephants move southwards within their range towards Kainuk and Kerio.

Mitigation measures must include:

- Development and implementation of BMP;
- The completion of an elephant management plan prior to commencement of construction. The management plan will identify procedures for encounters between construction teams and elephants;
- Demarcation of elephant critical habitat on construction plans and on the ground as environmentally significant areas; EPC (with TKBV support) consultation with KWS to understand the requirement for and provide logistical support to KWS in terms of monitoring elephant habitats and populations;

- EPC (with TKBV support) engagement with the relevant authority to identify any seasonal or temporal constraints in environmentally significant areas which will require demarcation as *No-Go* areas;
- EPC staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas and SoCC;
- The EPC to establish communication channels with KWS staff and to provide intelligence-led information to notify NGOs and KWS of any perceived or observed poaching threats or activities; and
- Development and implementation of an Influx Management Plan to include actions around access to the Malmalte River via the pipeline RoW.

Implementation of the recommended mitigation measures reduced the significance of this impact to **Moderate** (Table 7.7-4).

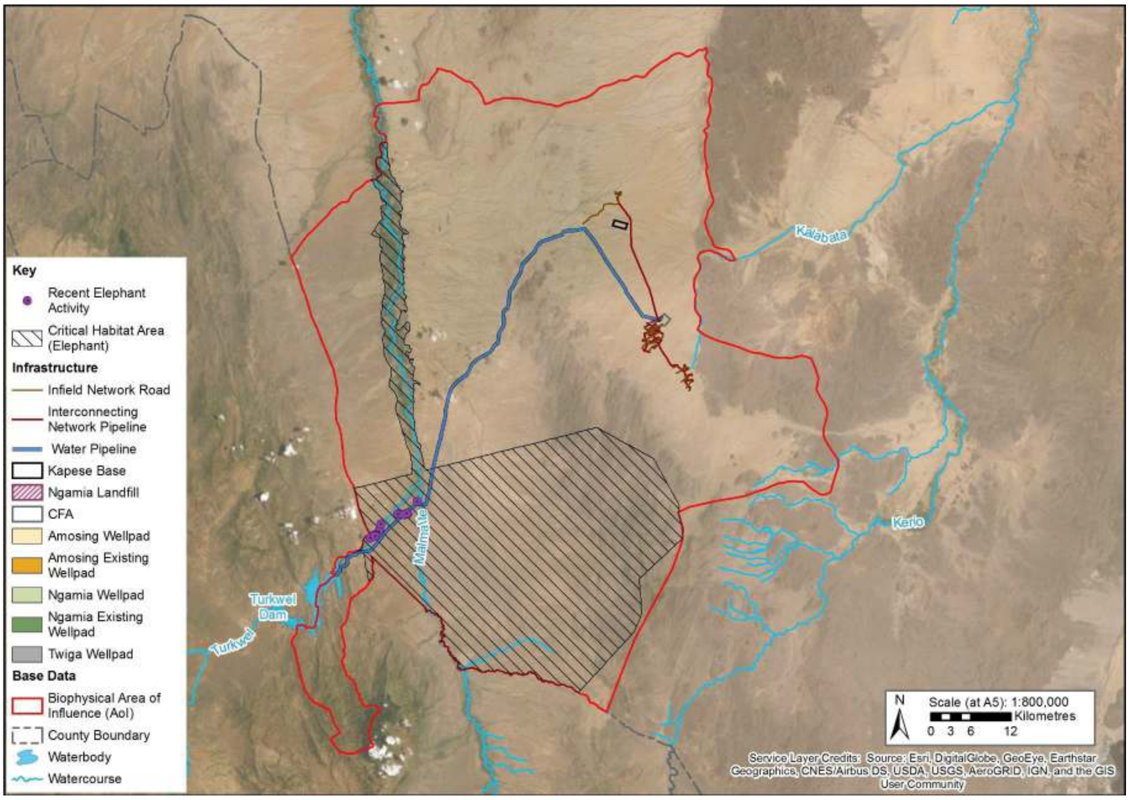

Figure 7.7-5: Map Showing Elephant Critical Habitat Within the Project AoI

Leopards and striped hyaena

Leopard and striped hyaena were both confirmed as present in the AoI during the biodiversity baseline (See Section 6.0). Both species are nationally listed as EN (KWCMA, 2013) and based on the critical habitat assessment conducted in consultation with B. Agwanda of NMK were deemed to meet the threshold for critical habitat status based on Criterion 1 (Annex I). It is expected that both species will experience a high level of persecution by nomadic pastoralists and that although they may occasionally move through the Project footprint under cover of darkness, they are unlikely to remain in these adjoining Critical Habitat Areas for extended periods of time. Instead they are expected to reside in core Critical Habitat Areas such as the rocky ridges interspersed and adjoining the AoI as well as the less densely inhabited and densely vegetated habitats along the Malmalte and Turkwel Rivers. A map showing critical habitat for these 2 species is provided in Figure 7.7-6.

Potential impacts associated with the construction phase include:

- Direct mortality due to increased vehicle traffic, especially at night;
- Sensory disturbance due to noise and lights; and
- Increased Human-Wildlife Conflict (HWC) due to increased human density in the AoI and improved access to critical habitat areas due to construction RoWs.

Mitigation measures must include:

- Inclusion of leopard and striped hyaena in the Project BMP prior to commencement of construction. The management plan will provide guidance to construction teams on how to deal with encounters with these species and will identify areas where encounters have an increased likelihood of occurring;
- Development and implementation of the Influx Management Plan;
- Development and implementation of Wildlife rescue procedure for animals trapped within open trenches e.g. the use of crawl boards; daily inspections prior to works commencing;
- Demarcation of leopard and striped hyaena critical habitat on construction plans and on the ground as environmentally significant areas to be avoided;
- EPC engagement with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as *No-Go* areas.
- EPC staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas and SoCC; and
- No night working or driving within core or adjoining critical habitat areas, where possible. If it cannot be avoided, then adherence to Project speed limits should be strictly enforced.

Implementation of mitigation measures reduced the significance of the impacts to **Moderate** (Table 7.7-4)**.**

Mammal Species of Conservation Concern

Other mammal SoCC that have been confirmed as present in the AoI include lesser kudu and Cape buffalo. Based on the critical habitat assessment (Annex I) these species do not meet the thresholds for critical habitat status and their importance was therefore rated as moderate. The potential impacts on these species match those listed above for leopard and striped hyaena but due to their reduced importance as receptors, the significance of the impact was rated as moderate pre mitigation and minor post mitigation (Table 7.7-4).

Mitigation measures mirror those defined for elephants, leopards and striped hyaenas. The *No-Go* areas for mammal species of conservation concern mirror those for leopard and striped hyaenas (Figure 7.7-6).

Vultures

Three vulture species (white-backed, Rüppell's and lappet-faced) were recorded in the AoI during the biodiversity baseline and based on the critical habitat assessment (Annex I) all three qualify as Criterion 1 critical habitat triggers. Based on the IUCN, populations of all three species are known to be decreasing and therefore they were assigned a very high receptor importance (IUCN, 2019). Although these species are expected to traverse the entire Project AoI, critical habitat was restricted to those areas where vultures are likely to encounter carrion, preferred flights paths and areas where they are likely to find large trees for nesting and roosting. These areas would include:

- Nasolot and South Turkana NRs;
- Malmalte, Turkwel and Kalabata Rivers; and
- Along rocky ridges.

A map of critical habitat for vultures is provided in Figure 7.7-6. The vulture critical habitat is mostly situated beyond the direct Project footprint with the exception of the proposed make-up water pipeline crossing of the Malmalte and the pipeline crossing of the north-south aligned ridge that separates Turkwel Dam from the rest of the AoI (Figure 7.7-6). Potential impacts to these vultures include:

- Direct mortality due to collisions with the proposed non-infield OHTLs and the cable crane associated with make-up water pipeline;
- Direct mortality due to collisions with the proposed infield OHTLs;
- Loss of critical habitat due to the potential dieback of suitable nesting and roosting trees associated with the dewatering of the Kalabata River[17]; and
- Sensory disturbance due to construction noise.

Power lines are a major cause of non-natural mortality for various species of birds across the globe (Birdlife International Data Zone, 2019). Collisions with wires affects large-bodied and migratory species characterised by low flight manoeuvrability (e.g. cranes, swans and bustards), whilst electrocutions on pylons may have a significant effect on large raptors (Birdlife International Data Zone, 2019).

In South Africa, mortality from power lines is widely considered to be an important contributory factor in the decline in range and numbers of the CR African White backed vulture (Birdlife International Data Zone, 2019). Vultures routinely perch and roost on power line structures (Birdlife International Data Zone, 2019). Due to their large wingspan they can easily span the distance between energised and ground components of power lines (Lehman et al. 2007). Research globally has shown that bird interactions with overhead lines are almost all negative (Scottish Natural Heritage, 2016). Furthermore, mitigation measures such as marking of lines to increase visibility only reduce bird impacts by around 50% (Bernardino et al., 2018).

The significance of potential impacts on vultures was rated as **Major** pre-mitigation (Table 7.7-4).

Mitigation measures must include the following:

- Development and implementation of BMP, including the compilation of a vulture management plan;

[17] Vultures typically nest in large acacia trees such as those along the Kalabata. Until impacts of groundwater abstraction (discussed further in relation to the Turkana toad and undescribed beetle) are fully understood this remains a potential impact.

- Demarcation of vulture critical habitat on construction plans and on the ground as environmentally significant areas to be avoided;
- Areas outside the Project footprint to be identified as *No-Go* areas for EPC staff;
- EPC staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas and SoCC; and
- Engagement with OHTL contractor (relevant Kenyan electricity company) and exert influence over relevant Kenyan electricity company to evaluate route alignment of linear infrastructure to minimise impacts on vultures and other bird SoCC;
- Encourage inclusion of bird-friendly measures into infield OHTL design, which may include:
  - Measures to deter perching and nesting;
  - Insulated components;
  - Configurations with fewer layers of vertical cables and without an earth-wire; and
  - Installing line markers to reduce collisions.
- Engagement with OHTL contractor (relevant Kenyan electricity company) to exert influence over relevant Kenyan electricity company for Inclusion of bird-friendly measures into non-infield OHTL design.

Prior to construction, analysis of the tree physiological stress test samples collected in December 2019 should be completed and a dry season survey should be conducted, when possible, to gather a similar level of tree stress data. Once this is complete, the outcome of the analysis should be used to develop trigger and control levels for physiological stress on trees. Implementation of the mitigation measures reduced the significance of this impact to **Moderate** (Table 7.7-4).

Bird Species of Conservation Concern

The Steppe eagle, Bateleur and Martial eagle are SoCC that do not meet the numerical thresholds for IFC critical habitat status (Annex I) and thus their importance was rated as high. These species face the same threats as vultures and the significance of potential impacts was rated as **Moderate** pre-mitigation (Table 7.7-4).

Mitigation measures for bird SoCC mirror those listed for vultures (Figure 7.7-6). Implementation of the recommended mitigation measures reduced the significance of impacts on these species to a **Minor** level.

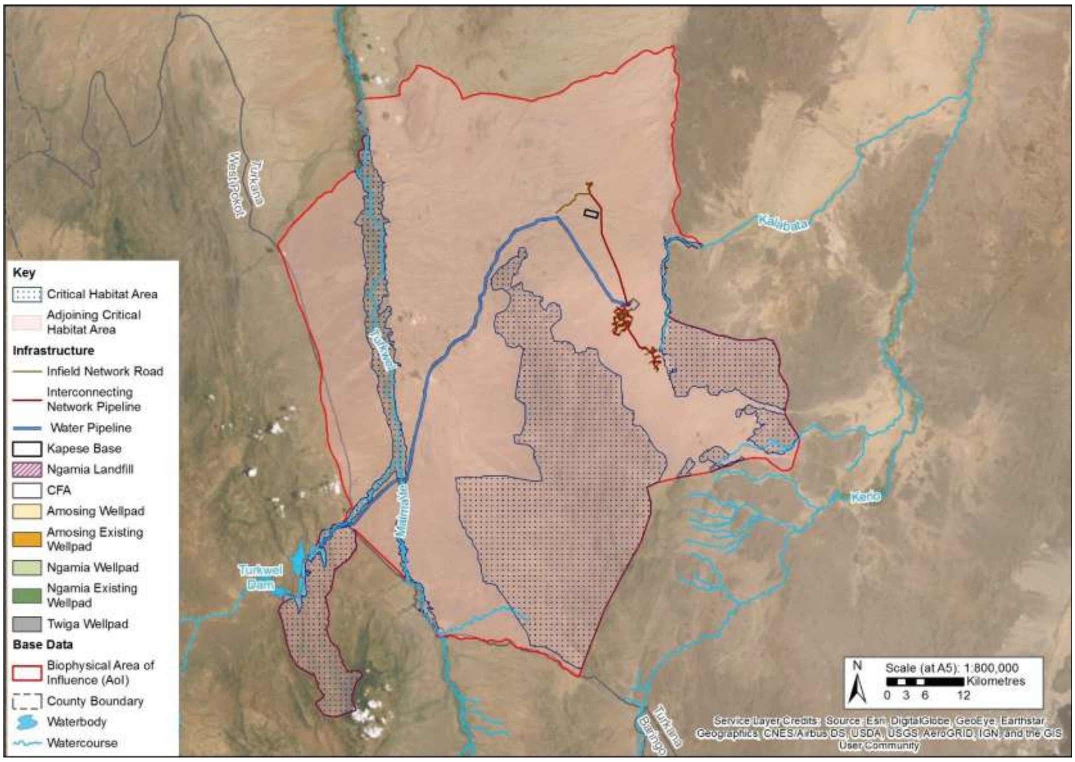

Figure 7.7-6: Critical Habitats for Leopard, Striped Hyaenas and Vultures Within the Project AoI[18]

[18] Adjoining Critical Habitat Area is the area adjacent to the critical habitat which will be used by vultures, leopards and striped hyaenas but which doesn't provide core habitat

Turkana Toad

The Turkana toad is a range restricted amphibian species that qualifies for critical habitat status based on IFC PS6 Criterion 2 (Annex I). Within the AoI this species has only been recorded in the vicinity of the Kalabata River and its critical habitat was mapped based on a combination of the biodiversity baseline records and historical records (Figure 7.7-7). Potential threats to this species during the construction phase include:

- Direct mortality due to increased vehicle traffic on roads and entrapment in open trenches;
- Loss of critical habitat along the Kalabata River associated with groundwater abstraction; and
- Attraction to accumulations of insects at lights during the night exposing the toad to increased predation.

The significance of potential impacts on the Turkana toad was rated as **Major** pre-mitigation. This is attributed to the very high level of receptor importance, limited knowledge on the distributional range and uncertainty regarding the impacts of groundwater abstraction on the ecology of the Kalabata River.

An additional Turkana toad survey was conducted in December 2019, but none were collected, despite comprehensive survey coverage along the Kalabata. It was concluded that the presence of the toad is likely to be seasonal in this area and an additional survey should be conducted in the long rainy season (ideally May/June) ahead of construction as part of the BAP work in order to further attempt to confirm the baseline presence of the toad.

Baseline survey results indicate that the riparian vegetation along the Kalabata River represents critical habitat for the Turkana toad.

Mitigation measures that will reduce the significance of impacts on the potential toad habitat on the Kalabata include the following:

- Development and implementation of BMP and ISMP;
- Demarcation of critical habitat on construction plans and on the ground as environmentally significant areas to be avoided;
- Continued monitoring of changes in humidity level within the Kalabata River riparian zone to establish baseline prior to commencement of construction.
- Prior to construction, analysis of the tree physiological stress test samples collected in December 2019 should be completed and a dry season survey should be conducted prior to construction, to gather a similar level of tree stress data. Once this is complete, the outcome of the analysis should be used to develop trigger and control levels for physiological stress on trees.
- Continuous monitoring of physiological stress levels in trees along the Kalabata River throughout the groundwater abstraction phase. Sampling should be undertaken twice a year (wet and dry season) and the results evaluated against the established trigger and control levels to guide mitigation.
- Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring at each humidity monitoring location. The baseline will be established up to the commencement of construction, with monthly data downloads. The data should be analysed to develop water level trigger and control levels.
- Turkana toad surveys should be completed during a rainy season (ideally May/June) prior to construction (the season when data was originally collected in 2016), to further establish likely baseline presence in the Kalabata and areas likely affected by groundwater drawdown during construction.

- Should evidence of the Turkana toad be collected during aforementioned surveys, the survey will be repeated on a yearly basis in May/June throughout the period of groundwater abstraction during the construction phase.
- From the commencement of groundwater abstraction during construction, monitoring of humidity levels and shallow groundwater will be continued in the same monitoring locations and compared to the baseline values.
- An action plan will be developed for the exceedance of water level and tree stress trigger levels to avoid long term stress of potential Turkana toad habitats. Actions may include targeted irrigation during groundwater abstraction.

Assuming trigger and control levels for mitigation can be established and monitoring plans as described above are maintained throughout the period of potential impact on the Turkana toad habitat from groundwater abstraction and until groundwater levels have recharged, the significance of the impact reduces to **Moderate.**

Herpetofaunal Species of Conservation Concern

The Kenyan sand boa, puff adder and rock monitor are SoCC that do not meet the IFC PS6 thresholds for critical habitat (Annex I). Threats to these species are similar to those faced by the Turkana toad with the addition of direct persecution of snakes.

Mitigation measures will include the following:

- Environmentally significant areas will be declared as *No-Go* areas, i.e. critical habitat (Figure 7.7-7);
- EPC staff should be educated on company policies and procedures related to sensitive and important fauna including procedures on dealing with snakes and other reptiles;
- Night work and driving to be avoided where possible. If night driving cannot be avoided, then adherence to reduced speed limits and awareness of sensitivity of these species will provide mitigation;
- Development and implementation of a BMP to include weekly inspection of well-pads by BCoW and translocation of species if found;
- Development and implementation of ISMP, with particular attention to be paid to the potential introduction of *Chytrid* fungus and other pathogens.

The significance of construction impacts on herpetofauna SoCC was rated as **Moderate** pre-mitigation and decreased to **Minor** post-mitigation.

Undescribed Beetle Species (Omophron sp)

During the biodiversity baseline a previously undescribed beetle species (*Omophron sp.*) was recorded in the Kalabata River. The specimen was deposited in the National Museum of Kenya in Nairobi and photographs of it were sent to taxonomic experts who confirmed the field identification. Based on the precautionary principle this species was assigned critical habitat status based on IFC PS6 Criterion 2 with the Kalabata River representing the only known distribution of this species (Figure 7.7-8). Threats to this species include loss of critical habitat due to abstraction of groundwater from the Kalabata and the resultant impacts on the vegetation communities. The significance of potential impacts on this species was rated as **Major** pre-mitigation (Table 7.7-4).

No additional specimens of the *Omophron* beetle were recorded in the Kalabata River during the December 2019 survey, despite comprehensive survey coverage of the habitat. It was concluded that the presence of the beetle (as with the Turkana toad) is seasonal and an additional survey should be conducted in the long rainy season (ideally May/June) ahead of construction as part of the BAP work in order to confirm the baseline presence of the beetle.

Based on the baseline data, the vegetation community along the Kalabata River forms critical habitat for the *Omophron* beetle. Mitigation measures that will reduce the significance of impacts on the potential beetle's habitat along the Kalabata River include the following:

- Continued monitoring of changes in humidity level within the Kalabata River riparian zone to establish baseline prior to commencement of construction.
- Prior to construction, analysis of the tree physiological stress test samples collected in December 2019 should be completed and a dry season survey should be conducted prior to construction, to gather a similar level of tree stress data. Once this is complete, the outcome of the analysis should be used to develop trigger and control levels for physiological stress on trees.
- Continuous monitoring of physiological stress levels in trees along the Kalabata River throughout the groundwater abstraction phase. Sampling should be undertaken twice a year (wet and dry season) and the results evaluated against the established trigger and control levels to guide mitigation.
- Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring at each humidity monitoring location. The baseline will be established up to the commencement of construction, with monthly data downloads. The data should be analysed to develop water level trigger and control levels.
- *Omophron* beetle surveys should be continued during rainy season (ideally May/June) ahead of construction, to further establish likely baseline presence in the Kalabata and areas likely affected by groundwater drawdown during construction.
- Should evidence of the *Omophron* beetle be collected during the aforementioned survey, the survey will be repeated on a yearly basis in May/June throughout the period of groundwater abstraction during the construction phase.
- From the commencement of groundwater abstraction during construction, monitoring of humidity levels and shallow groundwater will be continued in the same monitoring locations and compared to the baseline values.
- Environmentally significant areas will be declared as *No-Go* areas, i.e. critical habitat (Figure 7.7-8).
- EPC staff should be educated on company policies and procedures related to sensitive and important fauna including procedures on dealing with snakes and other reptiles.
- Development and Implementation of Influx Management Plan.
- Development and implementation of a BMP.
- Development and implementation of ISMP.

An action plan will be developed for exceedance of water level and tree stress trigger levels to avoid long term stress of potential *Omophron* beetle habitats. Actions may include using targeted irrigation during groundwater abstraction. Assuming trigger and control levels for mitigation can be established and monitoring plans as described above are maintained throughout the period of potential impact on the *Omophron* beetle habitat from groundwater abstraction and until groundwater levels have recharged, the significance of the impact reduces to **Moderate.**

Fish

During the June 2019 baseline field surveys two range-restricted fish species were recorded in the Turkwel River within the Project AoI. Both species are range-restricted species that were previously thought to be endemic to Lake Turkana. The records of these species from the AoI increased the distributional ranges of these species but even with this range extension both species qualify for critical habitat status based on IFC PS6 Criterion 2 (Annex I). Critical habitat for these species encompasses the length of the Turkwel and Malmalte Rivers throughout the AoI (Figure 7.7-9). No direct impacts are expected on these rivers during the construction phase, indirect impacts include increased fishing pressure due to the influx of people into the AoI.

Mitigation measures are focused on managing the influx of people into the habitat along the Malmalte via the Project RoW via an Influx Management Plan. An ISMP will be developed and implemented and environmentally significant areas will be demarcated as No- Go areas. The significance of this impact was rated as **Moderate** pre-mitigation and decreased to **Minor** post-mitigation.

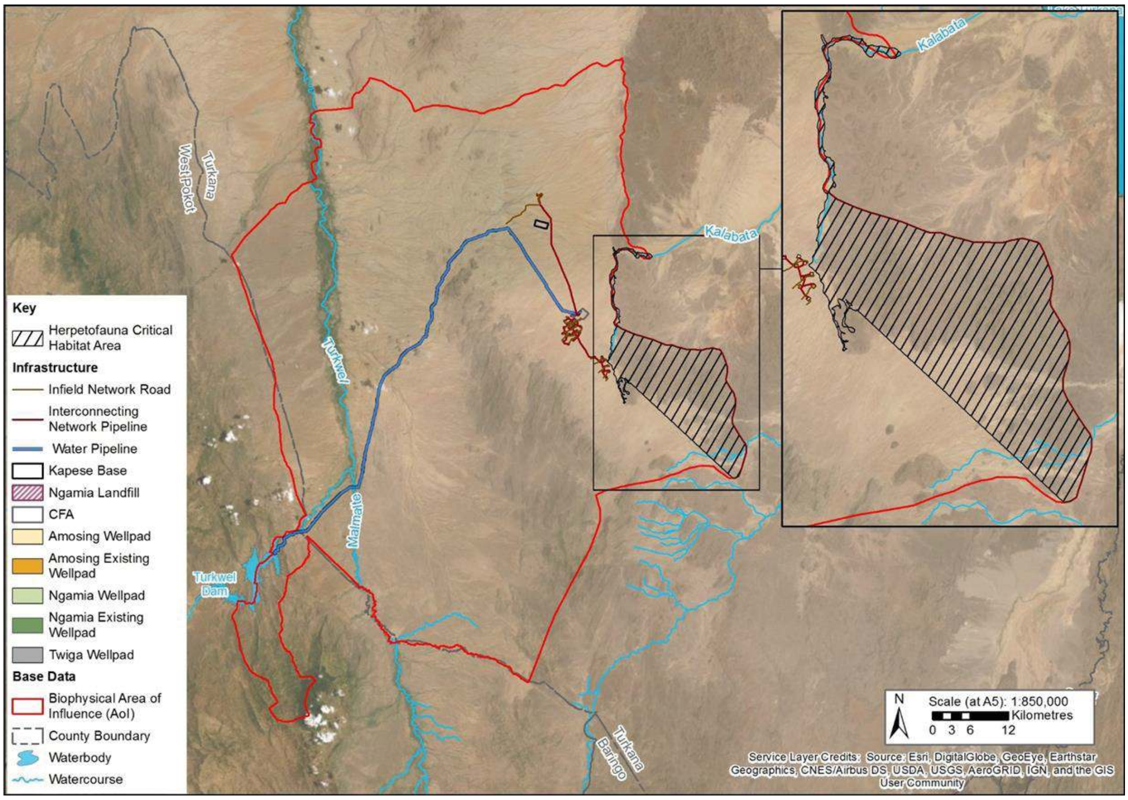

Figure 7.7-7: Map Showing Critical Habitat for the Turkana Toad Based on Records Collected During the Biodiversity Baseline as well as Historical Records

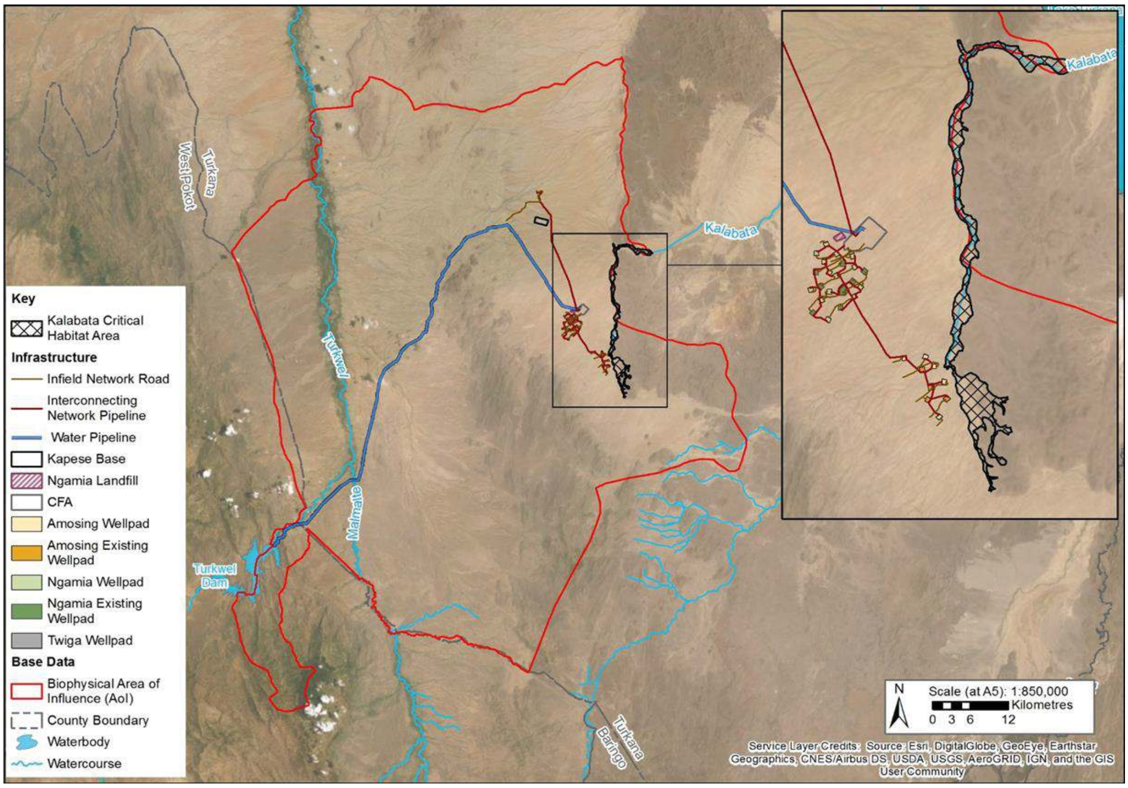

Figure 7.7-8: Critical Habitat of the Undescribed Beetle Species Recorded in the Kalabata River During the Biodiversity Baseline. The Critical Habitat Corresponds to the Riparian Vegetation Along the Kalabata River.

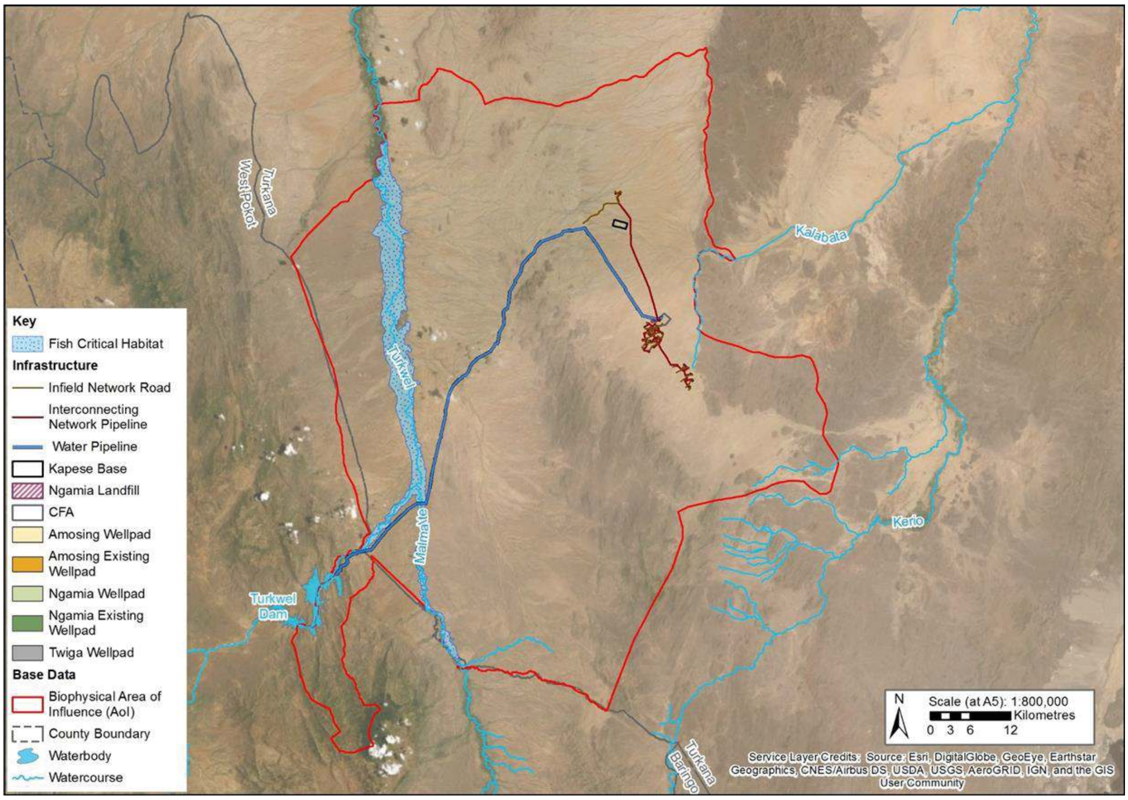

Figure 7.7-9: Critical Habitat for Range Restricted Fish Species Recorded During the Biodiversity Baseline

Table 7.7-4: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Nasolot NR (Very High)	■ Temporary land take for water pipeline RoW and associated infrastructure; ■ Temporary impingement of ecological connectivity; ■ Increased human and vehicle traffic contributing to direct mortality of fauna; ■ Sensory disturbance of fauna due to light and noise; and ■ Introduction of pests and weeds.	Direct – short-term - Medium	Moderate (adverse)	■ Nasolot NR boundary demarcated on construction plans and on the ground; ■ Contractor and staff environmental inductions; ■ Development and Implementation of BMP; ■ Wildlife rescue procedures to be developed; ■ Development and Implementation of ISMP; ■ Management plan for Nasolot NR; and ■ Development and implementation of vegetation rehabilitation plan.	Direct – short-term - Low	Minor
South Turkana NR & Pellow Community Conservancy (Very High)	■ Sensory disturbance of fauna due to light and noise.	Indirect – short term - low	Moderate (adverse)	■ South Turkana NR and Pellow Community Conservancy boundary demarcated on construction plans; ■ Development and implementation of BMP; ■ Development and implementation of ISMP; ■ Contractor and staff environmental inductions; ■ Implementation of BMP (for drilling); ■ Implementation of ISMP (for drilling); and ■ Development and implementation of vegetation rehabilitation plan.	Negligible	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Faidherbia - Celtis riparian forest community along the Malmalte River (High)	▪ Sensory disturbance (light, noise); ▪ Increased access for people and vehicles along permanent service tracks, RoW and roads resulting in increased resource abstraction, bushmeat hunting and potentially ivory poaching; and ▪ Introduction of pests and weeds.	Direct – short term - medium	Moderate	▪ Riparian vegetation communities to be demarcated on construction plans and on the ground; ▪ EPC engagement with the relevant authority to identify particularly sensitive *No-Go* areas for demarcation; ▪ EPC staff environmental inductions; ▪ Development and implementation of Influx Management Plan; ▪ Development and Implementation of BMP; ▪ Development and Implementation of ISMP; ▪ Development and implementation of wildlife rescue procedure; ▪ Inclusion of 100 m setback distances beyond the riparian vegetation boundary for the drill rig and pipe stringing; ▪ Rehabilitation plans (site specific) to be produced; and ▪ Implementation of site rehabilitation plan.	Direct – short-term - Low	Minor
Rocky ridges habitats (Very High)	▪ Sensory disturbance of fauna due to lights, noise.	Indirect – short term - low	Moderate	▪ Contractor and staff environmental inductions; and ▪ Environmentally significant areas will be identified as *No-Go* areas for EPC staff.	Indirect – short term - low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Northern Acacia-Commiphora bushlands and thickets (High)	■ Land-take required for Project infrastructure; ■ Clearing of vegetation during construction; ■ Increased human density in the vicinity of the Project area contributing to increased resource abstraction (e.g. charcoal production); and ■ Introduction of alien invasive plant species.	Direct – long term - medium	Moderate	■ Construction footprint to be limited and delineated; ■ Areas beyond the Project footprint to be identified as *No-Go* areas for EPC staff; ■ Development and Implementation of ISMP; ■ Production of Rehabilitation Plan; and ■ Implementation of rehabilitation plan.	Direct – long term – low	Minor
Euphorbia turkanensis (Very High)	■ Clearing of vegetation prior to construction; ■ Deposition of dust generated during construction activities; ■ Introduction of invasive species that could out-compete these species; ■ Increased collection of range restricted plant species by collectors.	Direct – short term - medium	Major	■ Inclusion and implementation of *E. turkanensis* management plan in Project BMP developed; ■ Education of EPC staff during environmental inductions as to company policies and procedures related to environmentally significant areas and SoCC; ■ Implementation of BMP; ■ Contractor and staff environmental inductions; and ■ Spot checks by BCoW/EPC for SoCC in areas prior to clearing.	Direct – short term - negligible	Minor
Plant SoCC (High)		Direct – short term - low	Minor		Direct – short term - negligible	Negligible

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Elephants (Very High)	• Disturbance due to noise and presence of humans; • Temporary loss of critical habitat during pipeline construction; • Temporary habitat severance; and • Increased HWC due to increased human density in the AoI.	Indirect – medium term - medium	Major	• Development and implementation of an elephant specific management plan in Project BMP; • Implementation of Influx Management Plan; • Implementation of the BMP; • Demarcation of elephant critical habitat on construction plans and on the ground; • EPC contractor engagement with the relevant authority (with TKBV support) to identify any seasonal or temporal constraints in environmentally significant areas which will require demarcation as *No-Go* areas.; • EPC staff environmental inductions; and • Communication channels to be established with KWS by BCoW/EPC.	Direct – medium term - low	Moderate
Leopard and striped hyaena (Very High)	• Sensory disturbance; • Increased persecution; • HWC; and • Direct mortality due to increased vehicle traffic on roads (especially at night);	Direct – medium term - medium	Major	• Demarcation of critical habitats on construction plans and on the ground; • EPC contractor engagement with the relevant authority (with TKBV support) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as *No-Go* areas; • Inclusion of leopard and striped hyaena in the Project BMP; • Communication channels to be established with KWS by BCoW/EPC. • EPC contractor staff environmental inductions;	Direct – medium term - low	Moderate
Mammal SoCC (Moderate)		Direct - medium term - medium	Moderate		Direct – medium term - low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				■ Night driving to be avoided where possible; ■ Development and Implementation of wildlife rescue procedure; ■ Implementation of Influx Management Plan; and ■ Implementation of BMP.		
Vultures (Very High)	■ Direct mortality due to OHTL and cable crane system for water pipeline construction; ■ Loss of critical habitat for vultures due to dewatering of Kalabata resulting in changes in vegetation and in particular the dieback of large roosting and nesting trees; ■ Sensory disturbance during construction; and ■ Increased persecution.	Direct – short term – high	Major	■ Inclusion and implementation of vulture management in Project BMP; ■ Demarcation of vulture critical habitat on construction plans and on the ground; ■ Areas outside the Project footprint to be identified as *No-Go* areas for EPC staff; ■ EPC staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas and SoCC; ■ Implementation of BMP; ■ Exert influence over relevant Kenyan electricity company to evaluate route alignment of linear infrastructure to minimise impacts on vultures and other bird SoCC; ■ Exert influence over relevant Kenyan electricity company for inclusion of bird-friendly measures into non-infield OHTL design; and ■ Encourage inclusion of bird-friendly measures into infield OHTL design.	Direct – short term – high	Moderate
Bird SoCC (High) (non-critical habitat trigger species)		Direct – long term - medium	Moderate		Direct – short term – low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Turkana toad (Very High)	■ Direct mortality due to increased vehicle traffic on roads and entrapment in open trenches; ■ Attraction to accumulation of insects at lights exposing them to increased predation; ■ Loss of critical habitat due to dewatering of Kalabata resulting in changes in vegetation composition; ■ Attraction to water storage facilities on wellpads (particularly relevant for Turkana toad); and ■ Direct mortality due to persecution (particularly relevant to snakes).	Direct – medium term - high	Major	■ Demarcation of critical habitats on construction plans and on the ground; ■ Collection of additional data on Turkana toad distribution; ■ EPC engagement with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as *No-Go* areas; ■ Turkana toad monitoring (including shallow groundwater and physiological stress of trees); ■ Development and implementation of BMP (including trigger and control levels for groundwater and physiological stress of trees); ■ Implementation of BMP, to include weekly inspection of wellpads by BCoW and translocation of species if found; ■ Contractor and staff environmental inductions; ■ Night driving to be avoided, where possible; and ■ Development and implementation of ISMP.	Direct – medium term - low	Moderate
Herpetofauna SoCC (non-critical habitat trigger species) (Medium)		Direct – short - low	Minor		Direct – short term - negligible	Negligible

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Ground beetle (*Omophron* sp) (Very High)	■ Direct mortality due to: ▪ Loss or modification of habitats, ▪ Attraction to lights; and ▪ Entrapment in trenches. ■ Loss of critical habitat due to dewatering of Kalabata resulting in changes in vegetation composition.	Direct – medium term - high	Major	■ Demarcation of critical habitats on construction plans and on the ground; ■ EPC engagement with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as *No-Go* areas.; ■ Additional monitoring of beetle distribution (including shallow groundwater and humidity monitoring of habitats); ■ Development and implementation of BMP (including an action plan for trigger and control levels for groundwater and physiological stress of trees); ■ Development and implementation of Influx Management Plan; and ■ Development and implementation of ISMP.	Direct – medium term - low	Moderate
Fish (Very High)	■ Increased fishing pressure due to population influx to nearby settlements during construction.	Direct – short term - low	Moderate	■ Environmentally significant areas demarcated as *No-Go* areas; ■ Development and Implementation of Influx Management Plan; and ■ Development and implementation of ISMP.	Direct – short term - negligible	Minor

7.7.9.2 Operational Phase

The operational phase impact assessment with respect to biodiversity is presented in Table 7.7-5.

7.7.9.2.1 Habitat Receptors

Natural vs Modified Habitats

The vegetation condition assessment (Annex I) identified the Faidherbia - Celtis riparian forest community along the Malmalte River as the only area of natural vegetation within the Project footprint (Figure 7.7-3). Potential impacts on this community during the operational phase include increased access for people and vehicles along permanent service tracks, RoW and roads resulting in increased resource abstraction, bushmeat hunting and potentially ivory poaching. Mitigation measures will consist of the following:

- Continued implementation of the ISMP;
- Environmental inductions for contractors and staff;
- EPC contractor engagement with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in environmentally significant areas which will require demarcation as *No-Go* areas; and
- Monitoring of the Malmalte River vegetation community within the Project RoW against baseline data. This will provide insight into long-terms trends in the state of this community and if it is shown that integrity of this community is decreasing due to Project specific impacts then adaptive management measures can be implemented.

The significance of operational phase impacts on the Faidherbia - Celtis riparian forest community was rated as **Moderate** pre-mitigation (Table 7.7-5). Implementation of the recommended mitigation measures reduced the significance of this impact to minor (Table 7.7-5).

Rocky Ridges

As the rocky ridge habitats are largely situated beyond the Project footprint, operational phase impacts are primarily indirect in nature and include:

- Sensory disturbance of fauna due to lights and noise around operational areas; and
- Edge impacts and establishment of alien invasive plant species.

The significance of these impacts was rated as **Moderate** in the absence of mitigation (Table 7.7-5).

Mitigation measures will include:

- Staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas;
- Implementation of an ISMP; and
- Where possible, reducing light pollution through the use of motion sensors, timers and cowls on outside lights.

Implementation of the mitigation measures reduced the significance of these residual impacts to **Minor** (Table 7.7-5).

7.7.9.2.2 Species Receptors

Elephants

Long-term monitoring data of the Nasolot - Kamnarok elephant population shows a continued downward trend in elephant numbers (Omondi et al., 2002; Chase et al., 2016.). Potential operational phase impacts on elephants are associated with the influx of people into areas such as Lokichar and increased access to core elephant habitats along the Malmalte River along the water pipeline RoW.

Mitigation measures will include:

- Staff will be educated on company policies and procedures related to elephants;
- The environmental team will maintain established communication channels with KWS staff and to provide intelligence-led information to notify NGO's and KWS of any perceived poaching threats or activities;
- TKBV will consult with KWS to understand the requirement for and provide logistical support to KWS in terms of monitoring elephant habitats and populations.
- Implementation of the Influx Management Plan compiled during the construction phase.

The significance of operational phase impacts on elephants was rated as **Moderate** in the absence of mitigation (Table 7.7-5). Implementation of the mitigation measures reduced the significance of these residual impacts to **Minor** (Table 7.7-5).

Leopards and Striped Hyaena

Operational phase impacts on these species are largely indirect and associated with the expected influx of people into the AoI potentially resulting in direct mortality on roads and increased persecution by nomadic pastoralists. The significance of this impact was rated as **Moderate** pre-mitigation and **Minor** post mitigation (Table 7.7-5).

Mitigation measures will include:

- The environmental team will maintain established communication channels with KWS in order to report any observations of these species and any information of expected poaching activities;
- Avoidance of night driving, where possible; and
- Staff will be educated on company policies and procedures related to leopards and striped hyaenas.

Mammal Species of Conservation Concern

Potential impacts and mitigation measures for mammal SoCC mirror those for elephants, leopards and striped hyaenas, excluding the potential logistics support for elephant monitoring. The significance of these impacts on mammal SoCC was rated as **Minor** prior to mitigation and remained **Minor** after mitigation (Table 7.7-5).

Vultures

Potential operational phase impacts on vultures include direct mortality associated with the:

- Infield OHTL network which is situated in close proximity to the Kalabata critical habitat;
- The 4.5 km, 66 kV OHTL managed by the relevant Kenyan electricity company that is expected to run alongside the make-up water pipeline (which is an associated development);
- An enclosed ground flare (30 m height and 9.8 m diameter) situated in the CPF.

The significance of operational phase impacts on vultures was rated as **Major** prior to mitigation (Table 7.7-5).

Mitigation measures will include:

- Production and implementation of OHTL monitoring programme to assess effectiveness of mitigation measures. The monitoring programme will include the in-field OHTL. If increased bird mortality is noted, then adaptive management measures should be implemented;
- If possible, TKBV will seek to exert influence over the relevant Kenyan electricity company, who will be developing the Turkwel OHTL, to implement and monitor the same mitigation measures as proposed for the infield OHTL in this assessment.
- Implementation of a start-up routine for flares that includes visual checking for the presence or proximity of birds.

Implementation of mitigation reduced the significance of this impact to a **Moderate** level (Table 7.7-5).

Bird Species of Conservation Concern

Impacts on bird SoCC mirror that of vultures. Mitigation measures will include:

- Production and implementation of infield OHTL monitoring programme to assess effectiveness of mitigation measures. If increased bird mortality is noted, then adaptive management measures should be implemented;
- If possible, TKBV will seek to exert influence over the relevant Kenyan electricity company, who will be developing the Turkwel OHTL, to implement and monitor the same mitigation measures as proposed for the infield OHTL in this assessment.
- Implementation of a start-up routine for flares that includes visual checking for the presence or proximity of birds.

Implementation of mitigation measures reduced the significance of impacts on these species from **Moderate** to **Minor** (Table 7.7-5).

Turkana Toad

Operational phase impacts on the Turkana toad include direct mortality due to increased vehicle traffic on roads and attraction to and entrapment in water storage facilities on well-pads. The significance of these impacts was rated as **Moderate** prior to mitigation and **Minor** after mitigation (Table 7.7-5).

Mitigation measures will include:

- Implementation of a Turkana toad monitoring programme in order to assess changes in toad populations.
- Staff will be educated and sensitised on company policies and procedures related to sensitive and important fauna including procedures on dealing with snakes and toads;
- Night driving in vicinity of critical habitat to be avoided where possible;
- BMP to include Weekly Inspection of well-pads by BCoW and translocation if found.

Herpetofaunal Species of Conservation Concern

Operational phase impacts on herpetofaunal SoCC mirror those on the Turkana toad with the addition of direct persecution of snakes by people. Mitigation measures will include appointment and training of TKBV environmental teams in the safe removal of snakes and reptiles from all Project related facilities.

Undescribed Beetle Species (Omophron sp)

Potential impacts on the undescribed beetle species include direct mortality due to:

- Loss and modification of habitats; and
- Attraction to lights.

Mitigation measures will include implementation of a monitoring in order to assess changes in beetle populations.

The significance of this impact was rated as **Moderate** prior to mitigation and **Minor** after mitigation (Table 7.7-5).

Table 7.7-5: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Faidherbia - Celtis riparian forest community along the Malmalte River (High)	■ Increased access for people and vehicles along permanent service tracks, RoW and roads resulting in increased resource abstraction, bushmeat hunting and potentially ivory poaching; and ■ Edge impacts and establishment and spread of alien invasive plant species.	Direct – medium term - medium	Moderate	■ Implementation of ISMP; ■ Environmental inductions for contractors and staff; ■ Implementation of vegetation and wildlife monitoring programmes; and ■ Engage with the relevant authority to identify any seasonal or temporal constraints in environmentally significant areas which will require demarcation as *No-Go* areas.	Direct – long term - low	Minor
Rocky ridges habitats (Very High)	■ Edge impacts and introduction or spread of alien invasive plant species; and ■ Sensory disturbance of fauna due to lights and noise, associated with operational activities.	Indirect – medium term - low	Moderate	■ Environmental inductions for staff; ■ Implementation of the ISMP; and ■ Where practicable, use of motion sensors, cowls and timers on outside lights.	Indirect – medium term - negligible	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Elephants (Very High)	■ Presence of a Project RoW providing increased access resulting in increased utilisation of resources, increased human-elephant conflict and increased poaching.	Indirect – medium term - low	Moderate	■ Environmental inductions for staff; ■ Maintain established communication channels with local KWS; ■ Offer logistical support for KWS elephant monitoring; and ■ Implementation of Influx Management Plan compiled during the construction phase.	Indirect – medium term - negligible	Minor
Leopard and striped hyaena (Very High)	■ Presence of a Project RoW providing increased access resulting in increased utilisation of resources, increased human-leopard/hyaena conflict and increased poaching; and ■ Direct mortality due to increased vehicle traffic on roads (especially at night).	Indirect – medium term - low	Moderate	■ Environmental inductions for staff; ■ Maintain established communication channels with KWS; and ■ Avoidance of night driving where possible.	Direct – medium term - negligible	Minor
Mammal SoCC (Moderate)		Indirect - medium term - low	Minor		Direct -medium term - negligible	Negligible
Vultures (Very High)	■ Direct mortality due to OHTLs and flares.	Direct – long term - high	Major	■ Production and implementation of infield OHTL monitoring programme; ■ Implementation of a flare start-up routine; and ■ If possible, seek to exert influence on the relevant Kenyan electricity company to implement an OHTL mitigation and monitoring programme for none-infield areas.	Direct – long term - low	Moderate
Bird SoCC (High) (non-critical habitat trigger species)		Direct – medium term - medium	Moderate		Direct – long term - low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Turkana toad (Very High)	■ Direct mortality due to increased vehicle traffic on roads; ■ Attraction to water storage facilities on wellpads (particularly relevant for Turkana toad); and ■ Persecution (particularly relevant to snakes)	Direct – medium term - medium	Moderate	■ Turkana toad monitoring programme; ■ Environmental inductions for staff; ■ Night driving to be avoided, where possible; and ■ Implementation of BMP, to include weekly inspection of well-pads by BCoW.	Direct – medium term – negligible	Minor
Herpetofauna SoCC (non-critical habitat trigger species) (Medium)		Direct – medium term - medium	Minor		Direct – medium term - negligible	Negligible
Ground beetle (*Omophron sp*) (Very High)	■ Direct mortality due to loss or modification of habitats.	Direct – medium term - medium	Moderate	■ Undertake ground beetle monitoring programme.	Direct – medium term – negligible	Minor

7.7.9.3 Decommissioning

As the operational phase of the Project nears its end, a decommissioning plan will be developed that will include measures to manage risks to biodiversity within the area of the Project through decommissioning. The decommissioning plan will include general and specific mitigation measures for biodiversity management.

Prior to the planned ‘End of Project’, a Decommissioning Plan will be developed for agreement with the appropriate authorities.

When the Project is decommissioned, the following decommissioning philosophy will be adopted:

- All above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use; and
- All decommissioning waste will be handled, stored and managed through the good practice outlined in the Waste Management section of the Decommissioning Plan.

7.7.10 Summary of Mitigation

A BMP will be prepared as part of the Project ESMP. The BMP will set out the mitigations and management controls defined in the ESIA in a clear, implementable and auditable manner. Mitigations will cover the complete mitigation hierarchy from avoidance through minimisation through to biodiversity restoration.

The BMP will provide details of required actions, procedures for documentation and communication, plus a description of implementation and monitoring needs. The BMP will be structured to ensure adaptive management can be followed with monitoring results providing feedback to earlier stages in the BMP development process. Mitigations can be refined through adaptive management, additional consultation with stakeholders and additional input from local specialists who have already assisted with the production of the ESIA. The BMP will also identify additional conservation actions that can be delivered to benefit SoCC within the AoI.

7.7.10.1 Construction Phase

Additional construction phase mitigation measures that will be undertaken to reduce impacts, or reduce the potential for creating the impact, include the following:

- Development of specific management procedures for the following:
  - *Euphorbia turkanensis*;
  - Elephants;
  - Vultures;
  - Leopards and striped hyaenas;
  - Turkana toad;
  - Undescribed beetle (*Omophron* sp.);
  - Invasive plant species;
  - Wildlife rescue procedures for animals trapped in open trenches;

  - Groundwater abstraction and its impact related to trees in the Kalabata River;
  - Vegetation Rehabilitation Plan for construction footprint; and
  - Influx Management Plan with specific reference to access to the Malmalte River.
- Identification of the following environmentally significant areas on construction plans but also demarcation on the ground:
  - All critical habitats;
  - Location of *E. turkanensis* colonies;
  - Riparian vegetation communities; and
  - Protected areas and community conservancies.
- Environmental inductions to be updated to include reference to environmentally significant areas and SoCC;
- EPC contractor shall appoint a BCoW to ensure compliance with relevant mitigation measures. The responsibilities of the BCoW will include the following:
  - Implementation of biodiversity-related management controls;
  - "*Stop work*" authority if any very high or high-value receptors are encountered so that the appropriate management procedures can be implemented;
  - Oversight of vegetation clearing and to conduct pre-clearing checks in areas (outside of make-up water pipeline RoW) to verify the absence of SoCC;
  - Engagement with KWS and appropriate NGOs in terms of management of issues such as HWC and poaching; and
  - Implementation of wildlife rescue procedures.
- All areas beyond the direct Project footprint to be identified as *No-Go* areas;
- Management of OHTL impacts on bird SoCC to include the following:
  - Exert influence over relevant Kenyan electricity company to evaluate route alignment of linear infrastructure to minimise impacts on vultures and other bird SoCC;
  - Exert influence over relevant Kenyan electricity company to incorporate bird-friendly design measures into the OHTL; and
  - Commitment to encourage inclusion of bird-friendly measures into infield OHTL designs.
- Night work and driving in vicinity of critical habitat to be avoided where possible. If night work or driving cannot be avoided, then measures such as reduced speed limits need to be implemented in order to avoid direct mortality or disturbance of SoCC.

7.7.10.2 Operational Phase

Additional mitigation measures that will be undertaken during the operational phase in order to reduce impact magnitudes, or reduce the potential for creating the impact, include the following:

- Implementation of management plans compiled prior to construction including but not limited to:
  - All long-term monitoring identified in the BMP and specific management plans; and
  - Implementation of an infield OHTL monitoring programme to assess effectiveness of bird impact mitigation measures.
- Ongoing awareness training for staff on biodiversity related issues;
- Implementation of a start-up routine for flares that includes checking for the presence or proximity of birds; and
- If possible, seek to exert influence over on the relevant Kenyan electricity company to implement an OHTL mitigation and monitoring programme for none- infield areas.

7.7.11 Summary of Residual Impacts

The significance of impacts was assessed before and after implementation of mitigation measures. In most cases the significance of impacts was reduced to minor or negligible with the implementation of mitigation.

In some cases, the significance of residual impacts remains moderate. This is because even with mitigation there remains a risk that must be monitored under the BMP and species-specific management plans. This is especially relevant for impacts associated with groundwater abstraction from the Kalabata riverbed during construction on the Turkana toad, *Omophron* beetle and vultures.

Special attention is required to ensure the following mitigation is put in place and a species-specific management plan includes monitoring. The following should be undertaken:

- Compilation of Turkana toad, *Omophron* and vulture management plans prior to commencement of construction;
- Continued water levels and tree stress monitoring with the results compared against the defined trigger and control levels and actions taken if these are exceeded; and
- Appointment of specialists to encourage the OHTL contractor (the relevant Kenyan electricity company) to assess optimal Turkwel OHTL route with the objective of minimising potential collision risks based on topography and identification of areas of high use.
- Commitment by Tullow to influence the OHTL contractor regarding the inclusion of bird-friendly measures into OHTL design including:
  - Measures to deter perching and nesting;
  - Insulated components;
  - Configurations with fewer layers of vertical cables and without an earth-wire; and
  - Installing line markers to reduce collisions.

The residual impacts relating to leopards, striped hyaena and elephants during construction remain moderate despite mitigation. Special attention is required to ensure the following mitigation is put in place and a species-specific management plans includes monitoring. Mitigation measures include:

- Completion of an elephant management plan prior to construction. The plan will detail procedures to be implemented should elephants be encountered during the construction phase;
- Critical habitat for elephant should be demarcated on construction plans and on the ground as environmentally significant areas;
- Impacts on demarcated environmentally significant areas should be avoided;
- Areas beyond construction footprint should be demarcated as *No-Go* areas;
- Staff should be educated on company policies and procedures related to elephants;
- The BCoW to establish communication channels with KWS staff and to provide intelligence-led information to notify NGOs and KWS of any perceived poaching threats or activities; and
- Influx Management Plan to include particular actions around access to Malmalte.

7.8 Ecosystem Services

7.8.1 Introduction

The Project aims to ensure that adverse environmental impacts on ecosystem services as a result of the Project's construction, operation, and decommissioning are avoided, or minimised, thereby sustaining the supply of priority ecosystem services to beneficiaries and maintaining Project operational performance. This can be achieved via the preservation and maintenance of the condition of the ecosystems that supply priority ecosystem services, throughout all phases of the Project, as well as limiting the potential for an increase in demand for Type I priority services as a result of the Project.

7.8.2 Area of Influence

The ecosystem services AoI is defined at two scales, the area within which impacts on ecosystems supplying ecosystem services could occur (the Biophysical AoI) and the area within which demand for ecosystem services by beneficiaries was characterised (the Social AoI) (see Section 3).

7.8.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.8-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.8-1: Criteria for Determining Importance of Receptors

Category	Importance of the receptor
Very high	■ Ecosystem service is irreplaceable, beneficiaries are unlikely to be able to adapt to loss in the ecosystem service benefit. ■ The ecosystem service is critical to the livelihoods, health, safety and/or culture of the beneficiaries.
High	■ Ecosystem service is not readily substitutable, there is a low or limited likelihood beneficiaries can adapt to loss in the ecosystem service benefit. ■ The ecosystem service is important to the livelihoods, health, safety and/or culture of the beneficiaries.
Medium	■ Ecosystem service is substitutable or replaceable, there is a low dependency on it by beneficiaries and a moderate likelihood that affected beneficiaries can adapt to loss in the ecosystem service benefit. ■ The ecosystem service plays a role in the livelihoods, health, safety and culture of the beneficiaries.
Low	■ Ecosystem service is readily substitutable or replaceable at a local scale. There is a high likelihood that beneficiaries can adapt to loss in the ecosystem service benefit.

7.8.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.8-2.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 66 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 66 months and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project, which in the case of this assessment applies largely as effects on ecosystems supplying services as a result of population influx.

Table 7.8-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Complete loss of a priority ecosystem service, loss of quality and integrity of the priority ecosystem service, severe damage to key characteristics, features or elements. Where the impact affects the ecosystems in such a way that the system's capacity to supply priority services is substantially affected to the extent that they will permanently cease to be supplied. Complete replacement and/or substitution of services is required. The demand for ecosystem services is noticeably elevated from baseline.	Large scale or major improvement to ecosystem service quality and supply, extensive restoration or enhancement.
Medium	Partial loss of a priority ecosystem service, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements of the service. Where the impact affects the ecosystems in such a way that the system's capacity to supply priority services is moderately affected, such that the supply base of priority services is affected, or supply may temporarily cease. Replacement and/or substitution of services may be required. The demand for ecosystem services is elevated from baseline.	Some benefit to key characteristics, features or parameters describing ecosystem service quality and supply.

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
Low	Some measurable change in/damage to attributes, quality or vulnerability of the priority ecosystem service. Minor loss of, or alteration to, key characteristics, features or elements. Where the impact affects the ecosystems in such a way that the system's capacity to supply priority services (i.e. the supply base) is slightly affected. The demand for ecosystem services is slightly elevated from baseline.	A minor increase in supply of services due to the project's activities.
Negligible	No significant predicted change from baseline. Supply of priority ecosystem services will not be significantly affected. Demand for priority ecosystem services will not increase	

7.8.5 Key Guidance and Standards

The guidance provided in the below-listed documents was followed in conducting the impact assessment for ecosystem services. These documents represent international best practices and standards in ecosystem services review and impact assessment:

- Landsberg *et al.* (2013): Weaving ecosystem services into impact assessment. World Resources Institute;
- IPIECA (2016). Biodiversity and ecosystem services fundamentals. Guidance document for the oil and gas industry. prepared by the BES Fundamentals Task Force, under the auspices of the IPIECA-IOGP Biodiversity and Ecosystem Services Working Group, with assistance from Edward Pollard and The Biodiversity Consultancy;
- IPIECA (2011): Ecosystem services guidance – Biodiversity and ecosystem services guide and checklists. The International Petroleum Industry Environmental Conservation Association; and
- Secretariat of the Convention on Biological Diversity and the United Nations Environment Programme-World Conservation Monitoring Centre (2012). Best policy guidance for the integration of biodiversity and ecosystem services in standards. Montreal, Technical Series No. 73, 52 pages.

7.8.6 Receptors of Interest and Importance

The categories of importance of Type I priority ecosystem services receptors are presented in Table 7.8-3. Type II priority ecosystem services are typically not considered separately in the impact assessment, as they relate to Project *dependence* as opposed to Project *impact* (Type I); however, since all of the Type II priority ecosystem services overlap with Type I services (Fresh water, spiritual services (sacred trees) and educational and inspirational values), Project impacts on these are considered.

Table 7.8-3: Receptors and Importance

Receptor	Importance	Comment
Cultivated foods	Medium	The Turkana have a strong tradition of sorghum gardens (*amana*, pl. *ngamanat*), which are planted during the rains and, if harvested, help supplement the pastoral diet and may provide an important livelihood sources for those who farm it.

Receptor	Importance	Comment
Grazing/browsing for livestock	High	The Turkana practise transhumance, a type of pastoralism or nomadism in which livestock are moved seasonally between fixed summer and winter pastures (Barrow, 1988). This way of life is almost entirely based on the availability of grazing/browsing resources for livestock.
Wild foods	Medium	Wild foods, particularly those obtained from various food plants, form an important dietary supplement for Turkana people, with over 53 species of plant actively harvested and processed. To a lesser extent, animal-derived wild foods including dik-dik meat and honey are obtained and used opportunistically.
Medicinal plants	High	Although dependence on medicinal plants has not been quantified in the ESIA or the social baseline, it is believed to be high, with most stakeholders interviewed making mention of the use of an array of species for various purposes; however, no specific areas or habitat types were identified as being of particular importance for the supply of medicinal plants during focus group meetings conducted as part of the ecosystem service prioritisation process.
Biomass fuel	Medium	Research in the Turkana region has shown that, typically, once all of the dead firewood within walking/carrying distance of permanent settlements has been collected, people tend to revert to harvesting live trees within walking/carrying distance of their homesteads, resulting in a radius of deforestation extending around permanent settlements (Amyunzu, 1991; Olang, 1982; Reid & Ellis, 1995.).
Biological raw materials: Wood and fibre	Medium	Various plant species are utilised in the construction of traditional homes, shelters and fencing. Wood from a range of tree species is used in the production of traditional carved sticks with curved heads, and *ekicholong* (Turkana seat/head rest), utensils, baskets.
Freshwater	High	Freshwater is obtained from the environment via rainfall, wells and from rivers such as the Turkwel and Malmalte; as well as at points throughout the AoI provided by TKBV via tanked water supply.
Regulation of water flows	Medium	The AoI spans the Turkwel, Kalabata, Kerio, Turkwel Dam Basin and Malmalte River catchments. These hydrological systems regulate water run-off, influence groundwater recharge, and maintain the water storage potential of the landscape.
Cultural sites (Sacred trees)	Very High	Cultural sites include the sacred trees (particularly *Maytenus* sp.) beneath which the men of the community and elders gather to discuss community issues, politics, marriages, community affairs. Such trees are vital to the Turkana way of life and play a pivotal role in cultural practices; as such they are considered irreplaceable.
Educational and inspirational values	High	The contribution of the landscape to the local people's sense of place; *ere* system of grazing/habitation rights; initiation sites; passing down of traditional knowledge.

7.8.7 Sources of Impacts

The Project has the potential to cause impacts on priority ecosystem services[18] during all of its phases, through changes in the physical landscape and socio-economic context. The Project Description (Section 6.0) has been reviewed, and key activities and sources of impacts relevant to priority ecosystem services are presented below.

The ecosystem services impact assessment has drawn on residual impact analysis results from other Project disciplines to ensure an aligned approach and avoid 'double-counting'. Where relevant, mitigation proposed elsewhere has been considered and built upon as deemed necessary. The following Project disciplines are relevant inputs to Ecosystem Services:

- Air Quality (Section 7.1);
- Noise and Vibration (Section 7.2);
- Water Quantity (Section 7.3);
- Water Quality (Section 7.4);
- Soils, Terrain, Geology and Seismicity (Section 7.5);
- Landscape and Visual (Section 7.6);
- Biodiversity (Section 7.7);
- Social (Section 7.9); and
- Cultural Heritage (Section 7.10).

Project impacts to ecosystem services are generally tied to land cover types and associated loss to the Project footprint (especially provisioning and regulating ecosystem services), or the presence of the Project in the landscape (cultural ecosystem services), which will be in effect for the lifetime of the Project. However, where potential impacts on ecosystem services are considered specific to a particular Project phase (for example, regulation of air quality is more likely to be affected during the operational phase of the Project), this is stated at the outset.

7.8.7.1 Construction Phase

Based on the Project Description and the understanding of the baseline ecosystem services conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to ecosystem services during the construction phase. The potential sources of impact, and routes by which they could impact ecosystem services are as follows:

- Changes in land cover and associated reductions in the supply of ecosystem services (particularly the potential removal of sacred trees) due to the construction of the make-up water pipeline from Turkwel Dam to the CFA, Project roads connecting the CFA, well-pads, satellite camps and Kapese Camp; creation of new well-pads, and the expansion of existing well-pads and facilities.
- Deposition of dust on vegetation communities supplying wild foods and medicinal plants, generated by increased traffic and Project activities.

[18] Priority Services include (1) ecosystem services upon which the local beneficiaries depend for their livelihoods, health, safety, and/or culture, and for which project activities may affect supply; and (2) ecosystem services that the project is directly dependent upon for operations, and as such could prevent the project from achieving planned operational performance (Landsberg *et al.,* 2013).

- Changes in surface water runoff and flooding regimes due to ongoing, non-rehabilitated construction works within floodplains, luggas or river channels, affecting ecosystems' capacity to regulate water flow and control erosion.
- Population influx as people seek jobs during construction of the Project, and to provide commercial services to the increasing population in the vicinity of the Project, and the concurrent increase in demand for ecosystem services; this is likely to impact the quantity and quality of ecosystem service supply to existing beneficiaries; and
- The introduction and spread of invasive plants, pests and diseases.

7.8.7.2 Operational Phase

Based on the project description and the understanding of the baseline ecosystem services conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to ecosystem services during the operational phase. The potential sources of impact and routes by which they could impact ecosystem services are as follows:

- The physical presence of the Project will lead to permanent loss of land, change the land surface and landscape and will potentially interact with priority provisioning and cultural ecosystem services - these are 'direct impacts', which are likely to affect both beneficiaries within or adjacent to the Project footprint and beneficiaries from further afield who may travel to gather natural resources (e.g. wild foods, wood for fuel or construction) or avail of cultural heritage ecosystem services intrinsically linked with the landscape (e.g. *ere*).
- Influx of people near the water off-take points is likely to impact the quantity and quality of provisioning ecosystem service supply to existing beneficiaries.

7.8.7.3 Climate Change

Climate change is likely to introduce considerable uncertainty in agricultural practices. The beneficiaries of ecosystem services identified in this study are the most vulnerable to the impacts of current and predicted climate variability. The potential primary route by which climate change could impact ecosystems and their services is the loss of livelihood and food sources (livestock) for Turkana pastoralists due to drought (as already seen during the severe drought experienced between 2016-2017).

7.8.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide measures to avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed.

The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.8.8.1 Design Measures

The following measures are part of the Project design and reduce the potential impact of the Project on ecosystem services:

- Speed limits will be maintained and enforced – this will reduce noise and minimise disturbance to beneficiaries whose cultural identity and sense-of-place is linked to the largely undisturbed landscape setting, and minimise dust deposition on possible sources of medicinal and food plants adjacent to the internal road network;
- Produced water will be stored in purpose-built facilities within the well-pad areas, where it will evaporate; the facilities are designed not to overflow and result in contaminated water entering the environment – this

negates the need for discharge of any treated water to the environment, and potential changes in the quality of the freshwater supply;

- Internal road and well-pad drainage will be designed to maintain flows in luggas in line with the natural regime;
- There will be no discharge of hydrotest water – this will reduce the potential to change flow regimes, increase erosion, and change flood risk downstream;
- All temporary land take associated with the construction of the Project facilities and roads will be rehabilitated and returned to communities following construction; and
- All abstractions from, or discharges to either groundwater or surface water will be within the volumes permitted under licence from NEMA.

7.8.8.2 Good International Industry Practice

Project activities will consider the measures defined below, to reduce the potential for creating the impact.

This impact assessment and the mitigation proposed is in accordance with IFC PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012) (including accompanying guidance - Guidance Note 6 (IFC GN6, 2019)).

- A permitted water supply will be available onsite for dust/particulate matter suppression/mitigation, using non-potable water, where possible and deemed appropriate;
- Where practical directional lighting of site, and no lighting on access roads - this will minimise light pollution and the visual amenity of the landscape for beneficiaries whose cultural identity and sense-of-place is linked to the largely undisturbed setting; and
- Education of staff about company environmental policies and procedures including ongoing training and auditing of effectiveness.

7.8.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were captured during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- Suggestions that Biodiversity and Ecosystem services should consider issues relating to salt licks, resins and gum trees.
- Comment on indigenous trees have great benefit on Turkana culture and are used for medicine and food. Additionally, they offer support to animals and the people.
- Concerns on gum and resins in Northern Kenya and loss of trees along pipeline corridor.

7.8.10 Impact Classification

As *Supporting* ecosystem services have no specific/direct beneficiaries, and impacts to these are captured within the *Provisioning, Regulating* and *Cultural* categories for this Project, they were not included in the prioritisation exercise and therefore are not included in the impact assessment.

Taking into account the baseline ecosystem services setting (Section 7.10), the relevant incorporated environmental measures (Section 7.8.8), and the potential sources of impact (Section 0) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised.

7.8.10.1 Construction

The construction phase impact assessment with respect to ecosystem services is presented in Table 7.8-4. Construction phase impacts on ecosystem services have been classified as the direct impacts on the supply of ecosystem services by particular ecosystems/habitats, due to loss in extent of those habitats to land-take for the Project, and the increased demand for ecosystem services that is expected to occur in tandem with population influx – although it is recognised that most of these impacts will extend throughout the operational life of the Project, until such a time as site rehabilitation and re-vegetation is well-established.

Provisioning Services (Food)

Direct impacts on food provisioning within the Project AoI will extend from construction and throughout the operation phase, due to the loss of land cover to the Project footprint, and the increased demand for wild food supply and grazing/browsing resources that is expected to occur as a result of population influx. The impacts of direct loss of land use due to water pipeline construction will be limited to the construction phase, because the water pipeline will be buried, and the RoW will be rehabilitated to its former land use following completion of the construction phase.

Cultivated Foods

Construction of the make-up water pipeline from the Turkwel Dam will result in a temporary loss of sorghum cultivation areas (*amana*, pl. *ngamanat*) in the vicinity of the Turkwel River at various locations along the water pipeline route. Some beehives could be directly affected, or, more likely, some flowering plant communities that bees forage in could be impacted. Prior to construction, a survey should be completed to identify cultivation areas that could be directly impacted. Following construction, the water pipeline route will be restored to its previous land use; however, within the permanent 6 m permanent RoW, some limitations on sorghum cultivation could remain. Project impacts on cultivated foods are expected to be of low magnitude and in the context of the medium receptor sensitivity, residual impacts on cultivated foods is predicted to be of **Minor** Significance. A concerted effort will be made to ensure that the water pipeline avoids beekeeping enterprises entirely, and immediate restoration of crop cultivation areas once the water pipeline is constructed, as well as consideration under the LRP for farmers/bee keepers whose harvest may be temporarily affected, would reduce the magnitude of the impact to negligible, resulting in a residual impact of **Negligible** significance.

Grazing/Browsing Resources for Livestock

Potential impacts on this ecosystem service are related to the loss of available grazing and browsing resources for livestock, as well as population influx to the AoI and increased demand for livestock grazing resources. Areas that are currently used for grazing/browsing resources for livestock will be reduced in extent as a result of land-take for the Project footprint in the AoI. Increased demand for ecosystem services could occur in areas where influx may focus, such as at water off-take points on the water pipeline, as well as radiating outward from the locations of tanked water supply points in the AoI. This will result in habitat degradation and exacerbate pressure on the supply of this ecosystem service, particularly during times of drought. The magnitude of the impact is considered medium, since the loss of land cover/ecosystems supplying grazing/browsing resources will be long-term as it will extend from construction into operations, affecting the supply base of this priority ecosystem service (but not resulting in a cessation of supply). Since the importance of the ecosystem service is high, an adverse impact of **Moderate** significance is predicted prior to mitigation.

The implementation of the recommended mitigation measures, including community development plans, influx management planning, sustainable farming education to address overstocking, physical access restrictions around tanked water supply points, and appropriate livelihood restoration, (see Section 7.8.11), will reduce the predicted impact magnitude to low; resulting in a residual impact of **Minor** significance.

Wild Foods

Exclusion of people from the fenced well-pads, CFA and CPF during construction and operation will reduce the extent of the area in which wild foods, such as fruits and honey, are supplied in the AoI. Although the extent of this effect will be minor in the context of the available alternative resources throughout the AoI, the demand for wild foods will shift to alternative supply areas, whose capacity to handle increased demand has not been quantified (neither has the current demand been quantified). This could therefore likely affect the condition of the ecosystems and their capacity to supply ecosystem services.

The construction of the water pipeline will cause a reduction in the amount of vegetation supplying wild foods (trees with extensive root systems will be removed). Increased numbers of livestock and people as a result of influx during Project construction and operation – particularly near water offtake points - could stimulate increased demand for wild foods in this area and subsequently may affect the quality and quantity of wild food sources available in the AoI and its vicinity.

The magnitude of the impact is considered medium, since the loss of land cover/ecosystems supplying wild foods will be long term, affecting the supply base of this priority ecosystem service (but not resulting in a cessation of supply). Since the importance of the ecosystem service is medium, an impact of **Minor** significance is predicted prior to mitigation.

The magnitude of the impact may be reduced to low with the implementation of recommended mitigation measures such as sustainable farming training programmes, surveys of baseline wild food use to set triggers in social management planning to addressed increased demand, and programmes to develop alternative food sources, resulting in a **Negligible** residual impact.

Medicinal Plants

Exclusion of people from the fenced well-pads, CFA and CPF during construction and operation will limit their ability to gather medicinal plants in the AoI, whilst construction of the make-up water pipeline will cause a short-term reduction in extent of vegetation communities that may support plants that are used medicinally. Although the impact is associated with the construction phase, it will last for the operational lifetime of the Project (with the exception of the water pipeline, for which the impact is restricted to the construction phase). Improved access to new resource areas via the permanent 6 m RoW associated with the water pipeline route and in-field roads could stimulate increased demand for medicinal plants in this area, which could affect the quantity and quality of the vegetation communities supplying the resources.

The magnitude of construction-phase impacts on this ecosystem service will be low in the context of the available alternative resources throughout the AoI and beyond; although the capacity of other ecosystems to sustainably supply this ecosystem service in the face of increased demand has not been established, it is unlikely that the shift would push the supply of this ecosystem service, or the ecosystems supplying it across a sustainability threshold. In addition, the demand for this service is not expected to be significantly elevated from baseline – based on the assumption that the requirement for medicinal plants is less frequent than that of say fuel wood, or wild foods. Impacts predicted prior to mitigation are assessed to be **Minor** significance.

Mitigation measures including further studies to understand the extent of use and reliance on medicinal plants and the inclusion of measures around medicinal plant use in the LRP as necessary are proposed, however it is unlikely that this will affect the impact magnitude; the residual impact will remain of **Minor** significance.

Biomass Fuel

The reduction in the extent of ecosystems supplying tree species that provide wood for fuel and charcoal production as a result of Project construction is considered an adverse, medium-term, low magnitude impact. Although in the context of the wide extent of the ecosystems supplying those services in the AoI the impact may appear to be of low magnitude, research in the Turkana region suggests that once dead wood within walking/carrying distance of settlements has been used, trees within walking/carrying distance of homesteads are harvested for wood (Amyunzu, 1991; Oland, 1982; Reid & Ellis, 1995.). Influx of opportunity seekers may result in increased demand for firewood and charcoal**,** with subsequent effects on the quality and quantity of vegetation communities supplying that resource. This negative feedback loop further reduces the ecosystems ability to supply this ecosystem service sustainably – an impact of medium magnitude. The receptor importance is medium, therefore impacts of **Minor** significance are predicted prior to the implementation of mitigation measures.

Surveys of biomass fuel use to ascertain baseline usage and enable the definition of triggers in social management plans for identifying where degradation of supplying ecosystems occurs and enforcement of a ban on purchasing locally-produced charcoal for sale outside camps for Project personnel, will reduce the magnitude of the impact to low, resulting in a residual impact of **Negligible** significance.

Wood and Fibre for Construction and Crafts

The reduction in the extent of ecosystems supplying tree species that provide wood for construction of traditional homes and craft/utensil production as a result of Project construction, together with increased demand for those species as a result of population influx, and concomitant degradation of ecosystems supplying services due to increased livestock numbers, is considered an adverse, medium-term impact. The magnitude of the impact is considered low in the context of the wide extent of the ecosystems supplying those services in the AoI and their easy accessibility for beneficiaries (AoI, pastoralists). Although the impact is associated with the construction phase, it will last for the operational lifetime of the Project.

Although the extent of the reduction of supplying ecosystems will be low in the context of the available alternative resources throughout the AoI, the demand for wood will shift to alternative supply areas; resulting in a slightly elevated demand for that ES compared to baseline. The construction-phase impact on this ecosystem service is therefore considered low magnitude, with an overall impact of **Negligible** significance.

Freshwater Supply

Ten existing boreholes in south Lokichar will be used to supply the Project, prior to commissioning of the make-up water pipeline. The proposed Project water use will be within the limits already permitted for the existing facilities. Groundwater in the area is typically encountered at depths between 5 m and 40 m below ground level, from gravels beneath the surface sands (Section 7.5). Local beneficiaries (pastoralists and AoI beneficiaries) traditionally source water from relatively shallow hand-dug wells in surface sands in luggas (and are supplemented with tanked water derived from the Project water use).

The magnitude of the potential construction-phase impact on freshwater supply to the above-mentioned local beneficiaries will be high, and complete replacement and/or substitution of potable freshwater obtained from groundwater resources (e.g. via wells) may be required for at least the duration of construction (short-term). The ecosystem service is of high importance, so the impact prior to mitigation is one of **Major** significance.

Mitigation measures, including the communication of existing alternative supplies (e.g. bowser fed water points and reticulated wells) and communication of changes to supply sources to local water users and ensuring that the groundwater abstraction rate does not draw down the available groundwater resource for community boreholes (Section 7.3), reduce the impact magnitude to low, and the resultant residual impact is of **Minor** significance.

Cultural Sites

Sacred sites, such as sacred trees, and other forms of intangible cultural heritage within the AoI, such as the knowledge associated with traditional home construction and wooden utensil carving, and sourcing medicinal and food plants, are intrinsically linked with natural ecosystems. Direct losses of sacred trees arising from Project land take, and changes in the ecological integrity of ecosystems that supply the service (e.g. as a result of wood harvest for charcoal production) are likely to affect the ability of local communities to benefit from this ecosystem service.

During Project construction, no loss of sacred trees will occur as micro-alignment of the route within the RoW will be used to avoid direct impacts; however, one sacred tree (CH-046 near Twiga) is located in close proximity to the RoW and its cultural significance could be disturbed as a result of visual impacts and construction dust. The impact will occur on a local scale and will be short-term. The impact magnitude is considered low as the construction-phase disturbance of the sacred tree may temporarily restrict social functioning at a local scale and present a reputational risk to the Project and to TKBV. The sensitivity of this receptor is very high because sacred trees consist of particular individuals of certain species that are used for particular occasions over generations and are thus irreplaceable. Therefore, the impact significance is considered **Moderate**, prior to mitigation.

Consultation with the local community (Lomokomar) will be undertaken to identify if there are any reasonable mitigation measures that could be implemented to reduce the impact of visual changes during construction. It is proposed that the EPC contractor will work with TKBV to develop and implement a communication plan involving relevant traditional leaders and local administrative leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure. A residual **Moderate** impact significance is predicted.

Spiritual values

Loss in extent of all natural habitats providing this ecosystem service arising from Project land take and changes in the landscape setting (visual and noise impacts) of ecosystems that supply the service (e.g. as a result of mechanical noise during construction activity) are likely to affect the ability of local communities to benefit from this ecosystem service. The sensitivity of the receptor is high as it is irreplaceable and the impact magnitude, should it occur, is also considered medium at the ecosystem service. The impact significance is thus considered **Moderate**.

The changed landscape setting will remain the case for the duration of the Project, resulting in a residual impact of **Moderate** significance extending throughout the operation phase as well as during construction.

Table 7.8-4: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Cultivated foods (Medium)	Changes in land cover and associated reduction in supply due to the construction of the water pipeline	Direct/short term/low	Minor	Avoid beekeeping enterprises and farms where possible. Pre-construction survey to identify any cultivation areas likely to be impacted. Rehabilitation of any affected cultivation areas immediately post-construction. Should cultivation areas be identified, PAPs affected to be included in LRP.	Direct, short term, negligible	Negligible
Grazing/browsing for livestock (High)	Changes in land cover and associated reduction in supply due to the construction of the water pipeline, infield roads new wellpads, and the expansion of existing facilities, increased demand due to population influx and reduction in capacity to supply.	Direct/long term/medium	Moderate	PAPs to be identified by survey undertaken by TKBV at cut-off date and included in the LRP. Share the Influx Management Plan with Turkana and West Pokot County governments. Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are directly impacted. Review economic and social importance of livestock to pastoralist livelihoods, sustainable farming education, physical access restrictions around tanked water supply points, and appropriate livelihood restoration for inclusion of appropriate management strategies in the LRP as necessary.	Direct/long term/low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Wild foods (Medium)	Reduced wild food plant availability due to reductions in woodland/ bush land cover that supports food plant/ animal species, increased demand due to population influx and reduction in capacity to supply. Reduced vegetation cover may limit wild bee's ability to produce honey.	Direct/ permanent/ medium	Minor	TKBV will agree an Influx Management Plan with Turkana and West Pokot County governments. TKBV to conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are impacted. TKBV to undertake studies to understand baseline wild food use, and inclusion of measures to address any effects on wild food use/supply in LRP as necessary.	Direct/short term/low	Negligible
Medicinal plants (High)	Reduced availability of traditional medicines due to reduction in woodland/ bush vegetation cover that supports plant species used for traditional medicine, increased demand due to population influx and reduction in capacity to supply	Direct/ permanent/ low	Minor	TKBV will agree an Influx Management Plan with Turkana and West Pokot County governments. Surveys by TKBV to increase understanding of use and reliance on medicinal plant use, and inclusion of measures to address any effects on medicinal plant use in LRP as necessary.	Direct/ permanent/ low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Freshwater (High)	Availability and quality of fresh water for drinking may be compromised by abstraction from groundwater, reliance on TKBV for supply to water points	Direct/short term/high	Major	Communication of existing alternative supplies (e.g. bowser fed water points and reticulated wells) and communication of changes to supply sources to local water users.	Direct/short term/low	Minor
Cultural sites (Very High)	The loss or disturbance of sacred sites could occur, particularly along the route water pipeline.	Direct/ permanent/ high	Major	Subject to survey work identified under Cultural heritage commitments, Contractor will avoid removing any sacred trees. Disseminate Cultural Heritage Management Plan (CHMP) amongst contractors and staff. The EPC contractor will work with TKBV to produce and implement a communication plan involving relevant traditional leaders and local administrative leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure. Establish a forum for recording grievances to identify and manage any issues beneficiaries may have.	Direct/long term/low	Moderate
Spiritual values (High)	Construction-phase changes in the visual, noise aesthetics of the landscape.	Direct/short term/medium	Moderate	Cannot fully mitigate until closure and rehabilitation of Project site are completed following decommissioning. The EPC contractor will work with TKBV to produce and implement a communication plan involving relevant traditional leaders and local administrative leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure. Establish a forum for recording	Direct/medium term/medium	Moderate

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				grievances to identify and manage any issues beneficiaries may have.		

7.8.10.2 Operational Phase

The operational phase impact assessment with respect to ecosystem services is presented in Table 7.8-5. Operational impacts on ecosystem services are limited to increased numbers of people and livestock in the vicinity of offtake points on the water pipeline and the presence of the Project in the landscape, although it is recognised that the impact of population influx assessed under the construction phase may extend to some degree throughout the operational lifetime of the Project.

Influx of People and Livestock to Water Off-Take Points Along Water Pipeline

The water offtake points that will be located along the make-up water pipeline route are expected to attract increased numbers of people and livestock to those locations, for the purposes of obtaining freely available water in the otherwise arid landscape.

Significantly increased demand for provisioning ecosystem services, particularly grazing/browsing resources for livestock, is likely to occur at the water off-take points on the water pipeline. This will result in a zone of habitat degradation (due to overgrazing) radiating outward from the off-take points, particularly during times of drought. The magnitude of the impact is considered to be medium because the loss of land cover/ecosystems supplying grazing/browsing resources will be long-term (extending throughout operations). This will affect the supply base of this priority ecosystem service, resulting in a cessation of supply of grazing/browsing resources in affected areas. As the receptor importance is high, the overall impact is of **Moderate** significance in affected areas. Whilst it is recognised that the water off-take points will be controlled and managed by the County Governments, TKBV can contribute to the mitigation of the impacts through working with the county governments to encourage sustainable use of water points and to discourage overgrazing and record issues as part of the grievance mechanism. If successful, the impact magnitude could be reduced to low and the residual impact significance reduced to **Minor**.

In addition, habitat degradation due to over grazing around the water off-take points will also affect the capacity of those habitats/ecosystems to supply other provisioning ecosystem services including wild foods, medicinal plants, biomass fuel, and wood for construction/crafts. The magnitude of the impact is expected to be medium for wild foods, and low for medicinal plants, biomass fuel, and wood for construction/crafts; however due to variable levels of receptor importance of these ecosystem services, only impacts of **Minor** significance are predicted for these priority ES prior to mitigation, and no additional mitigation actions are considered necessary.

Presence of the Project in the Landscape

Spiritual Values (Sacred Trees)

Visual impacts on the setting of a sacred tree (CH-046) from the long-term presence of the OHTL (Section 7.10.12) are predicted and will last for the duration of the Project. The impact is of low magnitude, resulting in an overall impact of **Moderate** significance. Various mitigation measures proposed in the landscape and visual assessment will assist in visually mitigating the impact of the Project's physical presence in the landscape, however full mitigation of the impact will only be possible when the facility is decommissioned and dismantled, and the resultant footprint areas rehabilitated.

Educational and Inspirational Values

The view of the landscape and its contribution to resident's sense of place may become diminished by the presence of the Project. The effect will extend to beneficiaries throughout the Project viewshed (Section 7.6).

The impact is of medium magnitude, resulting in an overall impact of **Moderate** significance. Various mitigation measures proposed in the landscape and visual assessment will assist in visually mitigating the impact of the Project's physical presence in the landscape, however full mitigation of the impact on beneficiaries' sense of place and belonging and heritage will only be possible when the facility is decommissioned and dismantled and the resultant footprint areas rehabilitated.

Table 7.8-5: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Grazing/browsing for livestock (High)	Influx of people and livestock to water off-take points	Direct/long term/ medium	Moderate	TKBV to work with County Governments to encourage sustainable use of water points to discourage overgrazing, and record issues as part of the grievance mechanism.	Direct/long term/medium	Moderate
Wild foods (Medium)	Influx of people and livestock to water off-take points	Direct/long term/ medium	Minor		Direct/long term/low	Minor
Medicinal plants (High)	Influx of people and livestock to water off-take points	Direct/long term/ low	Minor		Direct/long term/low	Minor
Biomass fuel (Medium)	Influx of people and livestock to water off-take points	Direct/long term/ low	Minor		Direct/long term/low	Minor
Wood and fibre (Medium)	Influx of people and livestock to water off-take points	Direct/long term/ low	Minor		Direct/long term/low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Spiritual values (Very high)	Presence of Project in landscape	Direct/long term/ low	Moderate	Establish a forum for recording grievances to identify and manage any issues beneficiaries may have. Full mitigation only possible when facility is decommissioned and rehabilitated.	Direct/long term/low	Moderate
Educational and inspirational values (High)	Presence of Project in landscape	Direct/long term/ medium	Moderate	Establish a forum for recording grievances to identify and manage any issues beneficiaries may have. Full mitigation only possible when facility is decommissioned and rehabilitated.	Direct/long term/medium	Moderate

7.8.10.3 Decommissioning

A Decommissioning Plan will be developed five years prior to the planned ‘End of Project’, this plan will be communicated with relevant authorities by that time.

It is assumed that Project facilities will be returned to their original (baseline) condition during the decommissioning phase.

The predicted Project impacts on ecosystem services arise from land take by the Project footprint, influx and presence of the Project in the landscape. Therefore, at this stage, no potential decommissioning phase impacts or mitigations for priority ecosystem services are anticipated.

7.8.11 Summary of Mitigation

The following section describes, at a high level, the mitigation measures that will be required for ecosystem services for which moderate and major impacts are predicted. The measures include those reiterated from the other specialist studies included in this ESIA that are specific to potential impacts on the supply of ecosystem services, as well as additional, ecosystem service-specific mitigation measures based on the guidance provided by IPIECA/OGP for oil and gas project impacts and dependencies (IPIECA, 2011). These mitigation measures follow the mitigation hierarchy (BBOP 2012) and will be detailed in the management plans, to ensure that the beneficiaries that are most reliant on priority ecosystem services within the Project AoI are suitably accommodated.

IFC PS 6 requires clients to “*maintain the benefits from ecosystem services*” when designing and implementing projects, as well as to “*implement mitigation measures that aim to maintain the value and functionality of priority services”*. The overall goal is to mitigate project impacts on priority ecosystem services so that the benefits people derive from these services are maintained when the project is developed, operated and then decommissioned. Similarly, for services used and depended on by a project, the goal is to ensure that there will be a sustainable supply throughout the project’s planned operational life and thereafter.

Recently published GIIP guidance (IPIECA, 2016) recommends the adoption of six Biodiversity and Ecosystem Services (BES) management practices to address impacts, dependencies, risks and opportunities on ecosystem services (and biodiversity) in the oil and gas sector:

1) Build BES into governance and business processes.

2) Engage stakeholders and understand their expectations around BES.

3) Understand BES baselines.

4) Assess BES dependencies and potential impacts.

5) Mitigate and manage BES impacts and identify BES opportunities.

6) Select, measure and report BES performance indicators

As a current corporate member of IPIECA, TKBV is committed to achieving GIIP, and as such fulfils the requirements of practices 1 and 6 through submission of annual sustainable development reports to the association. The ESIA process that is the subject of this report employs the other four management practises in its execution, the fifth of which is discussed in this section.

Mitigation measures provided include those from specialist studies that are specific to potential impacts on the supply of ecosystem services, and additional mitigation measures focussed on livelihood replacement and economic displacement, based on the commitments provided within the social impact assessment (Section 7.9) are also included. Further input from people/authorities providing potential sources of interventions (e.g. Ministry of Pastoralism), as well as additional studies to investigate supports for people whose (natural resource-based) livelihoods have been affected by influx will be necessary.

7.8.11.1 Avoidance

Avoidance measures include:

- Reuse existing or remnant road networks, where possible, should new access roads be required, in order to avoid impacts on ecosystem services arising from loss in extent of habitats supplying those services.
- In cases where the Project or third-party contractors associated to the Project may significantly impact on cultural heritage features (such as sacred trees) that are essential to the identity and/or cultural, ceremonial, or spiritual aspects of beneficiaries' lives, priority should be given to the avoidance of such impacts. TKBV are also committed to taking all possible measures to influence all third-party contractors working in the AoI to ensure the avoidance of impacts on such cultural heritage features.

7.8.11.2 Minimisation

Provisioning Services

- An influx management plan will be agreed and created with authorities in Turkana and West Pokot Counties, to address appropriate measures to mitigate the expected Project-associated in-migration effects on provisioning services.
- Degradation of vegetation communities suppling provisioning services in close proximity to off-take points on the make-up water pipeline must be managed as part of the agreed influx management plan. Whilst it is recognised that the water off-take points will be controlled and managed by the County Governments, TKBV can contribute to the mitigation of the impacts through working with County Governments to encourage sustainable use of water points to discourage overgrazing and record issues as part of the grievance mechanism, or situating off-take points in areas delineated as least-important in terms of ecosystem service supply.
- Economic displacement (e.g. loss of grazing/browsing resources) experienced by affected pastoralists will be addressed via the development of the LRP.
- TKBV commit to undertaking specialist assessments of the economic and social importance of livestock to pastoralist livelihoods as part of the LRP process, to formulate strategies to address the risks created by excessive grazing/browsing and subsequent effects on livelihoods, social status and degradation of vegetation communities.
- TKBV commit to surveys of medicinal plant use, wild food use and biomass fuel use (wood and charcoal), to ascertain the baseline usage as part of the LRP and set up triggers in the social management plans for identifying where Project-induced degradation occurs and whether further actions are required should the supply of this ecosystem service be significantly affected.
- Community development planning that will support beneficiaries in areas such as developing sustainable herding practises, crafts, ecotourism or other activities that provide alternative livelihoods and income.
- Enforcement of a ban on purchasing locally-produced charcoal for sale outside camps for Project personnel, to be implemented via inclusion in the employee/contractor Code of Ethical Conduct and site induction practices (Section 7.9).

Regulating Services

- Mitigation measures outlined in the water quantity and biodiversity assessments within this ESIA include the incorporation of engineered design features to ensure that water flows in impacted luggas are maintained. Mitigation measures should be applied as recommended.

Cultural Services

- The environmental setting for sacred sites close to construction/operation areas should be protected through demarcation of no-go areas for vehicles and Project personnel.
- A forum for recording grievances will be established to identify and manage any issues beneficiaries may have relating to sense of space, cultural identify and effects on sacred trees.
- A CHMP will be developed (see Section 8.10) which will include measures to minimise potential effects on sacred sites. The plan should be disseminated amongst Project personnel to engender respect for local cultural heritage and traditions.
- The EPC contractor will work with TKBV to produce and implement a communication plan involving relevant traditional leaders and local administrative leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure at the sacred tree CH-046 which may be disturbed by construction activity.
- Measures to reduce light pollution should be put in place to limit changes in people's sense of space arising from visibility of the Project at night.
- Cultural sensitivity training to be provided to Project staff and incorporated into the site induction process.

7.8.11.3 Reclamation

Long-term rehabilitation plans that include revegetation of disturbed habitat should be initiated for disturbed ground adjacent to Project roads and within the Project footprint, in an effort to restore any lost capacity to supply ecosystem services.

7.8.12 Summary of Residual Impacts

Two moderate residual impacts are predicted during construction, with all other residual impacts being minor or negligible. The residual impact on spiritual values (sacred trees) arises as a result of the disturbed setting of affected sacred trees, even if the construction activities avoid removing those trees, as recommended in the mitigation measures. Similarly, the residual impact on educational and inspirational values relates to construction phase changes in the visual, noise aesthetics of the landscape, and the inability to mitigate these impacts until the Project ceases operation and the site is rehabilitated.

Two residual moderate impacts are also predicted during the operational phase. This is a result of visual impacts on the setting of sacred trees (spiritual values) and the wider landscape (educational and inspirational values) from the long-term presence of the OHTL ultimately affecting beneficiaries' sense of place, heritage and cultural identity. As during construction, there is no additional feasible mitigation to reduce the impact magnitude until the Project ceases operation and the site is successfully rehabilitated.

7.9 Social

7.9.1 Introduction

Project impacts on PAP have been identified by social impact theme. Mitigation and management processes are set out, where necessary, to ensure that impacts are reduced as far as practicable.

7.9.2 Area of Influence

The Social AoI (Section 3.13) for the Project includes Turkana South Sub-county and three Locations of Turkana East Sub-county located in Turkana County and the areas of the Endugh, Kasei and Sekerr Wards, which are located in Pokot West, Pokot North and Pokot Central respectively, all located in West Pokot County.

For some social aspects, particularly related to community health and safety and social maladies, the influence of the Project extends to settlements along the transport corridor that will be used for the import of goods, but the AoI is focussed on the key geographical areas of Project development.

7.9.3 Receptor Importance

For social impacts, PAP are the main receptor. These include individuals and households occupying traditional mobile settlements or permanent settlements, including non-organised groups or the vulnerable. Such groups might include the elderly and people with disabilities. These groups are discussed in the narrative associated to each impact and mitigation/management in some cases is focussed on these specific groups thereby considering their varying sensitivity to impacts. Unlike environmental receptors, social receptors will not additionally be classified by importance as this is considered equal for all receptors.

Occupational health of TKBV and Contractor employees is not assessed specifically in this ESIA, although some of the impacts assessed do have a wide-ranging context and, in particular in the Community Health and Safety section (7.9.11.6), some commitments for occupational health provision are mentioned in the context of wider impacts.

7.9.4 Significance of Impact

As explained in Section 3.8, the evaluation of social impacts will differ from the evaluation of environmental impacts. The significance of a social impact will be assessed against the four criteria presented in Table 7.9-1 below.

Table 7.9-1: Impact Assessment Criteria for Social Themes

Direction	Consequence	Geographic Extent	Duration
Positive direction Impact provides a net benefit to the affected person(s) **Negative direction** Impact results in a net loss to the affected persons(s) **Mixed direction** Mixed directions or no net benefit or loss to the affected person(s)	**Negligible consequence** No noticeable change anticipated **Low consequence** Predicted to be different from baseline conditions, but not to change quality of life of the affected person(s) **Moderate consequence** Predicted to change the	**Household** Quantifiable household or households **Local** Administrative unit or units within the AoI **Regional** AoI in Turkana and West Pokot Counties **National** Kenya **International**	**Short-term** Effect is reversible at end of groundworks/ installation **Medium-term** Effect is reversible at end of operations **Long-term** Effect is reversible within a defined length of time or beyond decommissioning

Direction	Consequence	Geographic Extent	Duration
	quality of life of the affected person(s) **High consequence** Predicted to seriously change quality of life.	Beyond Kenya	**Permanent** Effect not reversible

For impact topics in Section 7.9.11.6 on Community Health and Safety, an additional criterion will be included. All impacts in this section will be assessed on Likelihood:

- Unlikely: likelihood is slight;
- Possible: likelihood is possible, i.e. less than 50% during the evaluated activity/period;
- Probable: likelihood is probable, i.e. more than 50% during the evaluated activity/period; and
- Definite: likelihood is certain.

Every social impact topic will be assessed to generate a significance rating of Negligible, Minor, Moderate or Major.

7.9.5 Key Guidance and Standards

The Kenyan policy and legislation documents presented in Section 2.2 and the International guidance and standards presented in Section 2.3 are relevant to this assessment. The following are of particular relevance:

- The Constitution of Kenya (2010); applicable as it encompasses the rights of the Kenyan people which could be incumbered upon based on the Project impacts. This overarching legislation provides a foundation to measure against potential social impacts;
- The National Environment Policy (2013): aims to provide a better quality of life for present and future generations through the sustainable management and use of the environment and natural resources;
- The NEAP, (1994 revised in 2009): provides a framework for the implementation of the Environment Policy and realisation of the National Millennium Sustainable Goals and Vision 2030;
- Strategic Environmental and Social Assessment of the Petroleum Sector in Kenya (2017): presents an opportunity for the country to systematically address environmental and socio-economic management issues pertaining to oil and gas activities in the context of sustainable development;
- The National Land Policy: aims to guide the country towards efficient, sustainable and equitable use of land for prosperity and provides legal, administrative, institutional and technological framework for optimal utilisation and productivity of land related resources in a sustainable and desirable manner at national, county and community levels. It addresses critical issues of land administration, access to land, land use planning, restitution of historical injustices, environmental degradation, conflicts, unplanned proliferation of informal urban settlements, outdated legal framework, institutional framework and information management;
- Kenya Vision 2030 (2010): a national long-term development blue-print to create a globally competitive and prosperous nation with a high quality of life by 2030. It aims to transform Kenya into a newly industrialising, middle to high-income country and to provide a high quality of life to all its citizens by 2030 in a clean and secure environment;

- HIV/AIDs Control and Prevention Act, (2006): provides measures for the prevention, management and control of HIV and AIDS, and for the protection and promotion of public health and for the appropriate treatment, counselling, support and care of persons infected or at risk of HIV and AIDS infection, and for connected purposes. The act requires for HIV and AIDS education in the workplace for employees of private and informal sector;
- Labour Relations Act, (2007): consolidates the laws relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratisation of trade unions and employers organisations and to promote sound labour relations through the protection and promotion of freedom of association;
- WBG EHS (2007) Environmental, health, and safety general guidelines; and
- IFC (2012) – PS for Environmental and Social Sustainability and accompanying Guidance Notes.

7.9.6 Sources of Impacts

Potential sources of impact with a range of consequences which will occur throughout the life of the Project are set out below:

- The Project will consist of a multi-billion dollar investment, which will influence a range of socio-economic impacts through government payments, taxes and profit sharing.
- The Project requires land for infrastructure. The key considerations related to the sources of impacts for the Project are land acquisition and changes to land use.

  The Project requires access to approximately 1,087 ha of land to develop the facilities required to construct and operate the Project. While the Project requires a defined footprint of approximately 1,087 ha, the MoPM has gazetted polygon areas measuring approximately 6,500 ha. The polygons will be classified as land for dual use, i.e. Project and community, but it is only the specific land requirements (defined footprint area) which are to be restricted for Project only use and thereby leased by TKBV.
- Employment and procurement during construction and operation phases. It is estimated that the construction workforce could range between 2,700 and 3,400. The final manpower requirements will be determined during detailed design and construction tendering prior to FID. Employment opportunities associated with the Project will consist of varying skill requirements, and will offer positions for unskilled, semi-skilled and skilled workers.

  Additional accommodation to house an increased workforce. The workforce will include continuation and expansion of existing security personnel.

  During the construction phase, additional temporary accommodation camps (e.g. Kapese camp, water pipeline construction camp, rig camp and drilling mini-camp) will be required. The main camps will be located at the CFA with satellite camps on the wellpads, at Kapese camp and for the water pipeline in the Turkwel area. These constitute a total of approximately 3,500 beds for the construction phase and approximately 500 beds will remain in the main permanent camp for the operational phase. For the operational phase, it is proposed that the CFA will act as the operations hub for the development. It is anticipated that most personnel will be housed in the main permanent camp.
- The transport of materials during construction and operation to the Project infrastructure areas will be undertaken by trucks along set access road routes. The movement of vehicles, especially in areas of relative insecurity, will require additional security measures from the Project. Security will also be continued and expanded to man guarded stations at wellpads and other Project infrastructure.

Sources of impacts relating to environmental determinants of health are identified under the specific environmental technical areas in Section 7.0. Residual impacts from those technical assessments are addressed in the Community Health and Safety impact analysis (Section 7.9.11.6).

7.9.7 Climate Change

The effect of climate change is experienced in Turkana and West Pokot Counties through the erratic rainfall patterns and longer extended drought periods, which are experienced more harshly in Turkana County. These worsening climatic conditions affect pastoral livelihood, which forms the predominant livelihood in both Turkana and West Pokot Counties. The search for adequate grazing land drives pastoralists long distances to seek resources for their livestock.

Climate related factors are part of the reason for violent clashes between pastoralists who compete over scarce grazing land and water resources. This is most prevalent along the border between Turkana and West Pokot Counties where theft of livestock is also common.

In an effort to mitigate against the effects of climate change, the County Governments are encouraging a diversification of livelihoods so that individuals are not at a loss of livelihood due to the effects of a lack of rainfall, reduction in available resources and increased conflict due to competition of these limited resources. Pastoralists are encouraged to diversify into agricultural livelihoods and to remain in permanent settlements where they have access to services like schools and healthcare.

7.9.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that avoid potential impacts or reduce their magnitude, prior to the impact analysis being completed. The measures presented in this section either relate to design measures or are widely accepted GIIP.

7.9.8.1 Design Measures

Incorporated environmental design measures pertaining to social includes:

- Where possible, the Project makes use of land that has previously been developed, thereby reducing the amount of land where direct impacts to land use and cultural heritage assets can occur.

7.9.8.2 Good International Industry Practice

The impact analysis also incorporates the corporate policies and procedures as designed by the Project proponent. TKBV have designed and developed their own internal policies and procedures for their operations in Kenya.

In addition, apart from the IFC PSs, there are GIIP guidelines that have also been incorporated into this assessment. The following are relevant when assessing social, including health impacts:

- IFC (2007e) – Stakeholder Engagement: A Good Practice Guide for Companies Doing Business in Emerging Markets;
- IFC (2009) – Good Practice Note: Addressing Grievances from Project-Affected Communities: Guidance for Projects and Companies on Designing Grievance Mechanisms;
- WBG and EBRD (2009) – Workers' Accommodation: Processes and Standards;
- IFC (2014a) – Environmental and Social Management System (ESMS) Implementation Handbook;
- WBG (2017) – Good Practice Note: Managing Contractors' Environmental and Social Performance;
- Voluntary Principles on Security and Human Rights (VPSHR) (2000); and

- EU Accounting Directive (2013/34/EU).

7.9.9 Considerations from Stakeholder Engagement

The following list of issues were captured during the scoping consultation meetings and socio-economic research and should only be used as a reference on this specific subsection (a relevant list of issues will be provided following the Project ESIA consultations):

- Information requested on employment opportunities;
- Concerns of potential influx (notably saturation of public services);
- Concerns regarding the potential rise of STIs;
- Benefits from social investment made by the Project proponent;
- Multiple interventions to request information on employment opportunities (skilled and unskilled positions);
- Impacts on livelihoods during Project construction; and
- Measures to protect conservancies.

7.9.10 Impact Classification

Taking into account the baseline social setting (Section 6.12), the relevant incorporated measures (Section 7.9.8), and the potential sources of impact (Section 7.9.6) determined from the Project description, the potential impact linkages are presented in this section.

Given the nature of social impacts some are experienced with greater intensity during construction than the operations phase. Key differences between the construction and operations phase of the Project that will result in differences in social impacts include the following:

- The operational phase workforce is significantly less than the construction phase workforce;
- Workforce interaction with communities will reduce once construction is complete;
- There will be less procurement and less employment opportunities during operations phase than during construction;
- Once constructed, certain infrastructure (e.g. water pipeline and flowlines) will have less impact on land use; and
- There will be less truck movement during operations.

Monitoring will be undertaken throughout the Project life to support the implementation of management and mitigation measures, to monitor their success and adapt such measures according to the findings of monitoring. This includes reviewing proposed operational mitigation measures at the end of construction.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below, which are organised around social impact themes. Each theme initially identifies social impact topics that will be assessed and assigned a predicted significance rating. The impacts and associated mitigation commitments are then summarised in two impact assessment tables Table 7.9-5 for construction and Table 7.9-6 for operations.

7.9.11 Social Impact Themes

Impacts on PAP have been identified by social impact theme, each of which describe one or more impact "topics". The theme discussions in the following sections concentrate on impacts during construction, with the proposed construction mitigation measures presented within Table 7.9-5. Operations phase impacts are disaggregated in the narrative and proposed operations mitigation measures presented in Table 7.9-6.

Mitigation and management measures will be refined throughout the Project based on monitoring outcomes. Operations phase social management and mitigation measures will be informed by the construction monitoring outcomes, although, it is unlikely that additional mitigation, not initiated during construction, will be required during operations.

One critical mitigation commitment applicable to all impact topics is TKBV's continued stakeholder engagement work, as set out in the Project SEP presented in Annex II. This cross-cutting plan sets the Projects commitments as it relates to information disclosure and consultation. It also sets out a set of engagement methods and events that are intended to maximise participation and to be appropriate for a given stakeholder group's needs and preferences.

Stakeholder engagement serves as a tool to identify unforeseen impacts as soon as possible. The SEP highlights past engagement efforts prior to the beginning of the Project, the approach to stakeholder identification, the future engagement programme and the roles and responsibilities for implementing the SEP.

The final section of the SEP is a detailed description of the grievance mechanism, a multi-tiered system for reviewing and resolving registered grievances. Implementation of the SEP and effective response to grievances is essential in managing all impact categories described below.

7.9.11.1 Administrative Divisions and Governance Structure

No impact topics have been identified in relation to administrative divisions and governance structure. Therefore, impact analysis or consideration of impacts is not considered any further in this assessment.

7.9.11.2 Demographics

One impact topic has been identified in relation to demographics: Project-induced influx and in-migration. Population change, whether increasing or decreasing, can have both positive and negative outcomes. New in-migrants can increase economic opportunities and expand the demand for goods and services. But unplanned and uncontrolled influx can overwhelm existing infrastructure and generate a series of indirect impacts. For the purpose of impact analysis, the direction of this impact is negative.

The terms influx and in-migration can be used interchangeably. The impact topic addresses the potential impacts of *Project-induced* influx and in-migration. This is distinct from other forms of migration that may take place from non-Project related dynamics.

Project-induced Influx and In-migration

Local population changes are complex and are difficult to measure in the AoI. Traditional movement of people, as it relates to pastoralism in Turkana and West Pokot Counties, makes it difficult to count the total population. Pastoralists move in search of favourable conditions during dry and rainy seasons and this periodic movement can be influenced by a volatile security situation linked to banditry or cattle raiding.

While reliable baseline data was difficult to find, the recently released 2019 census data indicates a general trend of population moving into urban settlements. Turkana Central, Turkana East and Turkana South are the fastest growing Sub-counties in Turkana. Turkana East is growing at the fastest rate, increasing its population by over 50% in the last 10 years. This is in stark contrast to other areas of the County that have seen their populations decrease in the same period.

The key urban settlements in the AoI are the Sub-county centres of Lokichar in Turkana South and Lokori in Turkana East. Key informants generally describe a population that is increasing, but many noted that there has been a slow down or even a reversal, of influx after TKBV scaled back operations in 2017. This suggests that this type of migration is closely linked to Project economic activity.

Project-induced influx is a cross-cutting topic that affects and can be affected by numerous social and environmental aspects of the Project. What may seem like standard administrative tasks, such as employee recruitment or where to accommodate workers, can have important effects on influx.

Key sources of impact on influx and in-migration are economic opportunities. Such opportunities include those derived from the direct workforce, which is expected to peak between 2,700 and 3,400 during the construction phase. This workforce will be recruited and managed by contractors, but initial estimates are that Unskilled, Semi-skilled and Skilled requirements will be 15%, 25% and 60% respectively. Economic opportunities are also created from a multiplier effect in which increased salaried employment generates more wealth and demand for goods and services. This demand encourages new opportunities. Such opportunities observed in baseline research include the demand for accommodation, entertainment and food. The increase in required workforce and potential local procurement opportunities during construction has the potential to increase influx and in-migration. The reduction of the workforce and local procurement opportunities during operations should reduce migration of this type.

Growing economic opportunities are generally considered a positive outcome, however, influx of people seeking economic opportunities can create problems if not monitored and considered with a given location's ability to absorb the newcomers. These negative impacts can be felt by a location's infrastructure, including schools, hospitals and other public services. Beyond just the size and capacity of infrastructure, health can be affected by changes in the increased prevalence of diseases like TB and STIs (Section 7.9.11.6), and social maladies, such as commercial sex work and crime (Section 7.9.11.5). Outsiders can also influence community cohesion in instances where jealousy over jobs creates resentment and possibly conflict.

Outsider influence can also have indirect impacts on intangible cultural heritage (Section 7.10), particularly in areas where communities following traditional practices are increasingly pressed into contact with outsiders who may have different cultural norms.

Rural areas can experience a strain on natural resources such as water supply, pastureland plants, and animals used by local people to maintain their livelihoods. In the AoI, this can impact on charcoal production or the collection of medicinal plants (Section 7.8).

Not all factors that drive influx are within the control of TKBV and its contractors, but the main elements that are governed by TKBV and need to be considered are worker recruitment, worker accommodation, the associated management of how workers (direct employees and contractors) interact with local populations, procurement of goods and services locally and social investment activities and projects. TKBV considerations must include:

- Worker recruitment, if not specific, can create incentives for people to move, especially in places such as Turkana and West Pokot where there is relatively limited salaried employment compared to other parts of the country.
- Procurement of local goods and services can also create incentives for people to move to certain places especially in the Project AoI given the very limited economic opportunities.
- Social investment activities and projects also create the potential for economic opportunities and access to services such as water. TKBV have maintained an active effort to identify and support social investment projects in its area of operation since 2011. At least 87 projects have been initiated with many completed and handed over to the Government or partners to manage. The primary areas for these projects are in

the fields of education, health and water. In the past, projects have been closely linked with agreements for land access, but many are simply a part of discretionary social investment. Like direct employment or other economic opportunities linked to a diversifying and expanding local economy, TKBV projects have and will continue to provide incentives for influx. The demand for services, particularly the provision of water, can be a strong motivating factor, especially in times of drought where livestock and people themselves are at risk. In this context, there is a risk that the Project can have an indirect and negative impact even when the initial objective was to assist a local population.

- In the Project AoI, the Sub-county centres of Lokichar and Lokori both report a general trend of rural-to-urban migration. This is linked to a concentration of economic opportunities in these centres. Both are likely to be settlements that will experience influx. Other settlements, particularly those closest to existing wellpads, such as Nakukulas in the Kochodin Location, are likely destinations as well, especially as this rural settlement has seen the most social investment. Overall, the Kochodin Location in Turkana East Sub-county and the Lokichar Location in Turkana South are the most probable areas that may be affected. Other major settlements along transport corridors may see increased Project activity, but this will not be of the same intensity as the aforementioned locations, which will host construction and operations accommodation.
- Other temporary accommodation camps, such as the Rig Camp for the CFA and Drilling mini-camps will be temporary in nature, creating only short-term business opportunities and therefore limited incentives for people to move into these rural areas.

Project-induced influx and in-migration is assessed to be negative direction, as the benefits linked to a growing population are out-weighed by the negative risks associated with uncontrolled influx.

During construction the consequence is high and the geographic extent of the change can be expected to be local, affecting PAP hotspots close to the Project infrastructure, including areas of construction. The duration of the construction impact is short-term. The impact significance for construction prior to mitigation is **Major (negative)**.

During operations the economic opportunities will reduce compared to the construction phase, the consequence therefore is predicted to be moderate and the geographic extent of the change can be expected to be local, affecting PAP hotspots close to the operations Project infrastructure with construction areas significantly reduced. The duration for the operational impact is medium-term. The impact significance for operations prior to mitigation is **Moderate (negative)**. Mitigation for Project-induced influx during both construction and operations must be organised in four key areas: monitoring, reducing incentives for uncontrolled migration, managing worker integration with local communities, and engagement. Additional work will be required, but eventually, an Influx Management Plan will be developed and shared with authorities in Turkana and West Pokot Counties at construction, and then maintained throughout operations. Such a Plan requires greater understanding from, and cooperation with, government officials. Any effort to monitor population movement will require consistent cooperation between TKBV and local authorities. This Plan should be directly linked to the overarching ESMP. In the Plan, TKBV will set out clear roles and responsibilities, especially as influx management is linked to disparate functions across the company and to contractors outside the company.

TKBV will conduct meetings with government officials to verify existing information and to confirm the most effective indicators to monitor population growth. While 2019 data provides some indication of demographic trends, baseline efforts have been unsuccessful in identifying demographic data other than the census taken every 10 years. While numerous key informant interviews found that Location Chiefs regularly record population estimates and a list of administrative units within their jurisdiction, there is no clear and consistent method for monitoring population spikes. Similarly, there is no existing reporting format through which Location Chiefs or any other officials pass information to centralised authorities.

Once identified, TKBV will make sure that monitoring indicators are collected at both hotspots, like the Lokichar and Kochodin Locations that are to host the majority of the permanent infrastructure, and also key areas that are relatively less likely to see regular Project activities. The exact number of monitoring locations will be determined in consultation with key stakeholders and stated in the Influx Management Plan. Engagement activities and meetings with key stakeholders will continue throughout operations for a variety of reasons as contained in the SEP. However, the frequency of meetings, engagement and monitoring activities relating to population growth may reduce following construction.

Implementation of the Influx Management Plan during construction should result in a reduction of the risk of influx and its consequences during operations. This could lead to influx management measures being less resource intensive during the operations phase. Monitoring will inform the ongoing management and mitigation programme for Project-induced influx and it will be adapted accordingly, the monitoring during construction will inform the operations phase management and mitigation programme. TKBV will make efforts to reduce the incentives for influx through its recruitment procedures. Key principles are to avoid confusion around the hiring practice and being clear on what job and local content opportunities are available, making sure this matches with external expectations.

Key existing documents guiding this process are the Employee Standard (2018), Recruitment Procedure (2018), Human Resources(HR) Contractor Standard (draft) and Contractor Local Recruitment Guidelines (2013). The Recruitment Procedure outlines the framework for hiring of all employees, as well as roles and responsibilities in that process. The Contractor Local Recruitment Guidelines outlines a similar framework to be applied by all contractors.

Prior to construction, TKBV will revise these key human resource and recruitment documents to ensure they fulfil the following key principles:

- Restricting informal hiring, often referred to as *"at the gate"* hiring;
- Establishing clear procedures for hiring unskilled and low skilled workers, those more likely to travel to the Project location in search of employment;
- Establishing explicit definitions for "*local*" or *"local-local*" hiring criteria; and
- Revising all recruitment procedures in line with external engagement practice outlined in the SEP.

These key principles help to mitigate the impact of rumours. Unclear procedure and definitions can cause job-seekers to move or re-establish themselves in areas where they think that might increase their chances of securing employment. The communication of each principle will extend beyond the closest Locations in Turkana and West Pokot Counties.

There are two key areas TKBV will emphasise to manage worker interaction with local residents. First, all employees will adhere to the existing TKBV Code of Ethical Conduct (the Code). This document sets the expectation for all who work for TKBV and their contractors. It places the responsibility of knowing about all policies, standards and procedures on employees, as well as contractors and temporary workers. Key elements of the standard are outlined as follows:

- Safe and sustainable operations;
- Our people;
- Personal and business integrity;
- Business partners;

- Host communities and stakeholders;
- Protection of financial and non-financial assets; and
- Safeguarding information.

While the Code covers a wide range of topics, it also applies to the way in which workers or contractors may interact with host communities.

The Code is available online and includes objectives on monitoring and reporting, which is managed by the Head of Ethics and Compliance. The Code also includes a confidential system, Safe Call, which allows any employee or contractor to anonymously report any violations of the Code using free telephone numbers or over the Internet.

It is acknowledged that there will be fewer workers during operations and the majority of the operational workforce will be under the direct contract/employment of TKBV. The recruitment principles above and the Code will apply throughout the construction and operational phases as well as decommissioning. Project-interventions during operations for the management of worker interaction with local residents are therefore anticipated to reduce given the operations workforce is approximately a sixth of the construction workforce. Management during operations of the workforce interaction with local residents will be informed by the monitoring undertaken during the construction phase. Both TKBV and their contractor's practices will be monitored with respect to this issue and where required, corrective action will be taken.

The second key means of managing worker interaction is linked to the management of all worker accommodation. All camps related to the Project will be "*closed camps*", limiting access to non-workers. This will apply to temporary camps needed for construction activities.

TKBV will ensure that all local labour needs and recruitment (including by contractors) will be disclosed through Community Resource Centres. TKBV and their contractors commit to making sure all government and community leadership understand that there will be no hiring from any of the Project facilities. TKBV will conduct a stakeholder engagement campaign, which will be designed to explain the employment and local content opportunities, as well as the procedures that people must follow to get employment.

TKBV will also establish a working group specifically focused on managing the aspect of Project-induced influx. This working group will be led by TKBV and include representatives of National and County government and civil society. Specific terms of reference for the working group will be set up prior to Project construction and will be reviewed at the commencement of operations.

Impacts related to Project induced influx and in-migration will be more significant during construction than in operations. Therefore, no additional mitigation is predicted to be required for the operations phase. Influx management measures should be less resource intensive during the operations phase. Residual impacts should be comparatively less during operations to those experienced during construction, but these will be experienced over a longer term. By implementing the mitigation commitments, Project-induced influx and in-migration is expected to be reduced to **Minor (negative)** during both construction and operations given that the consequence of uncontrolled influx should be reduced.

7.9.11.3 Infrastructure and Services

There are current limitations to infrastructure and services in both Turkana and West Pokot Counties. In general, by nature of its location, climate and relatively neglected history since independence, the infrastructure and services are poor.

The general lack of municipal waste facilities and management in both counties results in people illegally dumping waste. Increased pressure on existing poor waste and sanitation infrastructure due to in-migration is an indirect impact. However, the Project has a waste management strategy including relevant infrastructure to address the management of Project waste streams so no impact on municipal waste facilities and management is anticipated and this aspect is not assessed further in this impact assessment.

Education and health facilities are also limited, especially for those living as pastoralists. Health facilities are improving in Turkana especially in main settlements as a result of NGO activities and TKBV contributions and education facilities are improving in West Pokot due to funding by Faith Based Organisations (FBOs), and NGOs.

It is a challenge to introduce new infrastructure and facilities in areas affected by a lack of security. The challenge of conflicts arising from competing for resources like water can affect new infrastructure development and lead to underutilisation of infrastructure in these areas.

Access to water is generally inadequate in Turkana County due to the climate, lack of adequate water sources, and little utility infrastructure other than some NGO, TKBV and Government installed water supply wells. In West Pokot County, a majority of the population use rivers/streams as a water source and can travel significant distance to access these sources. The Turkwel Reservoir is a major water resource in the area and is used mainly for hydro-electric power through KenGen. Communities utilise the water downstream from the dam for domestic use, watering livestock and some other agricultural purposes.

The Project proposes utilising water from Turkwel Reservoir to meet the Project water demands. This is a potential impact to the Turkwel water resource, which already has existing water demands. Availability of water is currently a contentious issue in Turkana and West Pokot Counties. Contention indirectly leads to conflict and competition for water resources. Analysis of this impact is presented in Section 7.3.

The Project will be responsible only for the Interconnecting Network of roads. National roads, specifically the C46 and A1 will be unaffected by the Project other than the transport of construction materials along communal roads causing wear and tear on existing road conditions as well as potential road accidents arising from increased vehicular movement. These are potential negative impacts during the construction and operational phases of the Project, although the expected vehicular movements during operations will be less than during construction.

Direct impacts to existing infrastructure are anticipated to be through the expansion of the Project infrastructure and footprint area. However, no existing social infrastructure is predicted to be impacted during the land acquisition process. If it is necessary to move schools, clinics, water infrastructure or roads, this will be addressed in the LRP.

Indirect impacts linked to influx of people into the area can create pressure on existing infrastructure. These potential impacts are discussed in Section 7.9.11.2 of this report.

The impact on existing infrastructure in the AoI has a positive direction due to positive economic benefits of access to infrastructure. The consequence is moderate and the geographic extent of the change can be expected to be local to the AoI, affecting PAP in Turkana and West Pokot Counties. The duration of the construction impact is short-term and the operational impact medium-term. The impact significance prior to mitigation or benefit enhancement for both construction and operations is **Minor (positive).**

There are no identified direct impacts linked to existing services, therefore this aspect is not assessed further in this impact assessment.

Measures to enhance benefits of the Project include the development of Community Development Plans (CDPs), initially planned to be one per County, which will be the primary mechanism for improving infrastructure. The CDPs will provide a framework under which the Project impacts and benefits will be addressed. The CDP process will also provide a vehicle for community consultation and involvement in the management of the overall Project impacts and benefits.

Each CDP will incorporate agreements related to water access, impact management, benefits related to local content and shared infrastructure commitments, such as water and power. The specific content for each CDP will be negotiated based on the impacts and agreements will be based on priorities in the area and agreed with the communities.

The CDPs will be based on the following principles:

- Stakeholders self-determine their own development through a community-led consultative and transparent process;
- Management through a credible and representative forum using existing structures as much as possible; and
- Catchment areas (which will be defined in the CDPs) will benefit more, but benefits will also be provided to the Project AoI.

The CDPs will be managed through an engagement process. Initial plans include working with leadership at the County and Sub-county level. A County Steering Group will be a multi-stakeholder forum and will include representatives of government departments, private sector, NGOs and religious institutions, as well as other community representatives. A Sub-County Steering Group will replicate the County Steering Group at a Sub-county level.

Direct engagement through the multi-stakeholder forum will be used to draft County-specific CDPs. The process of reaching agreement on CDPs is expected to be iterative and will be documented. An initial Memorandum of Understanding is proposed, as this sets up the good faith basis of the relationship including roles and responsibilities and CDP elements to be agreed. The process will aim for a broad-based agreement with communities.

The CDPs will be used by TBKV to work with stakeholders to identify key performance indicators that help to monitor performance. These indicators will be part of on-going reporting.

The element of the CDP most related to infrastructure is the sustainable community water solutions programme. Within this programme TKBV will promote the development of sustainable community water solutions within the Project AoI, specifically focussing on the replacement of existing bowser-filled TKBV supplied water points. Such sustainable community potable water solutions will comprise both groundwater sources (existing boreholes or to be developed) and the development of closed reticulated systems connecting proximate communities that have accessed the roadside community water points. TKBV will connect community water points in the Kochodin Location. The source of water will be the Nakukulas 10 borehole, which has already been converted to a solar powered system and is being managed by the Kochodin Water Resources Users Association (KWRUA) and technical support through the Turkana County Government water services department. This system is now operated by KWRUA.

TKBV will also improve water infrastructure along the water pipeline. TKBV will make provisions for community offtake points allowing County water services providers to access the non-potable water. These providers will be responsible for the treatment of water to ensure it meets drinking water standards, and the distribution to surrounding communities water points. CWRUA will be formed in collaboration with the County Government's Department of Water Services, and WRA. The CWRUA's will be responsible for the management and operations of the supply schemes. TKBV, in coordination with Turkana County Government and CWRUA will encourage sustainable use of water points to discourage overgrazing, and record issues as part of the grievance mechanism.

Given the above considerations related to benefit enhancement, transparent communication and assuming the CDP is successfully implemented throughout the life of the project the residual impacts during both construction and operation are expected to be **Moderate (positive).**

7.9.11.4 Economics, Employment and Livelihoods

The following five impact topics have been identified in relation to economics, employment and livelihoods. Livelihoods is considered in this section in the context of salaried employment, whereas impacts on sectors of livelihoods such as pastoralism are considered in the Section 7.9.11.5 on land:

- Taxes and payments;
- Direct employment;
- Contractor (indirect) employment opportunities
- Business opportunities and local content; and
- Inflation.

Taxes and other payments

Taxes and other payments to National and County governments can be assumed to be a positive influence on the continuation of economic growth that Kenya has experienced since the early 2000s. Key areas that have driven growth include increased free primary education, improved health services and infrastructure developments, which should all be enhanced further by an increase in government revenue.

Kenya has achieved an average of 5.4% growth in GDP over the last five years, even if there are some signs of a slowdown linked to drought conditions on agriculture, decreased credit and political uncertainty. A stronger tax base serves to positively influence national economic indicators.

Kenya has shown improvement in its overall business environment, being listed as one of the top ten improved countries in the World Bank's annual report, *Doing Business*, partly due to improvements in its tax system in such a way to simplify and improve the process.

The key source of impact is the direct link between an overall multi-billion dollar investment and tax revenue. The impacts of taxes and other payments are predicted to be positive to net economic contribution, which should extend throughout the operations phase of the work.

Table 7.9-2 presents all payments made by TKBV in Kenya from 2014 to 2018. In Kenya, all payments are at the corporate level.

Table 7.9-2: Transparency Disclosure 2018: Kenya (all figures $000)

Year	Income taxes	Licence fees	Infrastructure Improvements	VAT	With-holding tax	PAYE & national insurance	Custom s duties	Training allowance	Total
2014	-	132	732	198	17,989	21,235	817	321	41,450
2015	9	486	-	157	9,003	21,634	993	958	33,240
2016	9	614	-	162	1,864	9,852	65	924	13,490
2017	1	451	195	156	1,911	14,392	407	765	18,278
2018	1	436	51	5	1,342	6,095	76	790	7,427

Source: TKBV Annual Report and Accounts 2014, 2015, 2016, 2017 and 2018.

Additional payments to be made from the Project are not available at this time. Revenue from the Project will be subject to the terms of the Petroleum Act, which came into effect in March 2019. The formula currently provides for profit derived from the upstream petroleum operations to be shared between the contractor and the National government. From the National government share, 20% shall be given to the County government and 5% to local community, which is defined as people living in a Sub-county within which a petroleum resource is situated and are affected by the exploitation of that petroleum resource. The local community's share will be payable to a trust fund managed by a board of trustees established by the respective County Government in consultation with the local community. The County Government will legislate on the establishment of a board of trustees, as well as on the utilisation of the fund "for the benefit of present and future generations".

While tax contributions are generally considered to be positive, their impact can have mixed results. Kenya is not a candidate country to the Extractive Industry Transparency Initiative (EITI) but has committed to implementing a progressive and transparent policy and legislative framework for all extractive activities, including transparency in licensing procedures, publication of contracts, labour requirements, environmental regulation and conservation requirements in line with international standards.

Taxes and other payments are assessed to have a mixed direction, though overall are expected to result in benefits of a positive direction. The consequence has the potential to be high, and the geographic extent of the change can be expected to be national, increasing tax revenue for National, County and smaller administrative units, although TKBV have no control over the continued distribution of tax benefits at a county and local level. The duration of the impact is short-term during construction and medium-term during operations. The impact significance prior to mitigation or benefit enhancement both during construction and operations is **Moderate (positive).**

TKBV has been an early adopter of the EU Accounting Directive (2013/34/EU), which came into force in 2014 in the UK as the Reports on Payments to Governments Regulations. This UK regulation requires UK companies in the extractive sector to publicly disclose payments made to governments in countries where they operate. These payments have been and will continue to be disclosed in Annual Reports.

Measures to enhance benefits of the Project include the creation of a board of trustees charged with overseeing government revenues, which will play an important role in the fair and equitable distribution of benefits related to the Project. TKBV will include the board of trustees in on-going meetings with government officials related to key social management plans, including the Influx Management Plan and CDPs, which form the core framework for community-wide impact mitigation and benefit enhancement.

Given the importance of transparency in tax payments, as well as the likely influence on other companies, the residual impact of these commitments is likely to increase benefits and reduce the risk that payments to all levels of government can be misused. The residual impact significance is **Moderate (positive)** for construction and **Major (positive)** for operations due to the difference in duration and the level of revenue during these different phases.

Direct Employment

Additional employment opportunities are expected to be indirect or contractor employment. There is no direct employment for TKBV and therefore no impacts related to direct employment and this aspect is not assessed further in this impact assessment.

Details of TKBV HR management is discussed in the following impact topic.

Contractor (Indirect) Employment Opportunities

Wage earners constitute only 6% of the population in Turkana County and 5% in West Pokot County. Both areas also have very high unemployment rates in great contrast to the rest of the country and reliable data is difficult given the large percentage of residents who are engaged in pastoralism, thereby working outside sectors that provide salaried employment.

Key issues for unemployment and low levels of salaried work are linked to inadequate skills/training for the local population, and also fewer employment opportunities.

TKBV have sought to maximise employment opportunities for Kenyans. Since 2013, they have maintained data on contract workers, including the number of expats, Kenyan nationals and Turkana workers given that the majority of the work to date has taken place in Turkana County. Analysis of that data indicates that there has been an average of 93% of the contractor workforce coming from Kenya and 61% coming from the host County of Turkana. At the peak of contractor employment in October 2014 when 3,842 people were employed, 90% of the contractor workforce was Kenyan and 62% from Turkana County.

Contractor employment in September 2019 was 814 with 98% from Kenya and 61% from Turkana. With the exception of two months in February and March of 2019, employment had not topped 1,000 workers since November 2017.

Available data does not disaggregate in such a way to show trends in gender, other demographic differences or skill level.

A key source of impact is the increase in direct contractor workforce, which is expected to peak at between 2,700 and 3,400 during the construction phase[19]. This workforce will be recruited and managed by a Contractor. It is estimated that Unskilled, Semi-skilled and Skilled requirements will be 15%, 25% and 60% respectively.

For the Project, workforce estimates are only preliminary. These figures are presented in a draft National Content Plan (2018) but are meant to be updated as part of an overarching Field Development Plan, which will contain a Local Content Plan expected prior to FID. The updated documents will incorporate upstream, midstream and well engineering work streams to be completed after the tendering process for contractors.

Employment and new jobs – direct and indirect through contractors – are generally considered a positive impact. However, the overall direction of new employment opportunities is mixed. Job creation, particularly in areas of limited opportunities for salaried employment, can exacerbate existing social divisions and, in some cases, generate local conflict if job seekers do not trust that recruitment and human resource policies are not transparent. This is true of all employment, but especially relevant if contractors have not been informed about core labour rights and best practices.

The impact of contractor employment has a mixed direction. The consequence is high and the geographic extent of the change can be expected to be national, going beyond the AoI. The duration of the impact is short-term during construction and medium-term during operations. The impact significance prior to mitigation or benefit enhancement for both phases is **Minor (positive).**

Measures to enhance benefits of the Project include management of the negative aspects of contractor employment, which is done through human resources management and procurement. TKBV are cognisant of the fact that a substantial number of skilled and semi-skilled workers will not be from the host Counties or Kenya.

[19] Worker estimates are based on two scenarios, one being a base case with a peak workforce of 3,400 and the second based on an assumption that some components of the CPF will be modularised and arrive in Kenya partially constructed, thereby reducing the number of workers needed in-country. Lower end estimated with modularisation are at 2,700.

TKBV will revise their National Content planning approach for increasing local opportunities by identifying what capabilities are available, where there are areas to develop or increase capabilities and where it is likely for the Project to go outside the local area and Kenya.

The draft National Content will be complemented with a Local Content planning approach, which will be developed into a Local Content Plan and a National Content Plan prior to FID. Prior to operations, the Local and National Content Plan will be updated to take relevant actions and commitments forward into the operational phase. The plans will include KPIs for monitoring changes in business opportunities and local content performance.

For the purpose of the National Content Plan, "*National Content*" refers to all of Kenya, whereas "*Local Content*" refers generally to the local area that will be subject to direct Project-related impacts[20]. TKBV will reconsider the administrative boundaries related to these definitions in the context of the Community Development Plans, described above and use that process to be more specific in the opportunity sharing formula.

Gender consideration is an important factor in increasing the positive benefits of contractor employment. TKBV will begin to track contractor employment by gender, allowing for better understanding of trends of directly employed workers. In the past, TKBV have partnered with the African Development Bank as part of their Growth Oriented Women Enterprise to train 60 women in business skills. Women have been encouraged and won tenders to provide goods to the Kapese Base camp. Future programmes will target women and TKBV will work closely with development partners to define specific programmes.

TKBV is committed to the development an HR Contractor Standard, prior to commencement of construction that will be used to manage contractor employment. Compliance with the Standard will be a contractual obligation for all contractors. It recognises that recruitment procedures vary due to the level of the role and location of the job, yet sets out a minimum set of points that all contractors must follow:

- Open advertising of all vacancies through Community Resource Centres, County Government offices and relevant Chief's offices;
- Transparent, objective and fair selection criteria and procedure;
- Thorough scrutiny of identification documents and certificates submitted;
- Adherence to the local content policy;
- Adherence to opportunity sharing agreements;
- Appropriately communicate to candidates at different levels of the exercise;
- Display names of candidates selected;
- Maintain documents for periodic audits;
- Adherence to the TKBV Code of Ethical Conduct; and
- Candidates submit Certificate of Good Conduct.

A key part of the TKBV Code of Ethical Conduct is the corporate commitment to equal opportunities. The Code states that TKBV aims *"to create an inclusive environment, free from discrimination, where individual differences and the contributions of all our staff are recognised and valued and everybody is treated fairly*". The document

[20] This will be defined in the CDPs and is likely to be generally the Social Area of Influence (i.e. Turkana South Sub-county, three Locations of Turkana East Sub-county of Turkana County and in West Pokot County, the areas of the Endugh, Kasei and Sekerr Wards, which are located in Pokot West, Pokot North and Pokot Central respectively).

emphasises that the company has "*zero tolerance*" for any form of discrimination and decisions related to recruitment selection, development or promotion are based upon aptitude and ability only.

TKBV's Contractor Procedures for Local Procurement explain that "*local communities are likely to agitate for open and transparent action when they feel the process of procuring local goods and services does not meet their expectations, which may result in work stoppages, blockades and verbal and/or physical threats of violence*".

To manage these risks, multiple policies are already in place. At the corporate level, the Policy Statement on Human Rights includes a commitment to respect fundamental labour rights and international labour standards, as set out in the Universal Declaration of Human Rights and the International Labour Organization's Declaration on Fundamental Principles and Rights at Work. This complements the core International Labour Organisation (ILO) Conventions that make up the basis of IFC PS2 (IFC, 2012e).

TKBV are committed to the continued implementation of the TKBV Contractor Non-technical Risk Management Policy which requires contractors to undertake all work in alignment with TKBV approach to management of Non-Technical Risks. Within the policy, all contractors must support TKBV's own efforts through the planning, resourcing, execution, monitoring and reporting of an agreed Non-Technical Risk (NTR) Management Plan. TKBV's own standard includes guidance on:

- Cultural Induction;
- Human Resource Guidelines for Contractors including employee grievance mechanism;
- Local Content Guidelines on Employment and Local Procurement;
- Community Grievance Management Procedure;
- Cultural Heritage including requirements for Chance Find Protocol; and
- Applicable guidelines as defined within the TKBV's ESMS.

The Contractor NTR Management procedure provides the basis for helping contractors to follow TKBV internal commitments. The rationale for the procedure is to ensure that TKBV Contractors are both aware of, understand and comply with NTR management requirements as defined by Kenyan law, TKBV Group and international standards. Specific definitions of responsibilities of TKBV, their contractors and supply chain will be developed to monitor the supply chain and how far down the supply chain TKBV policy, code of conduct and mitigation commitments will be applied. Contractor NTR performance is a key aspect of field level risk management and of TKBV reputation.

In relation to workforce management, contractors must comply (and TKBV are committed to ensuring commitment) with TKBV's Local Content Guidelines on Employment and Local Procurement in the recruitment of personnel and sub-contractors. Within these guidelines, contractors are provided with sample contracts that include critical elements relevant to IFC PS2 (IFC, 2012e), including:

- Contract period;
- Salary/payment;
- Benefits;
- Hours of Work;
- Overtime;
- Annual leave;

- Confidentiality; and
- Notice period.

The Contractor Procedure – Local Procurement and Local Recruitment require all contractors to provide a Local Procurement Plan prior to the time when goods and services are required. This plan is to be provided to TKBV and then shared with appropriate government authorities to assess the needs to consider sharing formulas with local communities.

As construction activities decline so will the need for local workforce therefore the procedures for Contractors will be required to include the notice process and the demobilisation process. TKBV will monitor these aspects carefully for Contractor practices.

To manage complaints, TKBV must ensure that contractors are committed to ensuring their workers use a grievance mechanism, which is to be copied by the contractor and provided to TKBV, or to utilise the TKBV Community Grievance Management Procedure operated by the SPT.

With the Human Resources commitments (by both TKBV and their contractors) and efforts to communicate transparently, the impact of contractor employment is assessed to be positive. The residual impact significance prior to further mitigation or enhancement is **Moderate (positive)** for both construction and operations.

Business Opportunities and Local Content

The AoI is predominantly a pastoralist zone with 80% of the population relying on livestock to provide the main source of food and cash income. Self-employment, which is the remaining 20% of business activity, is limited to charcoal, weaving and brewing. There is some crop farming near rivers that allow for some small-scale agriculture, primarily at the household level.

There is limited infrastructure and the National Content Plan has found that there are limited capacities in the engineering fields in Turkana County. Regional firms are limited to small scale civil works such as grading roads, building classrooms or other amenities. Reasons for the limitations cited in the National Content Plan are a lack of equipment, a lack of highly trained personnel, poor management systems, and low capital investment.

Similar to employment, the business opportunities created by the procurement of local content, goods and services are generally considered to be a positive social impact. However, a limited skills base and high standards for health and safety and quality assurance, limit the Project's overall ability to buy goods and services in the local and even regional economy. Also, in a similar way to contractor employment benefits, and business opportunities can have a negative impact without procedures for transparency. Even with such procedures, the high expectations among local residents create a dynamic where rumours about corruption can have detrimental effects.

There are no specific financial figures on the additional procurement related to the Project at this time. Capital expenditures were not completed at the ESIA stage but are expected in the National Content Plan when it is revised.

The impact of business opportunities has a mixed direction. The consequence is moderate and the geographic extent of the change can be expected to be national, going beyond the AoI. The duration of the impact is medium-term. The impact significance prior to mitigation or benefit enhancement is **Minor (positive)** during both construction and operations.

TKBV have developed principles for Shared Prosperity, which focus on

- Optimising local content and developing supplier capacity;
- Building local skills and developing people; and

- Focussed socio-economic investments that support local communities and economies.

These principles are complemented by a set of Local Content Principles:

- Local content creates a lasting legacy for Project Oil Kenya and includes employment creation, skills development, local contracting and knowledge transfer;
- Local content initiatives will be planned over the Project Life Cycle and will be geared towards delivering sustainable benefits;
- Successful Project delivery requires a balance between cost, schedule, quality and local content;
- Delivery of Local content is a shared responsibility by everyone in the business; and
- Our contractors and sub-contractors will share Project Oil Kenya's local content principles and will play a key role in delivering the Project's Local Content Plan.

As stated above, key mitigations and benefit enhancement documents for reducing negative impacts and maximising business opportunities are the National Content Plan, which will be complemented by an integrated Local Content Plan.

TKBV has established Enterprise Development Centres (EDC) set up in Lokori, Lokichar, Nakukulas and Lodwar. Through these EDC, micro, small and medium enterprises have been trained since 2017 with a total of 336 organisations receiving business skills in the process. TKBV will continue the activities of the EDC and establish, develop and approve a strategy for ongoing support to local enterprises. This strategy will be created with authorities in Turkana and West Pokot Counties and maintained through construction and operations.

It is currently envisioned in the National Content Plan that workshops and other community engagement will be organised to make sure interested companies understand procurement requirements and understand how to qualify for applicable scopes of work. The CDPs, as part of their benefit enhancement, will set commitments for local business capacity building, which can be developed during construction and maintained through operations to provide a sustainable foundation beyond the project.

The new strategy will work with stakeholders to identify key performance indicators that help to monitor changes in business opportunities and local content performance. These indicators will be part of ongoing reporting through construction and operations. Business opportunities are limited but will be managed transparently. Unanticipated issues related to local content will be captured by the existing grievance procedures.

Whilst the level of business opportunities may decrease in intensity during operations comparative to during construction, the operations phase is a much longer duration and therefore offers a longer period of potential benefits. Given the benefit enhancement commitments and efforts to communicate about business opportunities, the residual impact is **Moderate (positive)** during both construction and operations.

Inflation

Research suggests that the arrival of oil operations in Turkana has had both positive and negative impacts on the local economy. Overall, the economic activity is seen as positive, however numerous people noted that increased demand for products has triggered inflation. This has affected goods and services, as well as the price of land. In some cases, it is reported that there has been a tenfold increase in private land prices in more urban settlements since oil has been discovered. Inflation is not easily attributable to one factor. While it is likely linked to oil exploration and appraisal activities, key informants also suggest it is linked to climate factors and poor infrastructure that can hamper the food delivery and increase transportation costs.

Inflation is a negative impact that can often accompany the influx of new workers, even if contained to a workers' camp. The additional economic purchasing power can drive up the cost of local goods and services, making it even more expensive for local residents to meet their needs. While it is difficult to demonstrate that inflation is caused by Project activities, the potential impact can be felt by those with the least ability to give feedback.

During construction, impacts are short-term, but demand for local goods and services along with influx is likely to be more onerous due to the number of workers required. During operations, impacts are medium-term and demand for local goods and services and influx should decrease as the construction workforce reduces. Therefore, on balance, inflation is a negative impact and the consequence is assessed as moderate during construction and reduced to minor during operations. The effects of the impact will be most severe for those who are more vulnerable. The geographic extent of the change can be expected to be local, affecting those administrative units hosting Project workers on salaried employment. The impact significance prior to mitigation or benefit enhancement is **Moderate (negative)** for construction and **Minor (negative)** during operations**.**

TKBV will work with government authorities to select a standard "*basket of goods*" to monitor prices periodically. The selection will include common staples such as meat and maize but should also include prices of accommodation and other services that may be affected by an increase in job and opportunity seekers. The monitoring will include areas in hotspot areas such as Lokichar and Kochodin that are expected to experience influx, but also "*control*" areas beyond the AoI, which will indicate whether price increases are different near the Project's activities or reflect other trends that may be affecting the entire region, such as drought.

Prior to and during construction, TKBV will work with the NDMA to expand data collection surveys in Locations near Project activities. Such monitoring will allow for comparisons between the County-wide averages on socio-economic indicators and those same indicators near Project activities.

Based on monitoring of prices and comparison of NDMA indicators with County-wide averages, TKBV will determine if additional measures are needed. TKBV will set out within CDPs the key social programmes to support affected people to develop skills that can help them to react to any potential changes on the supply and demand of goods.

The need to continue monitoring prices for standard "*basket of goods*" in hotspot areas, as well as in the control areas and collection of data similar to NDMA monthly surveys on socio-economic indicators will be reviewed prior to the commencement of operations, based on the construction phase monitoring results. It is likely only during the initial period of operations (i.e. up to end of Year 2) such monitoring of prices and data collection would be deemed necessary at the same intensity. Thereafter an alternative appropriate method of monitoring will be sought for the operations phase.

Residual impacts should be comparatively less during operations to those experienced for construction but these will be experienced over a longer term. With careful monitoring and the commitment to act if there is substantial evidence of inflation, the residual impact is **Minor (negative)** during construction and operations**.**

7.9.11.5 Land Use and Ownership

Taking into account the baseline for land use (Section 6.12.2.6) and the planned Project land use and activities described in the Project description, this section presents the potential impacts relating to land use and ownership on receptors for the construction and the operational phases.

Summary of Land Baseline

Section 6.12.2.6 sets out the baseline situation of land use and ownership in areas affected by the Project footprint. Land in the Project area, including the TAN fields and along the interconnecting flowline routes and water pipeline route is unregistered community land, used by pastoralist communities for livelihood activities, principally livestock grazing. Homestead structures occupied by members of the community can be categorised as: long-term homesteads occupied throughout the year and occasionally moving short distances to new locations; short-term seasonal homesteads typically occupied for two to three months to access wet or dry season grazing; and very short term migratory homesteads used for a few days whilst on the move with livestock.

Land use baseline surveys have been undertaken by TKBV in the three field areas from 2015 to 2019 to record patterns of land use and numbers of occupied homesteads. The baselines of November 2018 and July 2019 provide an indication of the numbers and locations of occupied homesteads that may be present when land acquisition surveys are undertaken by the NLC and provide a basis for the assessment of impacts arising from Project land access.

The November 2018 and July 2019 lands baseline findings are summarised as follows:

- **Twiga Field Area:** The patterns, types and numbers of homesteads within and in the close vicinity of the Twiga field area recorded in baseline surveys have been generally consistent over the period 2015 to 2019. The November 2018 baseline survey identified **6 occupied homesteads**, mostly near the large lugga in the north-west of the Twiga field area and one long-term homestead just east of the Twiga-01 wellpad, (compared with 4 occupied homesteads in the Twiga field area in November 2015). In addition, there were 6 occupied homesteads just outside (within 300 m) of the northern Twiga field boundary. The July 2019 baseline identified only one occupied homestead in the Twiga field area, near the large lugga to the north-west of the field. The area is a livestock grazing area for camels, goats and sheep, used throughout the year by local households. The new Lomokamar Primary School classroom, constructed in 2018 and in use in November 2019, is located 120 m north of the Twiga field area - it will not be impacted by the Project.
- **Ngamia Field Area:** The November 2018 baseline found some **60 to 80 occupied homesteads** present in the Ngamia field area, a significant increase on the numbers recorded from 2015 to 2017 (20 occupied homesteads in November 2015). Two adakar clusters of occupied homesteads were observed for the first time in November 2018: the Lotiman adakar located just east of the main road 600 m inside the northern boundary of the Ngamia field containing an estimated 30 to 40 homesteads; and the Kode adakar located 200 m south-east of the Ngamia-1 wellpad on the eastern side of the road containing 30 to 40 homesteads. In July 2019 these two adakars were still present at the same locations and contained over 40 and over 20 occupied homesteads respectively. Both adakar are located near to TKBV supplied community water points. In addition, in November 2018 there were 16 occupied long-term or short-term seasonal homesteads in the Ngamia field area outside of the two adakar, and 9 occupied homesteads outside the adakar in July 2019, almost all of these located east of the main road. The Ngamia field area is a livestock grazing area, especially for wet season grazing. During the dry season, seasonal homesteads and livestock typically move towards the hills to the west outside of the Ngamia field area. The Ngamia Secondary School lies just inside the south-east boundary of the Ngamia field, approximately 1.8 km away from any planned wellpads for the Foundation Phase – it will not be impacted by the Project.
- **Amosing Field Area:** The November 2018 baseline found an estimated **40 to 50 occupied homesteads** in the Amosing field, a significant increase on the numbers recorded from 2015 to 2017 (27 occupied homesteads in November 2015). In November 2018, an occupied adakar cluster of homesteads was observed, containing an estimated 30 to 40 homesteads - the Lokosimekori adakar, located just east of the main road some 200 m inside the north-western boundary of the Amosing field area. In July 2019, **50 to 60 occupied homesteads** were identified in the Amosing field: the Lokosimekori adakar at the same location as in November 2018 contained an estimated 30 to 40 occupied homesteads, and approximately 20 occupied homesteads were located in another adakar, the Katamanak adakar, approximately 1.2 km inside the southern boundary of the Amosing field. This Katamanak adakar was not occupied in November 2018. In November 2018, there were an additional 12 occupied homesteads living in the Amosing field

outside of the adakar, but no occupied homesteads away from the adakar were observed in the Amosing field area in July 2019. The Amosing area is a livestock grazing area, especially for wet season grazing. During the dry season, seasonal homesteads and livestock typically move towards the hills to the west outside of the Amosing field area. The new Lokosemikori Primary School is located near the centre of the Amosing field area, approximately 800 m west of the Amosing-3 wellpad; the school was constructed in 2018 but was not yet in use as of November 2019 - the school will not be impacted by the Project.

- **Interconnection Routes:** The routes of buried flowlines and overhead transmission lines run for approximately 18 km between the Twiga and Ngamia fields and a shorter 800 m section between the Ngamia and Amosing fields. These interconnection routes fall outside the currently gazetted field areas. A 30 m wide RoW will be established for temporary land access during installation. Review of aerial imagery taken in early 2018 and a ground-based baseline survey undertaken in July 2019 were used to identify homesteads and community land use along the routes. The routes pass through sparsely populated areas of communal livestock grazing land, all classified as unregistered community land.

  On the Twiga to Ngamia section of the interconnection route, only one occupied long-term homestead area within the pipeline RoW was identified in July 2019, 4.6 km south of the Twiga field. No occupied homesteads were identified within the RoW of the 800 m section of interconnection route between the Ngamia and Amosing fields.

- **Water Pipeline Route:** The water pipeline route runs for approximately 90 km from the Turkwel Dam to the CFA located within the Ngamia field area. The pipeline will be buried and passes for 8 km from the Turkwel Dam through land in West Pokot and then for approximately 82 km through land in Turkana County. Land access for the water pipeline will involve temporary access to a 27 m wide corridor during construction and a long-term wayleave for a 6 m wide corridor. The construction RoW will be allowed to revegetate after completion of construction activities. No permanent structures or deep-rooted trees will be permitted within the 6 m long-term wayleave. All land through which the water pipeline passes in Turkana County is understood to be unregistered community land. The 8 km stretch in West Pokot is also understood to be unregistered community land, with a small area next to the Turkwel Dam understood to be owned by the KVDA. The vast majority of the route passes through remote and arid areas which are sparsely populated with little sign of community land use other than occasional animal shelters. Desk-based analysis of aerial images taken in July 2019 of the 27 m wide construction RoW identified just one corrugated metal sheet roofed building in West Pokot within the RoW near the start of the pipeline at Turkwel Dam and 21 traditional looking animal shelters or homestead structures within the RoW along the rest of the 90 km route in Turkana. However, approximately 15 of these structures (such as branch fence lines) were not present in aerial images taken in early 2018, which indicates that these may be temporary seasonal homesteads or animal shelters which may have been vacated since July 2019.

Summary of Project Land Requirements

The land requirements for components of the Foundation Phase are shown in Table 7.9-3.

The footprints of the Project facilities and land restrictions in the TAN field areas relative to locations of occupied homesteads identified in the recent (November 2018 and July 2019) land baseline surveys are shown in Figure 7.9-1, Figure 7.9-2 and Figure 7.9-3.

Table 7.9-3: Foundation Phase Land Requirements

	Land Requirements	Land Area (hectares)	Lease Agreement	Land Use Restrictions	Gazettement Status
A	**Land Requirements Within Gazetted Polygon Areas:**				
1	33 Wellpads in the TAN fields	257.75	Long term Lease (approximately 25 years)	Long term restriction (land fenced off). No pastoral grazing or settlement access	Land falls within the gazetted polygons
2	CFA area (temporary construction area).	243.77	Short term Lease (approximately 3 years)	Temporary restriction during construction period (land fenced off). No pastoral grazing or settlement access	Land falls within the gazetted polygons
3	CFA area long-term area for operations (long term lease). Area is within the bounds of the temporary construction area.	174.97	Long term Lease (approximately 25 years)	Long term restriction (land fenced off). No pastoral grazing or settlement access	Land falls within the gazetted polygons
3	Land fill area within Ngamia field	16.14	Long term Lease (approximately 25 years)	Long term restriction (land fenced off). No pastoral grazing or settlement access	Land falls within the gazetted polygons
4	Interconnecting/linear infrastructure falling within gazetted polygons (infield roads, infield OHTL, infield flow lines)	186.89	Infield power lines & flowlines - Wayleave* Infield Roads - Easement **	Temporary restriction during construction, no pastoral grazing or settlement access (30 m width, with an additional 10 m for OHTL). Post-construction pastoral grazing will be permitted but no permanent settlement permitted (10 m width).	Land falls within the gazetted polygons
	Sub-total *(based on CFA construction area)*	704.55			

	Land Requirements	Land Area (hectares)	Lease Agreement	Land Use Restrictions	Gazettement Status
B	**Additional Land Requirements Outside Gazetted Polygon Areas:**				
1	Interconnecting/linear infrastructure falling outside the gazetted area (roads, OHTL, flow lines)	122.12	OHTL & flowlines - Wayleave* Roads - Easement**	Temporary restriction during construction, no pastoral grazing or settlement access (30 m width, with an additional 10 m for OHTL). Post-construction pastoral grazing will be permitted but no permanent settlement permitted (10 m width).	Not yet gazetted
2	The requirements for the Water Pipeline from Turkwel Dam to the CFA area (Temporary construction period width of approximately 27 meters and a temporary construction period lay down area- outside the Turkwel dam area). Following construction activities, a 6 m wayleave will be required, 98.41 hectares.	260.32	Water pipeline - Wayleave* Temporary construction lay down area - short term lease (approximately 3 years)	Temporary restriction during construction (27 m width). No pastoral grazing or settlement access. Long term restriction (6 m wayleave). Pastoral grazing permitted but no settlement access.	Not yet gazetted
	Sub-total	382.44			
	TOTAL	**1,086.99**			

**Way leave - an agreement between a land owner and the Project, permitting the Project to access land in the RoW to carry out works. Does not exclude pastoralist activities, but will restrict permanent residence on the land.*

***Easement - a right that the Project will hold over land owned by somebody else, e.g. for a Project road to pass across land owned by someone else.*

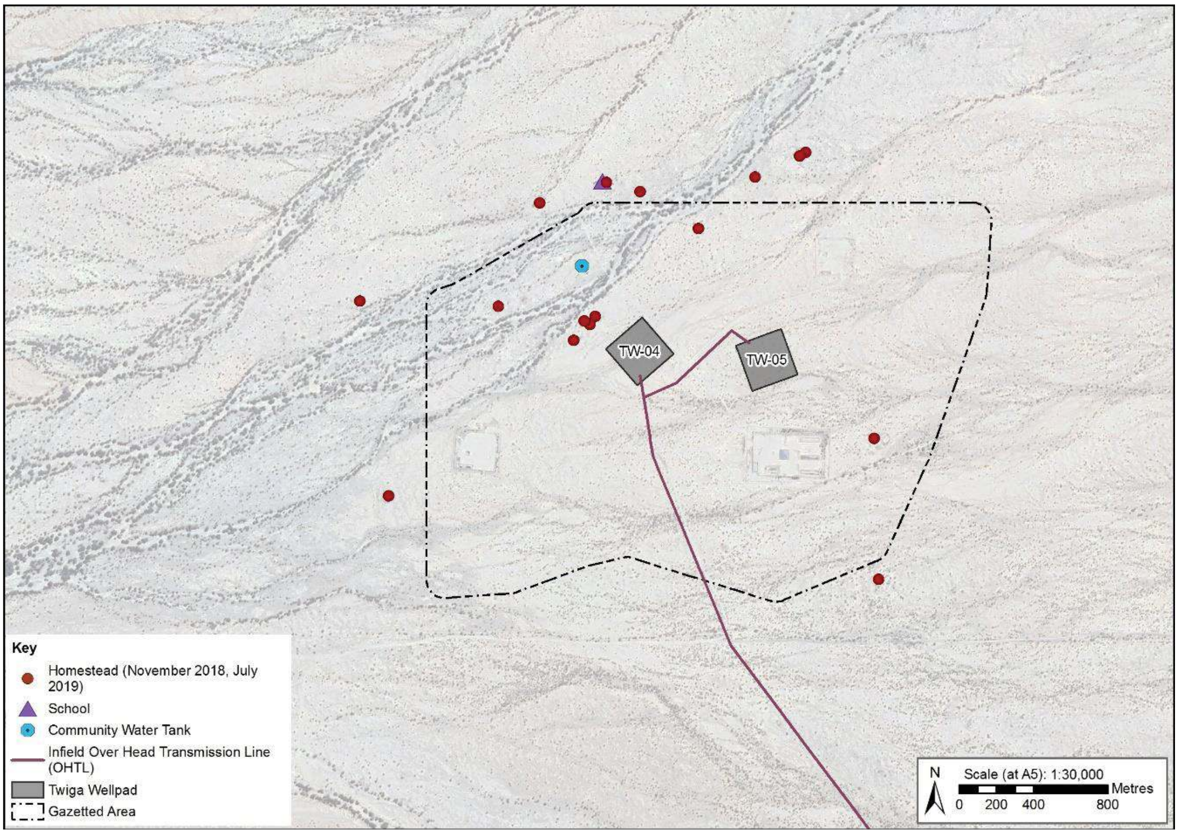

Figure 7.9-1: Twiga Field - Location of Homesteads Identified in the November 2018 and July 2019 Land Baseline.

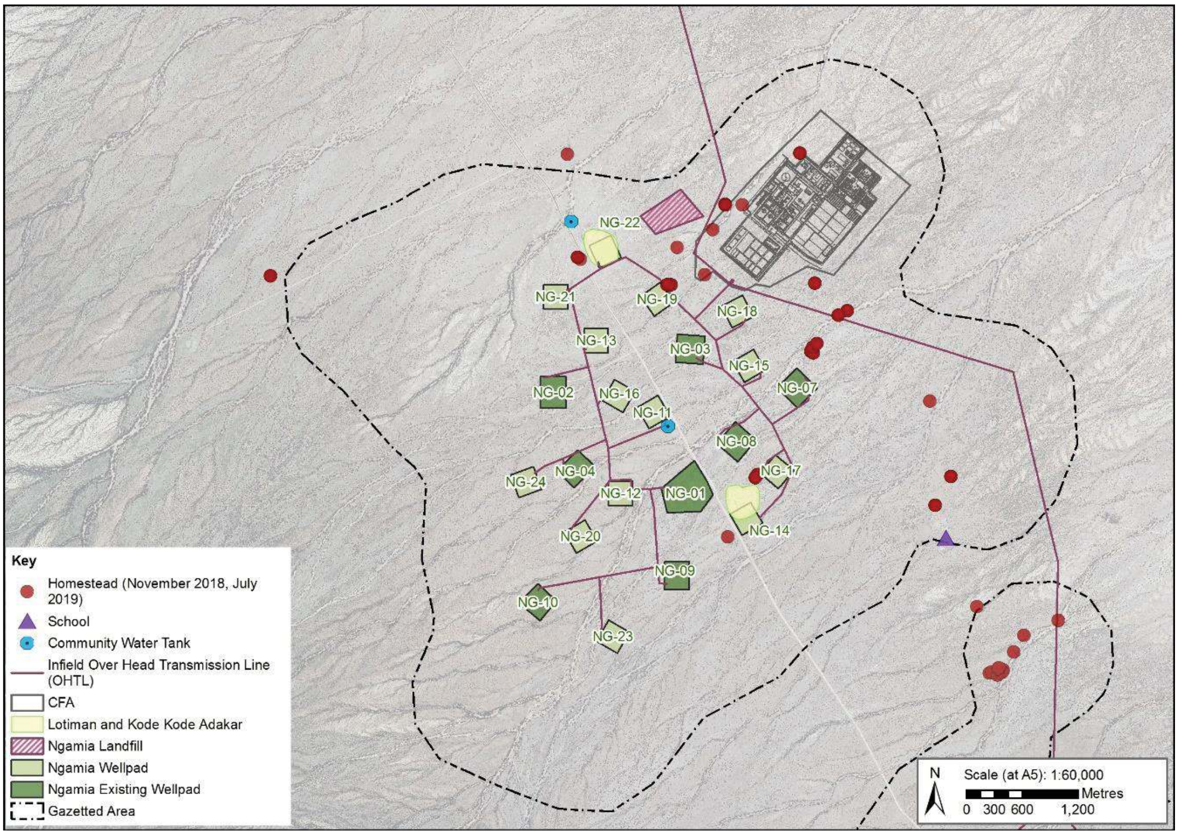

Figure 7.9-2: Ngamia Field - Location of Homesteads Identified in the November 2018 and July 2019 Land Baseline.

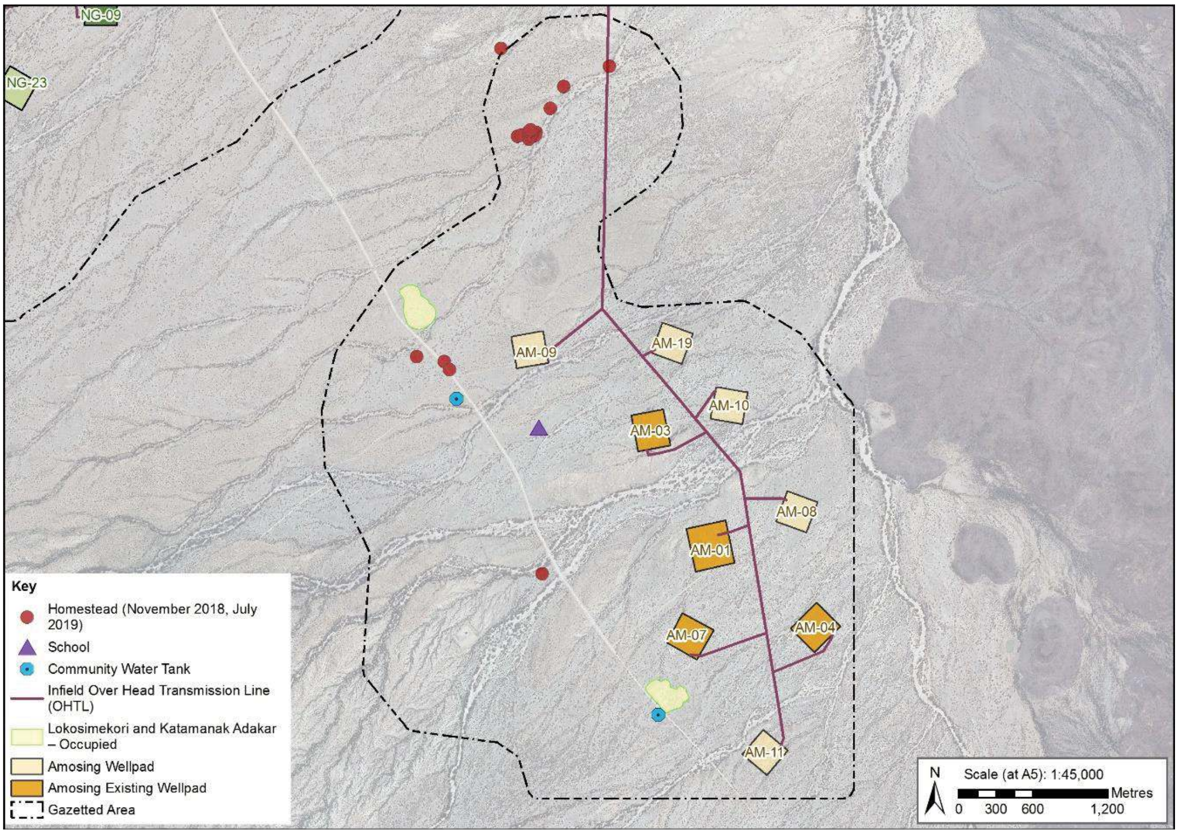

Figure 7.9-3: Amosing Field - Location of Homesteads Identified in the November 2018 and July 2019 Land Baseline.

Approach to Project Land Access

Land acquisition for the Foundation Phase will be undertaken in line with Production Sharing Contracts (PSC) between the Kenya Joint Venture (KJV) and GoK, which specify that land will be acquired by GoK (through provisions set out in national legislation) and then made available to KJV through long term lease agreements. A Government-led approach to securing land access is therefore being followed, in compliance with Kenyan legislation and with the NLC) playing the lead role in land acquisition.

The KJV will ensure that land acquisition for the Project meets applicable international standards, notably IFC PS5 on Land Acquisition and Involuntary Resettlement. IFC PS7 on Indigenous People also sets requirements for Free Prior and Informed Consent (FPIC) in circumstances where Project impacts (such as land access) occur on PAP who are deemed to meet the criteria for Indigenous People.

IFC PS5 states that when land acquisition is the responsibility of government, the Project should collaborate with the responsible government agency, to the extent permitted, to achieve outcomes that are consistent with IFC PS5. In the case of land acquisition resulting in physical displacement, if government processes do not fulfil all requirements of IFC PS5, the Project is required to prepare a Supplemental Resettlement Plan (covering resettlement and livelihood restoration) and undertake supplementary activities to meet IFC PS5 requirements.

An initial land application for specific coordinates for the land components (wellpads and the CFA) was submitted by KJV to GoK in August 2018 and gazetted by GoK in February 2019. The final application comprising the CFA, wellpads, landfill area, interconnecting infrastructure and the Turkwel make-up water pipeline was submitted in August 2019. While the Project requires a defined footprint of approximately 1,087 ha, MoPM has gazetted polygon areas measuring approximately 6,500 ha. These polygons will be classified as land for dual use i.e. Project and community use, but it is only the specific land requirements (defined footprint) which are to be restricted for Project only use and thereby leased to KJV. The community will be able to continue to use land areas in the gazetted polygons that are not affected by the Project footprint - therefore, physical and economic displacement will only potentially occur on land areas affected directly by the Project footprint or, temporarily (through the encouragement of avoidance), within those areas defined in Section 7.2 as being within the high magnitude noise impact area during construction. Land acquisition and access will be prior to construction and during. No additional land acquisition is planned during operation.

Mitigation for Land Acquisition

Mitigation related to land acquisition is guided by the draft Upstream LARF. At the time of writing this ESIA, the document remains as a draft internal document, which will be agreed with the GoK. The Project will meet the requirements of Kenyan legislation and the IFC PSs.

Land Acquisition and Resettlement Framework (LARF)

The LARF will be agreed between the GoK, TKBV and the KJV partners. The LARF outlines the current land footprint for the Project. The GoK is obliged to make available land reasonable for the Project and has gazetted its intention to acquire various parcels of land for purposes of the Project.

The objective of the LARF is to define the approach and principles by which land will be secured, how any physical displacement or economic displacement will be addressed and how the impacts associated with the Project will be addressed.

The LARF process will be publicly disclosed after approval from GoK and the KJV. This document will serve as the main framework for all Project related land acquisition.

While the exact roles have yet to be finalised, the procedures will include:

- Collection of process data such as public participation reports, survey report and compensation reports that will be used to facilitate the preparation of a LRP;
- Conducting stakeholder engagement to support the achievement of FPIC;
- The Land acquisition process will be publicly disclosed before the ESIA consultation;
- GoK representatives and KJV land team will attend ESIA stakeholder engagement;
- Agreeing a mechanism to manage land that is not taken up by the Project and that will be available for public use;
- Preparing a Resettlement Action Plan (RAP)[21];
- Preparing a LRP;
- Sharing information on the components of the market value being considered for purposes of compensation under applicable law; and
- Securing that community land user rights are adequate (as included within the gazetted area but outside of the Project footprint).

The government will create an assets survey database that will contain a final list of all affected parcels of land, registered assets and the details of the owners. On the basis of the assets survey database and census documentation, public consultation and participation forum will be held and include any owners of affected parcels and assets, users and all other stakeholders who have an interest or might be affected by the Project.

[21] The RAP will be prepared to meet the relevant requirements of IFC PS5 (IFC, 2012f). where there is Government-Managed Resettlement and comprise a Supplemental Resettlement Plan as referred to in requirement 31 of IFC PS5 (IFC, 2012f).

This public consultation will demonstrate evidence of attendance and participation and evidence of participation by gender.

Eligibility for compensation will be limited by a cut-off date, to be agreed with the NLC. Government surveys will set an appropriate date that will allow for accurate census documentation and minimise speculative in-migration.

Separate to the LARF, any E&A land legacy issues will be resolved through agreement between KJV and the GoK.

Non-Statutory Process

The objective of the Non-statutory Process is to set out how the KJV can meet the requirements of the IFC PSs. Compensation will be paid in accordance with Kenyan Law. Any additional requirements to meet the IFC PS5 requirement for compensation at full replacement cost, will be addressed as part of the supplemental Resettlement and Livelihood Restoration Plans to be implemented by KJV, as no additional “top up” asset-related compensation will be paid.

KJV will be responsible for the completion of socio-economic survey of PAP. Where available, data from the GoK led acquisition process will be used to support the socio-economic surveys. This survey will serve as a census of persons who (i) have formal legal rights to the land or assets they occupy or use; (ii) do not have formal legal rights to land or assets, but have a claim to land that is recognised or recognisable under national law; or (iii) have no recognisable legal right or claim to the land or assets they occupy or use. The census will establish the status of the displaced persons. The objectives of the census shall be to:

- Identify vulnerable groups;
- Collect information on the standards of living of the PAP both identified within the gazetted areas and those identified as impacted through the results of the ESIA;
- Collect information on social cultural characteristics of the affected community and persons;
- Collect information on stakeholder resettlement assistance and compensation preferences; and
- Conduct livelihood studies to inform design of livelihood programs for the affected community.

The Non-statutory Process states that survey results will be used to create an Entitlements Matrix based on impact scenarios. This will be based on different impact categories for PAP, confirm eligibility conditions and provide indicative entitlements for each impact topic. It will also inform key performance indictors needed for monitoring and data requirements.

Agreements made as part of the non-statutory land acquisition process will be incorporated in CDPs. The CDPs will not include any compensation covered by Kenyan land legislation.

The CDPs will be developed in each of the Counties where the Project is located. In addition to land, the CDPs will incorporate other agreements related to water access, impact management, benefits related to local content and a Shared Prosperity Fund that will deliver community social benefits.

The CDPs are expected be coordinated through an engagement process with multi-stakeholder forums, including leadership at the County and Sub-county level, for example the County Steering Group which is a multi-stakeholder forum co-chaired by National and County governments, and includes representatives of government departments, private sector, NGOs and religious institutions and community representatives. The County Steering Group is replicated at a Sub-county level. Finally, in addition to a Project Grievance Mechanism, an additional Governmental grievance procedure will be available to address land related grievances.

Summary of Impacts

The following 12 impacts topics arising from land access relating to the Project have been identified and are described below:

- Long term loss of community land;
- Temporary restriction on land use, notably pastoral grazing and settlement access, during construction due to direct physical works on land or indirect restrictions of land use relating to modelled air quality;
- Long term restrictions on settlement, along the water pipeline wayleave (6 m wide) and interconnection route wayleaves and easements (10 m wide);
- Loss of occupied homesteads (physical displacement);
- Loss of access to particular areas of land where households have previously located long-term or seasonal homesteads;
- Loss of household structures other than homesteads – e.g. animal shelters or dug water holes;
- Loss of business structures and impacts on businesses – e.g. shops;
- Temporary loss of access to or use of TKBV supplied community water points;
- Increased travel/walking distances to community assets or TKBV supplied community water points;
- Impacts on livelihoods due to loss of communal lands (economic displacement);
- Impacts on graves; and
- Impacts on vulnerable persons.

These potential impacts and associated mitigation measures are described below. A discussion for each impact includes brief baseline context, impact analysis narrative, significance rating prior to mitigation, specific mitigation commitments to be implemented by the Project and residual impact significance.

Long Term Loss of Community Land

The NLC has Gazetted land areas totalling 6,500 ha for dual use (Project and community use). However, only the 1,087 ha directly affected by the Project footprint will not be available for continued community use. The affected land in the AoI in Turkana is unregistered community land, which is recognised as being owned by the whole Turkana community.

As described above in Section 1.3, GoK will provide compensation for loss of land in line with Kenyan law and statutory processes. Any additional requirements to meet the IFC PS5 will be addressed as part of the LRP.

The compensation for Project use of community land will include compensation for land within the Foundation Phase footprint occupied by existing facilities, such as existing wellpads, which until now and during the exploration and appraisal phase, have been subject to temporary lease agreements between KJV and Turkana County Government.

Long-term loss of community land is negative and has a high consequence. The geographic extent is local, affecting only the Locations that require land acquisition and the duration is long-term. The unmitigated impact on livelihoods will be most felt during the construction phase when land is acquired. Some impacts on livelihoods will extend into the operations phase and for longer if livelihood restoration measures are not implemented and available at the time of displacement. The livelihood restoration measures within the LRP will be implemented and available to PAP, at the latest when displacement arises, and continue until livelihoods are restored, and if possible, improved to pre-displacement levels. The unmitigated construction impact is **Major (negative)** because of the importance of communal land to Turkana communities' ways of life and the high sensitivity of Turkana communities to the loss of community land. With successful implementation of all committed mitigation the residual impact significance relating to loss of community land is rated as **Minor (negative).**

Temporary Restriction on Land Use, Notably Pastoral Grazing and Settlement Access, During Construction

During the construction phase, temporary restriction on land use (pastoral grazing and settlement) will apply to: a 27 m wide construction corridor RoW along the water pipeline (approximately 82 km of which is in Turkana and 8 km is in West Pokot) and a 30 m wide RoW for the interconnection routes, with an additional 10 m for OHTLs; and 69 ha of land required for the construction phase around the CFA (CFA construction area minus the CFA footprint). The July 2019 land use baseline identified one homestead on the interconnection routes likely to be subject to physical displacement for temporary construction.

On the water pipeline route, desk based analysis of aerial images taken in July 2019 of the 27 m wide construction RoW identified just one corrugated metal sheet roofed building in West Pokot near the start of the pipeline at Turkwel Dam and 21 traditional looking animal shelters or homestead structures along the rest of the 90 km route. Ground based survey work will be undertaken to confirm whether these or other homesteads will be impacted.

Project affected persons will be compensated in line with Kenyan law and any additional measures to meet IFC PS5 requirements will be addressed as part of the LRP. Local communities using land areas affected by temporary restrictions on grazing and settlement will be able to access similar land areas nearby.

The temporary restriction on land use is only considered to be an impact during construction and will not extend into operations. Temporary restriction on land use is negative with a high consequence. The geographic extent is at the household level and the duration is short-term. The unmitigated impact is rated as **Major (negative)** because at least one household is expected to be physically displaced on the interconnection routes and 22 structures in total, one corrugated metal sheet roofed building in West Pokot near the start of the pipeline at Turkwel Dam and 21 traditional looking animal shelters or homestead structures along the rest of the 90 km total route, were identified from aerial images and may be affected. The residual impact significance during construction assuming successful implementation of the RAP and LRP is rated as **Minor (negative)**.

Long Term Restrictions on Settlement Along the Wayleave of the Water Pipeline

The water pipeline route, of which approximately 82 km lies in Turkana and 8 km in West Pokot, requires a 6 m wayleave to allow for on-going access and maintenance. Pastoral grazing will be permitted but members of the community in Turkana and West Pokot will not be able to reside on the 6 m wide wayleave. Desk based analysis of aerial images taken in July 2019 of the water pipeline route identified just one corrugated metal sheet roofed building in West Pokot near the start of the pipeline at Turkwel Dam and 21 traditional looking animal shelters or homestead structures along the rest of the 90 km route. Ground based survey work will be undertaken to confirm whether these or other homesteads will be impacted, and the required compensation and assistance will be provided to affected land users. Compensation will be provided to the owners of land along the 6 m wide water pipeline wayleave in line with Kenyan law and any additional measures to meet IFC PS5 requirements will be addressed as part of the LRP.

Restrictions on settlement along the wayleave is a negative impact with low consequence. The geographic extent is local and will only affect locations traversed by the water pipeline. The duration is long-term. Due to the fact that any homesteads or other structures on the 6 m wayleave would already have been relocated and compensated during the temporary construction work (assessed above), and because of the very limited width of the wayleave, the impact of long-term restrictions is considered to be **Minor (negative)** and the residual impact significance is rated as **Negligible.**

Loss of Occupied Homesteads (Physical Displacement)

Physical displacement will occur if a household is occupying a homestead structure at time of the NLC land and asset survey and is required to move away from an area affected by the permanent footprint of a new Project facility or other areas temporarily affected by the construction phase. This is expected to only apply to occupied long-term and short-term seasonal homesteads, or very recently built unoccupied homesteads in a good state of repair since Turkana people do not re-use shelters that they have vacated unless they have been very recently built and in good repair. Physical displacement would not apply to very short-term migratory homestead structures, since these tend only to be used for two or three days and would be vacated in a few days in any case.

Even if a household is affected by physical displacement, the extent of the impact could be relatively limited since nomadic pastoralists in the Project area frequently move the location of their homesteads, either to access better grazing elsewhere, or to avoid pests or disease associated with dung build-up in animal shelters next to the homestead.

In recent years, the number of homesteads in the Project area has varied according to factors such as seasonal rains which affects quality of grazing, and the security situation vis a vis the risk of livestock raiding. The location of occupied homesteads has also varied from year to year. It is therefore difficult to predict the exact number of occupied homesteads that would be affected by physical displacement at a future point in time (at the time of the NLC's land and asset survey). However, the numbers and distribution of occupied homesteads identified in the November 2018 and July 2019 baseline surveys are indicative of the likely number of households that could be subject to physical displacement from occupied homesteads.

It is estimated that 120 to 130 households will be subject to physical displacement, comprising:

- **Twiga field:** Based on the locations of occupied homesteads observed in the 2018 and 2019 baseline surveys, **no households** would be physically displaced from the Twiga field area during the construction phase or the operational phase.
- **Ngamia field:** An estimated **75 households** in the Ngamia field would be physically displaced, which equates to approximately 90% of the households occupying homesteads in the Ngamia field area in the 2018 and 2019 baselines, since the two adakar locations containing 60 to 70 households in the recent baselines would both be directly impacted by the Project footprint.
- **Amosing field: 25 to 30 households**, which equates to approximately 50% of the households occupying homesteads in the Amosing field area in recent baselines, since the two adakar occupied in July 2019 would both be partly affected by the construction of interconnection routes within the Amosing field area.
- **Interconnection routes outside of the three field areas: one household** located on the interconnection route some 4.6 km south of the Twiga field.
- **Water pipeline route:** an estimated **22 households** indicated from review of aerial imagery taken in July 2019 (1 in West Pokot and 21 in Turkana).

Households occupying homesteads subject to physical displacement will receive compensation in line with Kenyan law and any additional measures to meet IFC PS5 requirements will be addressed as part of the LRP. IFC PS5 requirements include: offering feasible alternative options to cash compensation for homesteads, such as in-kind replacement homesteads or assistance to households in building homesteads elsewhere; relocation assistance suitable to the needs of the displaced persons; and potential additional assistance for households containing vulnerable persons.

Physical displacement is a negative impact with high consequence of a permanent duration which is not reversible. The geographic extent is at the household level. The impact would be felt at the point of displacement which will be prior to and/or during construction when land acquisition and access is planned by the Project. Compensation will be provided prior to physical displacement with relevant resettlement assistance and livelihood restoration measures implemented post-displacement mostly during the construction phase. Some livelihood restoration measures for physically displaced households may continue, where necessary, into the operations phase until livelihoods are restored to a pre-displacement level and improved where possible. The unmitigated impact during construction is rated as **Major (negative)** and **Moderate (negative)** during operations. The residual impact significance, with successful implementation of the Land access programme and the RAP is rated as **Minor (negative)** during construction. Some livelihoods mitigation measures will continue into the operations phase. With continued implementation of the LRPs during operations, the mitigated impact will be reduced to **Negligible**.

Loss of Household Structures Other Than Homesteads

This could affect animal shelters/enclosures which Turkana people construct next to their homesteads – made of circles of branches and twigs cut from nearby trees and shrubs, in which goats and camels are typically kept overnight. These are temporary structures that are quick to construct. When the people leave a homestead, the animal shelters fall into disrepair and would not be re-used due to build-up of dung and risk of disease, animal ticks and other pests. Even when a household stays in an area for a longer period spanning wet and dry seasons, the household typically moves the homestead and animal shelters every few months to avoid risk of pest and disease associated with build-up of dung in the animal shelters next to the homesteads. Therefore, the extent of the impact of loss of a household's animal shelters would be limited.

Based on recent baselines, the loss of other household structures such as animal shelters would affect an estimated 80 to 100 households (70% of the estimated number of households subject to physical displacement and assuming that 30% of households currently occupying homesteads in the Project affected land areas do not also have animal shelters in these areas).

Other private physical assets which could potentially be affected by Project land access, include dug water holes, though these have not been observed in the TAN fields in recent years due to the provision of TKBV community water tanks. These will also be subject to supplementary compensation if still in use. Affected owners of these structures will receive compensation in line with Kenyan law and any additional measures to meet IFC PS5 requirements will be addressed as part of the LRP.

Loss of structures other than homesteads is a negative impact with low consequence. The geographical extent is at the household level and the duration is long-term although would be felt and mitigation measures will be applied prior to displacement and into the construction phase. The unmitigated impact is rated as **Minor (negative)** for construction only. The residual impact significance during construction is rated as **Negligible** and would not extend into operations.

Loss of business structures

Only one potentially affected shop structure, in the Ngamia field, was identified in the November 2018 and July 2019 lands baselines on land areas within the Project footprint. One other shop structure was identified in the Amosing field but outside of the footprint area. It is therefore estimated that at the time of the NLC land and asset survey, there will be two affected shop businesses subject to displacement in all Project affected land areas.

Owners of a shop subject to displacement will receive compensation in line with Kenyan law and any additional measures to meet IFC PS5 requirements will be addressed as part of the LRP.

Loss of business structures is negative with a low consequence. The geographical extent is at the household level and the duration is long-term. Mitigation measures will be applied prior to displacement and as relevant continue during the construction phase. The unmitigated impact is rated as **Minor (negative)** for construction only. The residual impact significance during construction is rated as **Negligible** and would not extend into operations.

Potential Temporary Loss of Access to or Use of TKBV Water Tanks

Mapping of TKBV community water tanks within the Project footprint areas indicates a potential impact during the construction phase of disruption of community access to the two water tanks in the Ngamia field area, due to the location of these tanks in relation to construction activities. The Project will aim to design and manage construction activities to avoid or minimise this potential impact, but if unavoidable it is proposed that the Project will engage with PAP and authorities in helping to identify suitable alternative sources of water.

Loss of access to TKBV water tanks is a negative impact with moderate consequence. The geographical extent is local and will only affect Kapese and Kochodin Locations during construction and therefore has a short-term duration. The unmitigated impact is rated as **Moderate (negative)** for construction only. The residual impact significance during construction is rated as **Negligible** and would not extend into operations.

Increased Travel/Walking Distances to Community Assets or TKBV Water Tanks

Potential impact of increased travel/walking distances to community assets or TKBV water tanks, in the field areas and during construction of the interconnection routes and water pipeline route. Depending on where physically displaced households relocate to, this could potentially apply to access to the Lomokamar Primary School just north of the Twiga field, the Ngamia Secondary School and the new Lokosimekori primary school in the Amosing field, or to TKBV community water tanks in the Ngamia and Amosing field areas.

The extent of this impact will only be known when it is known where physically displaced households relocate to, but it is expected that there will be suitable locations for homesteads nearby. As noted above, if necessary, it is proposed that the Project will engage with PAP and authorities in helping to identify suitable alternative sources of water and suitable alternative locations for homesteads which have similar or better access to communal facilities.

Increased travel time is a negative impact with low consequence. The geographical extent is local and the duration is short-term, i.e. construction only. The unmitigated impact is rated as **Minor (negative)**. The residual impact significance is rated as **Negligible** and would not extend into operations.

Impacts on Livelihoods Due to Loss of Communal Land (Economic Displacement)

The majority of the Project footprint area (1,087 ha) is used for nomadic livestock grazing, 98% of the area lies in Turkana County and 2% in West Pokot. Grazing activities vary depending on seasonal rains. Wet season grazing typically takes place from April to June and November to December, and at other times of the year pastoralists take their livestock to dry season grazing areas generally located towards hills 10 km to 25 km west and south-west of the Project area.

Whilst all Turkana people are able to access community land in Turkana for grazing livestock, in practice it is the people who live in and around the Project area and the wider Locations and Sub-county areas who use the Project affected land on a regular or intermittent basis for livestock grazing.

The impact of Project land use on grazing livelihoods is expected to be minor in view of the large areas of available grazing land in and around the Project area. Furthermore, communities already access grazing areas outside in the Project affected areas, particularly during dry seasons when livestock are typically moved to dry season grazing areas towards the hills some 10 km to 25 km west and south-west of the Project area. Estimates of the economic value of livelihood contributions from livestock grazing on Project affected land areas indicate relatively low economic values.

Temporary disruption of livestock movement could potentially occur, e.g. due to construction of linear infrastructure such as buried flow lines, but in reality this impact is expected to be minimal since only limited stretches of land would be affected at any one time and animals could easily find alternative routes and mitigation will include livestock movement paths through the linear construction areas.

There are large areas of similar grazing land surrounding Project affected areas which the community will be able to access. The local community already accesses this surrounding land for grazing livestock. In this way, affected persons will be able to access alternative resources with equivalent livelihood-earning potential and accessibility.

As well as using land for livestock grazing, communities in the vicinity of the Project area use a variety of natural resources: wood for fires and construction of homestead shelters, medicinal plants, food (wild fruits and roots) etc. Land clearance for construction purposes will involve the loss of these resources in areas of the Project footprint. However, the actual level of impact on communities is expected to be low due to availability of similar natural resources across large areas of community land in the vicinity of the Project footprint. Furthermore, since linear infrastructure will not be fenced, it is not expected that significant restrictions on access to such resources will occur.

KJV will provide livelihood restoration assistance in line with IFC PS5 requirements, to ensure that livelihoods of PAP are maintained or preferably improved. These measures will be contained in the LRP. KJV will engage with PAP to develop CDPs, which will be created with authorities in Turkana and West Pokot Counties. Subject to agreement with the PAP, the CDPs may support, for example, skills development, micro business support; and livestock grazing improvements. Economic displacement is a negative impact with moderate consequence. The geographic extent is local and will affect only those mobile pastoralists who use the land in the Lokichar and Kochodin Locations.

Impacts on livelihoods and the implementation of the LRP will be after land access but impacts will be felt from the point of displacement and during the construction phase, with impacts on livelihoods and livelihood restoration measures continuing into the operations phase. Therefore the duration is long-term and the unmitigated impact for construction and operations is rated as **Moderate (negative)**. Assuming successful implementation of the LRP and CDPs, the residual impact significance for both construction and operation is rated as **Negligible**.

Impacts on Graves

Graves are very important to Turkana communities and are located across the landscape (see further detail on locations in section 7.10) and not in specific communal burial areas. It is likely that some graves will be affected by the Project footprint's land requirements. Micro-alignment of the interconnecting network within the RoW will be used to avoid direct impacts to graves, where feasible. For any unrecorded graves that may exist within the Project footprint, the Chance Finds Procedure (CFP), which will be administered by an on-site CoW, will also include information regarding processes to be followed. Where graves cannot be avoided, in highly exceptional circumstances, culturally appropriate steps will be agreed in consultation with site guardians and the affected communities, to relocate graves.

Compensation will be provided in line with Kenyan Law, which recognises graves and the costs of rituals required to relocate graves, as part of the Government-led statutory land acquisition process. TKBV will engage with the community to agree procedures for demarcation (e.g. demarcation and communication of '*No-Go*' sensitive locations and mapping and communication of cultural heritage 'constraints') or relocation and reburial of graves, carefully reflecting cultural sensitivities. This is to be completed prior to construction by TKBV. Details of grave relocation, compensation and assistance will be presented in the LRP.

Impacts on graves is a negative impact with local consequence. The geographic extent is at the household level and the duration is permanent. The impact would be felt, and mitigation measures will be applied during the construction phase. The unmitigated impact is rated as **Major (negative)** during the construction phase only. The residual impact significance is rated as **Minor (negative)** and, assuming successful provision of compensation and relocation assistance for graves, would not extend into operations.

Impacts on Vulnerable Persons

Vulnerable persons are defined as people who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status may be more adversely affected than others by resettlement, physical and/or economic displacement. For the purposes of the Project, potential criteria for identifying vulnerable persons include: female headed households; elderly headed households; members of household with mental and/or physical disabilities.

TKBV will provide supplementary activities to identify vulnerable persons and provide additional assistance to ensure that they are not more adversely affected by resettlement than others. Details of vulnerable persons support will be presented in the RAP and LRP.

Impacts on vulnerable people is negative with a moderate consequence. The geographic extent is at the household level and the duration is long-term. Impacts would be felt, and mitigation measures will be applied during the construction phase. The unmitigated impact is rated as **Moderate (negative)** from the point of displacement and during construction. The residual impact significance is rated as **Minor (negative)** and, assuming successful implementation of the RAP and LRP would generally not extend into operations apart from certain on-going livelihood restoration activities.

7.9.11.6 Community Health and Safety

Five impact categories have been identified in relation to community health and safety:

- STI, including HIV/AIDS;
- Communicable diseases;
- Zoonotic diseases;
- Accidents and Injuries; and
- Environmental determinants of health.

The way in which EHAs identified in the Social baseline (Section 6.12) have been linked to each impact theme are described in Table 7.9-4.

Table 7.9-4: Linkage Between Impact themes and Environmental Health Areas

Impact themes	Impact	EHA
STI, including HIV/AIDS	Introduction and transmission of communicable diseases between Project workforce and PAP.	EHA 4
	An increase in the burden of disease along the Project's transport corridors as a result of Project drivers spreading communicable diseases.	EHA 4

Impact themes	Impact	EHA
Vector related diseases	Effects of environmental alteration on vector densities	EHA 2
	Introduction of new vector related diseases and strains due to Project logistics	EHA 2
Communicable diseases	Introduction and transmission of communicable diseases between Project workforce and PAP.	EHA 1
	Outbreaks of infectious conditions within Project camps affecting the health of the local workforce and PAP.	EHA 1, 3
Zoonotic diseases	Increase transmission in zoonotic diseases as a result of Project activities (specifically the IWMF)	EHA 8
Accidents and injuries	Project logistics activities resulting in accidents affecting communities	EHA 7
	Occupational health and safety incidents resulting in injuries in local workforce members	EHA 7
	Project construction activities resulting in accidents affecting communities	EHA 7
Environmental determinants of health	Impacts related to air quality	EHA 9
	Impacts related to noise and vibration	EHA 9
	Impacts related to water quality and quantity	EHA 3, 9
Social maladies	Impacts related to Project employment (nutrition, non-communicable diseases, social cohesion, gender equality and others)	EHA 5, 6, 10
	Increase in gender-based violence, commercial sex work and transactional sex.	EHA 4, 10
Influx and migration	Influx resulting in the introduction of new diseases or higher disease transmission rates.	EHA 1, 2, 3, 4
	Increased risk of fire in informal settlements	EHA 7
	Deterioration in environmental health conditions and lack of basic services that may increase the potential for communicable disease transmission due to overcrowding, poor hygiene and sanitary conditions.	EHA 1, 2, 3, 4
	Impacts related to food security and nutrition as a result of influx	EHA 5
	Increase in zoonotic diseases as a result of influx	EHA 8
	Influx potentially resulting in an increase in social ills, potentially leading to an increase in gender-based violence, crime, drug use and alcoholism, amongst others.	EHA 10
	Increased pressure on existing health services and increased uptake on traditional health practices.	EHA 1

Sexually Transmitted Infections, Including HIV/AIDS

HIV/AIDS is among the top health challenges and priorities in Kenya and the AoI itself. According to baseline findings, the HIV prevalence in Turkana County has decreased from 7.6% (2013) to 3.2% (2017/18) and from 2.3% (2014) to 1.5% (2017/18) in West Pokot County. Despite this improvement, knowledge on the prevention of HIV transmission remained poor, with only 49.2% of women and 2.4% of men reporting that using a condom and limiting sexual contact to one uninfected partner were effective prevention methods. Stigma associated with a positive HIV status, limited access to treatment services and poor treatment adherence contributed to the challenges in managing HIV/AIDS in the area. High-risk populations included female commercial sex workers, adolescent girls and fisher-folk around Lake Turkana.

Stakeholders noted several potential hotspots for HIV infection in the AoI, including the Kitale-Lodwar-Lokichogio transport corridor, as well as certain urban settlements, specifically Lodwar and Lokichar. Commercial sex work activity, specifically in Lokichar, was reported to be on the increase with an influx of commercial sex workers from areas outside of the AoI noted as a particular concern.

The utilisation of a Project workforce that originates from areas where the burden of disease related to STIs and HIV is higher than in the AoI, may affect the existing burden of disease in the AoI. Even though it has been confirmed that the Project will implement a "*closed camp*" status for accommodation facilities, local, unskilled workers are typically hired locally to work in camps and on other Project sites, while residing in nearby communities, enabling some interaction between workforce and community members. As in other projects, it is customary that some of the facility-based work positions reserved for local, semi-skilled and unskilled workers, are to be filled by women, e.g. cleaners, food servers and administration personnel. These female workers will be especially vulnerable to transactional sex advances from male workers who reside inside the camp.

Similarly, it is expected that certain work crews will partake in construction and other Project-related activities outside of camps or facilities. If not managed, these work crew members may seek interaction and fraternisation with female community members. Adolescent girls and commercial sex workers are deemed to be at higher risk for this interaction.

Communities that are at higher risk for this impact include Lokichar, in proximity to Kapese Base camp, communities in the West Pokot Locations in proximity to the Make-up Water Camp in the KVDA area at the Turkwel dam, households in the Kochodin Location close to where the CFA will be constructed, as well as households and settlements in the Lokichar and Kochodin Locations that are located in proximity to the drilling mini-camps.

Further to the above, it is anticipated that the Project will require substantial logistical support during the construction phase, including the transport of materials from Mombasa harbour as well as other hubs within Kenya. Research by the Kenyan National AIDS Control Council (NACC) and the National AIDS and STI Control Programme (NASCOP), has recognised that transport workers (especially long distance truck drivers) are a high-risk group (often referred to as 'core spreaders'), as they are known to have multiple sexual partners and to developing sexual networks along their transport corridors. Women, most commonly commercial sex workers, often target truck drivers as they are away from their usual family network and have disposable income, while the truck drivers (generally men) target women as a form of companionship and entertainment. These encounters are often transactional in nature, and commonly involve a sexual relationship. This will most likely take place at rest stops. The mobile nature of commercial sex workers, however, may result in the spread of disease beyond these areas.

This increase in burden of disease will impact negatively on the quality of life of the affected women, broader community and Project workers, affecting their future health status, need for medical intervention and, potentially, their future work potential and life expectancy. In addition to this, the increase in burden of disease will increase pressure on the existing health services, and the nature of HIV disease can cause significant social implications in affected communities.

This impact is considered to have a negative direction of high consequence based on the nature of the diseases, while the likelihood is definite, given the current baseline. The impact will affect those settlements in proximity to accommodation camps, where workforce members may be accommodated during construction as well as communities along the transport corridor from Mombasa and onwards to the Project site, resulting in the geographic extent of the impact being national. During operations there will be fewer work crews, contractors and vehicle movements (including to and from Mombasa) than during construction. However, due to the chronic nature of the diseases and the operations phase having a longer duration than the construction phase, the impact would be of **Major (negative)** significance throughout the life of the project if left unmitigated.

All community-related health, safety and security mitigation will be organised under a Community Health, Safety and Security Management Plan (CHSSMP). TKBV will develop and implement this plan prior to construction commencing and will maintain the plan and monitoring of the outcomes throughout construction and operations. This plan will be linked to the Environmental and Social Management Plan and establish:

- Roles and responsibilities for community health, safety and security;
- Key mitigation, including all policies, programmes and distinct health-related management plans; and
- Monitoring, including setting key performance indicators that will be used to measure implementation of the plan.

As part of Project impact mitigation specific to STI, TKBV will develop an HIV Policy and Programme that addresses the workforce, contractors and PAP in local communities. The programme will specifically identify and recognise high-risk groups (e.g. local female workers, commercial sex workers, young girls in the communities and all Project associated drivers, including contractors) and develop specific control measures for these cohorts. Programme elements will include, but not be limited to:

- Education and public campaigns;
- Social marketing of condoms[22] in the workplace;
- Condom distribution;
- STI screening;
- Promotion of voluntary HIV testing; and
- Support of enrolment in care and treatment programmes to promote prevention and treatment, where relevant.

Where possible, HIV interventions in the workplace will be integrated with STI and tuberculosis management programmes.

The Project will adopt the 95-95-95 strategy for the workforce throughout construction and operations. In this strategy, 95% of HIV infected people are aware and informed of their status. Of that group, 95% are on the appropriate treatment and 95% of those who are on treatment have achieved sustainable viral suppression. In this scenario, transmission of the disease is markedly reduced, as are Project associated impacts on community health. This reduction of risk is dependent, however, on successful and sustainable implementation of the

[22] Social marketing of condoms is where ongoing market research is used to inform three main components of the intervention, i.e. condom branding, the logistics system and a sustained marketing campaign. For all three components, the need for local adaptation and implementation is stressed.

strategy, requiring long-term commitment in terms of resources and funding and will require entering into a partnership with the NACC or NASCOP.

TKBV will implement and maintain a "*closed camp*" status at all accommodation facilities during construction (Kapese Base camp, CFA camp, Make-up Water camp, Rig camp and the Drilling mini camps) and operations (worker accommodation) to reduce opportunities of transactional sexual activity between Project staff and PAP in local communities. Sufficient capacity in accommodation facilities will be planned for to ensure that all non-local Project-related staff are accommodated in camps and not in local communities, thus eliminating the need for local beds in Lokichar. TKBV or the contractor responsible for the Project camp will develop adequate entertainment and recreational facilities in Project camps and rest stops.

TKBV will enforce the existing TKBV Code of Ethical Conduct (Code) that prohibits sexual harassment by Project staff. Failure to comply with any aspect of the Code or related policies, standards or procedures may lead to disciplinary action up to and including dismissal and, in the case of contract staff or business partners, termination of contract. Where there is suspicion of, or an actual breach of the Code, an internal investigation may be initiated as per the existing procedures.

TKBV will develop a Transport Management Plan (TMP) for construction, which will be adapted and maintained through operations. The TMP to mitigate risks associated with logistics activities. As part of this plan, designated rest stops will be identified for exclusive use by Project-related long-distance drivers. The selection of rest stops will include evaluation of existing services to limit the risk for potential influx in these areas. Service level agreements with rest stop service providers will be developed and implemented to maintain a specific accommodation standard that reduces the occurrence of social ills (e.g. commercial sex workers, alcohol use, access control and transactional sex) and to provide adequate entertainment and recreational facilities in rest stops. TKBV will develop an Influx Management Plan (as per Section 7.9.11.2) and associated measures to reduce, manage and, where possible, mitigate influx.

TKBV will monitor specific key indicators related to community health by developing a Community Health Information System (CHIS) to track pre-defined metrics. The CHIS will be used to longitudinally capture and process information about the health status of PAP as well as the activities and outcomes of community health interventions. The system will, at a minimum, consider the inclusion of the following components:

- Processes and activities through which data will be collected and recorded. This may include activities such as cross-sectional health surveys as well intervention-based data collection. Data collection methodology will be developed in conjunction with and with approval by the relevant health authorities in Turkana and West Pokot Counties;
- Analysis of data to identify and track trends and outcomes associated with impacts and interventions, where relevant; and
- Effective feedback of the outcomes to the relevant stakeholders to ensure continuous improvement of interventions, if/when required.

Specific indicators will be selected based on the anticipated community health impacts related to the Project and cover multiple health topics while data collection methodology will be developed in conjunction with and with approval by the relevant health authorities in Turkana and West Pokot Counties. In the absence of adequately accurate data at the local level, a community baseline survey should be considered to inform the point of departure prior to the construction period, with longitudinal monitoring conducted at specified intervals.

To extend the benefits derived from the above mitigation measures, TKBV will support specific Health Systems Strengthening (HSS)[23] activities in areas at higher risk for HIV transmission due to Project impacts. This support should be rendered through a third-party service provider and in close alignment and cooperation with the relevant health authorities.

As part of occupational health, safety and environmental management, TKBV will offer the existing Medical Fitness to Work Specifications and Procedures to include all Project staff mobilising to site. Where required, revise existing plans to include screening and treatment for STIs, hepatitis B and hepatitis C as part of pre-employment screening, but with an opt-out option. Individuals who elect to undergo the above screening and who test positive, will be referred for counselling to consider undergoing a voluntary HIV test (on an opt-in basis). Individuals who test positive for the above conditions, will be referred for counselling to consider undergoing a voluntary HIV test (on an opt-in basis). Medical evaluations will be performed prior to mobilisation via a centralised approval system so that no staff member can travel to the AoI before potentially infectious conditions have been excluded. All staff will be screened for active TB, although screening programmes for latent TB will not be required. All suspected cases should be tested to exclude multi drug resistant TB. Specific screening appropriate to the risk associated with spread of disease through food handlers will also be performed.

TKBV will ensure the development and implementation of Contractor Non-Technical Risk Management procedure to ensure continued, verifiable compliance by all Project contractors to all of the relevant Project occupational health, safety, social and environmental management measures and standards.

Implementation of the aforementioned management plans and the CHIS and HSS activities during construction along with the reduced workforce, contractors and vehicle movements during operations should result in a reduction of the risk of STIs during operations. Monitoring will inform the ongoing management and mitigation programme for STIs and they will be adapted accordingly, the monitoring during construction will inform the operations phase management and mitigation programme.

With the 95-95-95 strategy successfully and sustainably implemented in the Project workforce and contractors that reside in accommodation camps, the residual risk may be substantially reduced as the consequence, duration and geographic distribution is likely to reduce even further, concluding in a residual impact of **Minor (negative)** significance during both construction and operations.

Vector Related Diseases

Malaria is an important health concern in the AoI with the burden of disease, and therefore risk, considered to be higher than is generally reported on malaria spatial distribution models.

According to the national malaria policy, the entire Turkana County is considered low risk for malaria and therefore, does not benefit from any mass targeted malaria control programmes. There are no mass distribution programmes of long-lasting insecticide treated nets at a community level and no facility-based issuance of these nets to high risk groups such as children and pregnant women. The absence of these measures increases the risk to populations in the event of a localised epidemic, as was observed in Loima Sub-county in 2017.

Assessment of the local health facilities in Lokichar, Katilu and Lokori, confirmed that malaria is among the top-five reasons for outpatient consultation. Rapid diagnostic test kits for malaria and treatment were generally available in public health facilities, with these provided to the public at no cost.

Arboviral diseases (arthropod borne viruses) are a risk in the Project AoI. These acute viral fevers (dengue, chikungunya, yellow fever and Rift Valley fever) are transmitted by a day-biting mosquito from the *Aedes* genus, which breeds mainly in human-made (artificial) containers. These diseases are often poorly recognised and

[23] In the context of the Project, HSS pertains to any array of initiatives and strategies that improves one or more of the functions of the current health system and that leads to better health outcomes through improvements in access, coverage, quality, or efficiency

documented due to limited awareness by health care providers and lack of diagnostic capability. Studies have documented a dengue antibody positivity rate of 12.5% nationally, with clustering around coastal and north-eastern regions of the country. In the last five years, there have been several outbreak reports of dengue and chikungunya in the north-eastern part of Kenya.

Alteration of the physical environment from Project construction activities, such as trenching, road building and dust suppression activities may lead to the formation of habitats that are conducive for the breeding of insect vectors (e.g. mosquitoes). The resultant increase in vector densities may cause increased biting rates associated with human/vector contact, which may potentially result in increased disease transmission (including malaria and arboviral diseases) in populations in proximity to these activities. Similar effects may also occur in Project facilities (e.g. camps, wellpads, laydown construction and salvage yards) where housekeeping, waste management and other activities may result in conditions that are conducive the collection of standing water, promoting the proliferation of vectors. While the potential effects are likely to be limited to a localised area in the camp and work area (and thus also pose a workplace risk), there is the potential for these conditions to spread into the surrounding communities.

The risk will be more intense in the construction phases as physical environmental changes and creation of vector breeding sites is likely to be greatest in this period. The risk will extend into operations on a lower scale. In theory this would lead to a lower impact during operations, however without monitoring information of the impact of project activities on vector related diseases and taking into account the duration of impacts will be longer at operations, the significance of impacts prior to mitigation between construction and operations should remain the same.

PAP include those communities and households in proximity to the make-up water pipeline construction activities located in the Endugh, Korpu, Kapitur, Katilu, Lokichar and Kochodin Location, those in proximity to Project camps, CFA, wellpads, in-field roads and activities associated with the infield network construction in the Kochodin Location.

The transport and import of goods (especially tyres), packaging and equipment from arboviral endemic areas may also play a role as infected larvae or eggs can be transferred on ships from these areas (e.g. Asia) into Kenya. Importantly, mosquitoes that transmit dengue fever do not have to acquire it from a human host before they can transmit it. Eggs or larva can emerge with the virus with resultant transmission. There is thus the risk that supply chain management may introduce infected larvae and/or mosquitoes to the port locations, along the transport corridors and in the Project AoI. This has the potential to cause localised introduction of arbo-viral diseases, and while the risk will be higher in the construction phase, it may extend into operations, albeit at a lower potential significance.

The impact has a negative direction with an associated moderate consequence based on the acute nature of the relevant diseases. As the impact considers construction activities that will take place across a significant portion of the AoI, the geographic extent is considered to be regional with a medium-term duration, extending into operations. The likelihood is possible and results in an inherent impact with a **Moderate (negative)** significance for both construction and operations.

As part of occupational health, safety and environmental management, TKBV will develop, implement and maintain throughout the project a country specific Malaria Management Plan in alignment with the WHO ABCD principles with a focus on:

- Source reduction and habitat control (primary controls);
- Workforce education and awareness, bite prevention activities, chemoprophylaxis (secondary controls); and

- Information campaigns to encourage early medical care in the event of the development of suspicious symptoms (tertiary controls).

Specific larval and source control measures to address potential arboviral diseases import at ports will be evaluated as part of the Malaria Management Plan.

As part of the Construction and Operational Environmental Management Plans (CEMP and OEMP, respectively), TKBV will implement and maintain strict source reduction environmental controls around construction sites and associated areas. This may involve backfilling, draining and/or management of any area that may, or has collected water. A permitting system will be implemented for environmental alteration, with a process to ensure minimal disturbance and effective remediation as a priority. As part of this plan, standing water along access roads where water may pool on road ruts and along drainage channels will be managed by promoting run-off, although larviciding may be required as part of the Malaria Management Plan. In addition, source reduction may be required in lay-down construction yards. Metrics related to vector related diseases will be monitored through the CHIS described above.

Project-interventions during operations for the management of vector related diseases (e.g. Malaria Management Plan) are anticipated to reduce during operations. Monitoring will inform the ongoing management and mitigation programme for vector related diseases and they will be adapted accordingly.

The residual impact retains a negative direction, with a moderate consequence but with a local geographical extent and a medium-term duration. This reduction in risk results in a residual impact of **Minor (negative)** significance after mitigation through construction and operations.

Communicable Diseases

Acute respiratory tract infections are prevalent in the entire Project AoI, with these conditions reported in the top five causes of morbidity and incidence rates in Turkana and West Pokot higher than national averages. Prevailing environmental conditions and poor housing were identified as the main predisposing factors.

Tuberculosis contributes to this burden, with the number of bacteriologically confirmed cases showing an upward trend in both Counties, likely due to an increase case detection efforts. As a result, TB was listed among the top ten health challenges in Turkana County. Multi-drug resistant TB is an emerging threat especially in Lodwar, Kakuma and Lokichar, with this representing a significant public health risk. There is currently no TB treatment centre in Lokichar, with the nearest centre at Katilu Sub-County Hospital or the Lodwar County Referral Hospital.

Measles remains an important disease of public health concern nationally, with sporadic outbreaks reported annually. Both Turkana and West Pokot Counties are prone to measles outbreaks owing to prevailing sub-optimal vaccine coverage compounded by the nomadic lifestyle and the significant movement of pastoralists. Measles vaccine coverage in Turkana County, is estimated at 72%, which is below the minimum recommended coverage of 90-95% required for herd immunity. West Pokot County reported immunisation coverage below the minimum threshold for all vaccines (85%), including measles at 58% and polio at 61%. Additionally, meningococcal meningitis is an outbreak risk as the north-western tip of Kenya lies within the African meningitis belt.

Faecal contamination of community-based water sources as a result of inadequate sanitation services and poor hygiene practices were noted as major challenges. It was estimated that only 16% of the population have adequate latrine facilities, with indiscriminate open defecation practice commonly. As a result, diarrhoeal diseases were reported as a major health concern in the AoI, including conditions such as cholera, typhoid fever, amoebiasis and dysentery. Cholera outbreaks were noted to occur periodically (every 9 to 10 years), with the most recent outbreak occurring from January to August 2018 in five sub-Counties: Loima, Turkana Central, Turkana South (Lokichar and Katilu), Turkana North and Turkana West. The length and magnitude of the outbreak that occurred in two waves was linked to the poor sanitation services and behaviours as well as the weak institutional outbreak response mechanisms in the Ministry of Health in the various Counties.

Sections of the Project workforce may originate from another area (within or external to Kenya) where the burden of communicable disease (relating to this impact topic), is appreciably higher than in the Project AoI. This may increase local transmission patterns in the Project workforce, which may, ultimately, spill into communities through various pathways.

A certain amount of interaction between the Project workforce and PAP is anticipated throughout the project life, even if a "*closed camp*" status is implemented at Project accommodation facilities. This can occur at the planned Lokichar local beds (as the housing of Project workforce members in local communities will potentially exacerbate the impact as interaction is more likely under these circumstances) or through interaction with the locally hired workforce (who reside in the local area and interact with the local community) and the incoming workforce.

This interaction may result in the spread of communicable diseases from the workforce to the community. This topic also considers the potential introduction of multidrug or extreme drug resistant disease strains (in the case of TB), diseases that do not commonly circulate in this environment (e.g. influenza), novel strains of disease into the AoI. The weak public health systems and poor healthcare seeking behaviour are also likely to play a role in this communicable disease risk and transmission. Potential delays in diagnosis, outbreak preparedness and response will potentially further enable disease transmission.

Multiple factors related to workforce, occupational health and camp management may also result in the outbreak of infectious diseases in Project camps. If appropriate measures to prevent and manage these outbreaks are not implemented, it is possible that outbreaks of infectious conditions may be transferred to PAP located in proximity to the camps through the previously described pathways.

Project activities have the potential to generate significant amounts of waste belonging to diverse waste streams. Specific waste streams, such as grey water, human excreta and medical waste may result in the transmission of infective conditions. The approach of centralised management of all Project waste at an IWMF located at the CFA and waste management protocols at all camps significantly reduces the risks associated with this potential impact.

The above impacts are expected to affect PAP that reside in communities close to Project infrastructure such as camps, wellpads and construction sites where interaction between community members and workforce may potentially occur. This includes communities and households in the Kochodin Location as well as those in proximity to the water pipeline construction activities located in the Endugh, Korpu, Kapitur, Katilu, Lokichar and Kochodin Locations. The potential impact is likely to be highest in the construction period due to the presence of a larger externally contracted and mobile workforce. In theory there would be a lower impact during operations due to the change in numbers, however without monitoring information of the impact on communicable diseases and taking into account the duration of impacts will be longer at operations, the significance of impacts between construction and operations remains the same.

This impact has a negative direction with a high consequence on human health and is expected to have a local distribution. The duration of the impact is expected to be medium term, i.e. throughout construction and operations and the impact probability is rated as probable, resulting in a pre-mitigation significance rating of **Major (negative)** for construction and operations. Therefore, this impact requires specific mitigation.

As part of Project impact mitigation, TKBV will plan for and provide sufficient capacity in accommodation facilities to prevent overcrowding and to ensure that all Project-related workers are accommodated in camps and not in local communities. Effective camp cleanliness and hygiene standards will be developed and maintained to avoid the risk for disease outbreak and transmission. A "*closed camp status*" will be maintained in all Project camps and maintain the Code of Ethical Conduct and maintain the existing Medical Fitness to Work Specifications and Procedures as described previously.

As part of the Project Waste Management Plans, TKBV will develop and maintain effective waste management procedures and plans that include wastewater, sewerage and medical waste management. As part of this plan, access to landfill areas will be restricted for the general public, discouraging scavenging or waste picking. Wastes from different waste streams will be disposed of via rotary kiln incineration.

Effective food hygiene programmes, in line with industry good practice will be developed and implemented.

As part of occupational health, safety and environmental management, TKBV will develop and implement a workplace TB Management Programme that integrates into the HIV Programme, where possible. Elements will include awareness and education, screening as part of medical fitness to work as well as care and treatment. The latter element will require the development of partnerships with the County health authorities.

A country specific Infectious Disease Health Management Plan (in alignment with the TKBV Infectious Disease Health Management Guideline) will be developed and implemented to reduce the impact of any suspected or confirmed outbreak at the local level. This will require support and interaction with the County health authorities as site-based programmes cannot be managed in isolation. The plan will consider the provision of immunisations for the relevant vaccine preventable diseases to all Project staff. Vaccine selection will be based on risk for travellers and at-risk occupations and include, but not be limited to:

- Seasonal influenza;
- Measles;
- Polio;
- Meningitis; and
- Others as relevant to occupation or Project destination (e.g. Typhoid, Hepatitis A and B and Yellow fever) in alignment with the existing Global Travel Procedure.

Monitoring of metrics related to other communicable diseases through the CHIS will be required as described previously. As part of the Project CDPs, TKBV will support existing clean community campaigns in communities in proximity to Project infrastructure.

Project-interventions during operations for the management of communicable diseases are anticipated to reduce given the lower numbers of workforce. Monitoring will inform the ongoing management and mitigation programme for vector related diseases and they will be adapted accordingly.

Effective mitigation implemented during construction and maintained throughout operations will reduce the consequence to minor and should also reduce the duration to short-term. As the probability is reduced to unlikely, the residual impact is rated as having a **Minor (negative)** significance during both construction and operations.

Zoonotic Diseases

Rabies is endemic nationally, with the most common mode of transmission through the bite or saliva of infected animals. No reported cases of rabies have been notified in the Project AoI from 2016 to 2018, but the disease remains a considerable risk as evidence from secondary data shows multiple incidents of dog bites.

Viral haemorrhagic fever is a general term for a severe viral illness, sometimes associated with bleeding and multi-organ failure, but associated with high mortality rates. This includes diseases such as Ebola, Marburg and Crimean-Congo fever. While no cases of viral haemorrhagic fever have been registered in Kenya to date, the risk remains linked to global movement of populations as witnessed with the recent (2014 to 2016) Ebola outbreak in West Africa and the current Ebola outbreak in the north-eastern area of Democratic Republic of Congo. Brucellosis and echinococcosis (dog tape worm infection) are the commonest zoonotic diseases in the AoI.

Garbage and general domestic waste generated by Project facilities require effective management to ensure proper hygienic conditions. Rodents and other wild animals may be attracted to areas where food is prepared, stored or disposed of. This may result in the increase of the rodent population in Project facilities but also at landfill sites. Increased populations of rodents may cause an increased risk for transmission of diseases associated with poor sanitation, but they may also act as an attractor for predators, including snakes, feral dogs and other animals. Interaction between these predators and the community at landfill sites and other at-risk localities may increase the risk for bites or injuries.

This impact also considers the local transport corridors and construction sites if food packs are provided to workforce members and not properly disposed of. It should be noted that increased number of wildlife in camp areas may also have a negative impact on workforce health for similar reasons.

At risk PAP include residents and households that reside in proximity to accommodation camps where waste may be temporarily stored, prior to transport to the IWMF, as well as those in proximity to the engineered landfill to be constructed outside of the CFA. The risk associated with this impact topic will be higher during the construction phase of the Project. It will extend into operations but on a lower scale due to a decrease in Project staff and activities. Therefore in theory there would be a lower impact during operations due to the change in numbers, however the landfill will be maintained through operations and taking into account the duration of impacts will be longer at operations, the significance of impacts between construction and operations remains the same.

The impact on human health has a negative direction and will have a high consequence over the medium term, i.e. throughout construction and operations. Its geographic distribution is local and probability rating is possible. The overall significance prior to mitigation is **Moderate (negative)** for construction and operations.

As part of occupational health, safety and environmental management, TKBV will develop and implement a Pest Control Programme for the landfill and other Project facilities to prevent the attraction of animals and other pests to these areas. As part of this programme, snake controls in the workplace and camps will be developed that consider the following elements:

- Training and equipping personnel who can respond to and remove a snake from the workplace;
- Education and awareness programmes in the workforce on avoiding snakes, preventing snake bites and immediate first aid; and
- Effective protocols, medical supplies and personnel to manage a snake bite from the Projects workplace medical service.

Following effective mitigation implemented during construction and maintained throughout operations, it is anticipated that the consequence will be reduced to low with a reduction in duration to short-term. The geographic distribution remains local while probability is reduced to unlikely. The residual impact will have a **Negligible** significance for construction and operations.

Accidents and Injuries

The national rise in road traffic accidents has been attributed to increased use of motorised transport (including motorbikes), poorly regulated public transport, driving while under the influence of substances, speeding and poor utilisation of safety equipment such as seat belts and helmets. Safety gear and seatbelts are not routinely worn, increasing the severity of injuries. During the period from 2015 to 2018, Turkana County recorded 33 cases of severe head injuries related to road traffic accidents. Poor road conditions were regarded as contributing factor, but this may also play a role in limiting severe injuries as speeding was not always possible on poor road surfaces.

Emergency medical services in Turkana have shown some improvement in capacity with the number of ambulances increasing from two in 2013 to thirteen in 2018. Despite this increase in capacity, stakeholders believed that this was still inadequate to serve the needs of the County. Importantly, ambulances are generally used to transport patients between facilities and they rarely respond to pre-hospital incidents as primary responders.

The Project requires substantial logistical support. This increase in the quantity of road traffic on existing roads (notably the C46 and A1) as well as the infield access roads (to be constructed by the Project), may increase road traffic and pedestrian-vehicle accidents more notably during construction, but also into operations, resulting in an increase in morbidity and mortality amongst community members, with children noted as an especially vulnerable group.

Unskilled or semi-skilled workers, especially those from the rural communities, are unlikely to have had exposure to work conditions and safety standards associated with a Project of this nature and magnitude. This will be most evident during the construction phase and appropriate health and safety standards will need to be introduced to reduce incidents and accidents to as low as reasonably practicable. This approach will be maintained during operations. Although the local unskilled workers may not necessarily be utilised in all high-risk activities and numbers required will reduce during operations, the risk for involvement in occupational incidents resulting in injury and mortality remains.

Similarly, community members may gain access to Project construction sites and other facilities, resulting in injuries from accidental interaction with mobile construction equipment, falling into excavation pits or from interaction with construction materials or other Project infrastructure.

At risk PAP include those who reside in communities alongside transport corridors and infield access roads, as well as those in proximity to construction sites. The risk associated with this potential impact will be highest during construction due to the increased number of activities and work sites. It may, however, extend into operations but generally limited to permanent Project infrastructure and to a lesser degree, transport corridors and access roads.

The impact is considered to have a negative direction on human health and safety, associated with a high consequence over a short-term duration during construction and a medium consequence over a medium-term duration during operations. The difference is due to a reduced number of sources of impacts from construction sites and activities and reduced numbers of project traffic during operations. Despite the extensive geographic distribution of the Project’s logistics activities, the impact will likely only affect specific individuals within communities along major transport routes, those in proximity to access roads and those in proximity to construction sites, resulting in a national distribution when all transport corridors are considered. As the likelihood of this impact occurring is probable, this impact is rated to have a **Major (negative)** significance during construction and **Moderate (negative)** during operations.

As mitigation, TKBV will maintain the existing Safe and Sustainable Operations Policy (2017) throughout construction and operations, which states its commitment to create a working environment that causes no harm to people. All workers and those working on TKBV’s behalf are empowered to stop any activity they regard to be in with contravention of the policy.

As key elements related to the reduction in accidents and injuries, the Safe and Sustainable Operations Policy states that it will:

- Comply with the law or TKBV Standards, whichever sets higher expectations, and hold our contractors to the same;
- Identify and assess environmental, health, safety, security and social risks and manage them proactively throughout the Project life cycle;
- Set goals and targets, and measure performance against them to continuously improve our performance.

In addition, prior to commencement of construction, TKBV will develop and implement a TMP, which will include a procedure for the management of emergencies or accidents in the community related and/or unrelated to the Project's activities. The T|MP will be adapted and maintained throughout operations. The TMP will consider the following elements as it pertains to Project drivers:

- Specific medical fitness to work specifications for Project drivers;
- Fatigue management;
- Driver training;
- Vehicle roadworthy standards; and
- Substance misuse, amongst others.

TKBV will support a road safety campaign in the AoI, targeting roads users and pedestrians, with a specific focus on communities that reside or travel along the infield access roads.

Appropriate access control measures (e.g. access control of open excavations and construction sites) will be maintained to prohibit unauthorised entry by community members.

TKBV will develop and implement a communication process to inform communities in the AoI when construction activities are active in their area, what these activities entail, the risks to community members and the duration of these activities.

Monitoring of metrics related to accidents and injuries will be done through the CHIS throughout the project life. This will be especially useful to evaluate 'hot-spots' that can direct interventions, but also to support the longitudinal monitoring to support management measures.

Data on occupational accidents and injuries will be tracked through the EHS Incident Reporting, Investigation and Data Procedure. Data collected in this manner will be used to inform the risk assessment process and support amendments to processes and procedures.

Implementation of mitigation measures will result in a negative impact with high consequence, short term duration, local distribution and a probability rated as unlikely during construction and the same evaluation except it will be medium-term during operations. This results in a reduced residual impact of **Moderate (negative)** significance during construction and the significance being maintained at **Moderate (negative)** during operations due to the high consequence.

7.9.11.7 Environmental Determinants of Health

The purpose of this section is to cross-reference key environmental determinants of health and highlight the linkages with community health. Unlike the previous impact topics, no additional mitigation measures will be added. All mitigation measures are included in the environmental sections, but linkage between the environment and social impacts are described here.

Air quality

Potential impacts related to air quality may occur during both the construction and operational phases of the Project. Project-related activities may generate oxides of Sulphur (SO_x) and Nitrogen (NO_x) as well as dust deposition. This may potentially result in negative health impacts as suspended particulate matter from dust may have the potential to impact human health. This is, however, largely dependent on particle characteristics, particularly particle size and chemical composition and the duration, frequency and magnitude of exposure.

The potential of particles to be inhaled and deposited in the lung is a function of the aerodynamic characteristics of particles in flow streams. When the particle size is smaller than $PM_{2.5}$, the particles are respirable and may penetrate deep into the lungs causing serious health problems including respiratory tract irritation, chronic bronchitis, or asthma exacerbation.

Potential PAP at risk from these impacts are those that reside in settlements adjacent to construction sites, permanent Project infrastructure and unsealed access roads as well as transient individuals, although it is expected that exposure in the latter cohort would be less due to a shorter exposure period. Children, the elderly and those with existing chronic lung conditions such as asthma and chronic obstructive pulmonary disease will be at higher risk.

Modelling performed as part of the air quality impact analysis has shown that the potential for impacts related to NO_2, SO_2 and CO exposure are negligible during the Project timeframe, while the potential for impacts as a result of PM_{10} particulate matter exposure during the same period, is low. Three households located in proximity to the CFA footprint in the Kochodin Location, are potentially at risk of excessive exposure to $PM_{2.5}$ particulate matter.

As part of the Project impact mitigation, TKBV will implement management measures as per the Air Quality section (Section 7.1) of the ESIA.

Noise and Vibration

Evidence from epidemiological studies have demonstrated that environmental noise is associated with an increased incidence of arterial hypertension, myocardial infarction, and cerebro-vascular accidents (stroke). Both observational and experimental studies indicate that, in particular, night-time noise can cause disruptions of sleep structure, vegetative arousals (e.g. increases of blood pressure and heart rate) and increases in stress hormone levels.

As part of the Project impact mitigation, TKBV will implement management measures as per the Noise and Vibration section (Section 7.2) of the ESIA.

Water Quality and Quantity

Multiple Project-related activities may potentially impact on the quality and quantity of water sources available to PAP in the AoI. A decrease in the availability of safe water may lead to an increase in water and sanitation related diseases in an area that is already deemed to be water-stressed and where sanitation related diseases where reported as a major health concern by stakeholders.

As part of the Project impact mitigation, TKBV will implement management measures as per the Water quantity and quality sections (Section 7.4 and 7.5) of the ESIA.

7.9.11.8 Education

One impact topic has been identified in relation to education: changes in access to education. This impact topic considers primarily indirect impacts on access to education since there are no expected direct impacts on education through displacement.

Change in Access to Education

There are numerous challenges to the education context in both Turkana and West Pokot Counties. High dropout rates and low enrolment numbers of young girls in schools have been associated with early marriage and the pastoral lifestyle. This is an ongoing challenge and the Project may have an indirect impact due to availability of economic opportunities in the AoI, which could indirectly affect this continual marginalisation of young females.

Another challenge is the low enrolment in schools of children from pastoral livelihood families in both Turkana and West Pokot Counties. The ministry in Turkana and West Pokot have taken initiatives to address this lack of access to education by providing teachers who would travel with the mobile family units.

The Project has the potential to indirectly impact pastoral movements and disturb this livelihood. This may have a positive effect of driving pastoralists to remain in permanent settlements thus their children would then have access to school facilities. It has been noted from Key Informant Interviews that the attendance and enrolment of children in school is low during times of conflict and instability.

Anticipated Project-induced in-migration would also have an indirect impact on access to education for PAP. Influx in urban areas has the potential to increase pressure on already limited education facilities. Key Informant interviews noted that children have to travel long distances to schools. It was also stated that teachers are moving into other sectors of employment where they are offered better salaries and benefits.

The impact to education is the change in access to education for PAP. There is no expected direct impact on any school building due to the placement of Project infrastructure and loss of land triggered by the Project. However, changes can be anticipated indirectly. Such changes can be both positive and negative.

In general, new investment, employment and business opportunities create more opportunities that create incentives for more diverse and skilled students. The opportunities create incentives for gaining new technical and business skills which is a positive outcome. However, the limitation in available educational infrastructure can make this a negative impact. Currently there are only 32 secondary schools in Turkana County and 142 in West Pokot County which is a limitation for students to continue their education. There is also a limited access to technical colleges and vocational training programmes. These new economic opportunities would create a need for more secondary schools and technical colleges which would allow for children to further their education into a skilled service or technical vocation.

Increased employment opportunities generated by the Project provide some with added income and the ability to support children in school. Similarly, increased business opportunities linked to local content also can increase household income. While these trends are positive, both can also have negative impacts. While salaried employment provides more income, it can also increase domestic work within the household and cause incentives to keep some children out of school to take on a bigger share of these domestic tasks.

As local businesses grow and multiply, there can also be incentives for children to leave school and seek work to increase household income. This dynamic was observed in some parts of the AoI where gold mining was noted as a factor in keeping children from going to school. It was observed that short-term income is valued over the longer-term benefit of education.

Indirect impacts caused by Project influx can have an influence on the number of students seeking an education. These indirect impacts are further discussed in Section 7.9.11.2. Potential indirect impacts associated with security that could affect children’s attendance and enrolment in schools in conflict areas will be discussed in Section 7.9.11.8.

The changes to access of education has a mixed direction and it is difficult to predict. The consequence is moderate, and the geographic extent of the change can be expected to be regional, affecting PAP in Turkana and West Pokot Counties. The duration of the impact is medium-term, i.e. throughout construction and operations. The impact significance prior to mitigation or benefit enhancement is **Minor (positive**) during construction and operations**.**

Since 2011, TKBV has planned and undertaken approximately 56 social investment initiatives related to education in Turkana. These projects range from building new school infrastructure, maintaining existing school infrastructure, including classrooms, dormitories, and latrines. Projects also include the provision of training and education bursaries. Many of the projects have been undertaken in the context of land access during the Exploration and Appraisal phase, while others are linked to discretionary social investment. Such social investment extends to the County centre in Lodwar where projects have sought to support the development of technical skills at the Lodwar Vocational Training Centre.

As of May 2018, 6,000 primary and secondary students had received support through bursaries, 200 received scholarships for vocational training and 30 specific schools had received either infrastructure or equipment. Some initiatives have targeted girls. As of June 2019, enrolment at the Uhuru Girls High School had increased from 360 in 2015 to 580, partially due to the increased student accommodation that increased the capacity for girls to attend school.

While such social investment is expected to address the negative impacts related to the Project, the educational projects would benefit from a more comprehensive strategy, which must be expanded to include equal opportunities for Project-affected settlements in the AoI. This strategy will be developed with the participation of relevant educational stakeholders and PAP. The coordination will include, the Turkana and West Pokot County departments and Education Ministries to further develop this strategy and align the social investments with government and even NGO initiatives.

The new strategy will work with stakeholders to identify key performance indicators that help to monitor access to education. These indicators will be part of on-going reporting. Indicators will be disaggregated by gender, as girls have a disadvantage when it comes to access to education due to early marriage and pregnancy.

Finally, TKBV will use continued stakeholder engagement to assess potential negative indirect impacts. The key engagement tools will be periodic public consultation, as well as promotion of the community grievance mechanism.

If the strategy is developed to be more comprehensive and measurable, the changes to access of education will have a residual impact of **Moderate (positive)** starting during construction but continuing throughout operations.

7.9.11.9 Social Maladies

Crime, Commercial Sex Work and Other Nuisances from Growth

Social determinants of health are the conditions in which people are born, grow, live, work and age, including the health system. These circumstances are shaped by the distribution of money, power and resources.

Education is a key determinant to support and may uplift the health status and wellbeing of an individual in a society, and indeed entire communities. Literacy levels in the Project AoI are amongst the lowest nationally, with nearly two-thirds of women (64%) and over a third of men (35%) in Turkana County having no formal education.

Substance abuse, particularly alcoholism, was reported as an emerging health challenge in Turkana County. The trend is increasing particularly in urban areas and peri-urban informal settlements. Use of illicit drugs such as marijuana was reported in Lodwar town and Lokichar urban settlement.

Commercial sex activity was reported in Lodwar, Lokichar and Lokori and was linked to the economic development in these areas. Teenage pregnancies were largely attributed to early marriages, with most girls in the area married at the age of 14 to17 years. As a result, educational attainment was low in this group and was noted to be a contributing factor to poor health education and poor awareness of health issues. In addition to this, women were perceived as marginalised in many aspects including education, employment opportunities and decision-making capabilities.

It is generally recognised that women are primarily impacted by domestic gender-based violence which creates both a health and psychological burden. It also recognised that in many societies, women are socialised to accept, tolerate and even rationalise the practice. Data shows that in 2018, Turkana and West Pokot Counties recorded 439 cases and 477 cases of sexual violence, respectively. Violent behaviour was reported as common in general society, with this reflected in the high rates of violence-related injuries as well as gender-based domestic and sexual violence. Ethnic animosity and substance abuse were reported as contributing factors.

The lack of general employment opportunities in the AoI and the subjective expectation that the Project will support significant employment opportunities and economic development, has the potential to create social disharmony especially towards the Project, if these expectations are not realised. This may result in negative perceptions of well-being within communities or sections in the communities who may not directly or indirectly benefit from the Project.

Although a proportion of the Project workforce will be recruited from the local communities during the construction phase, this will only provide employment for a period of three years. While this will be the period in which the local communities can benefit the most from direct employment; the skill sets and experience in the community will limit their potential for employment in senior roles. In the operations phase, there will be a smaller workforce, that requires a small number of local workers (estimated at 200 persons) to be utilised in semiskilled and unskilled roles.

Therefore, while local communities will benefit from local employment, employment opportunities are of short duration and will be markedly reduced in the operational phase. The benefits derived from this will likely be outweighed by potential negative impacts. Project employment may result in negative health consequences, including:

- Employment of community members for a short period, with a resultant alteration from subsistence livelihood to earning a paid wage. This may change traditional practices, especially in men who may not want to return to subsistence livelihoods once the employment opportunities cease.
- Development of a cash economy that may erode community cohesion and traditional bonds, which are an essential element in mutual help structures and local culture. Project induced in-migration (PIIM) may also influence these traditional structures and also create supply and demand of products and services with escalating inflation, especially during construction.
- The development of a cash economy may also limit informal trading and bartering, which may limit access to certain sectors of the community to the local economy.
- Increased financial gains obtained by men from Project employment may not necessarily translate into benefits for other members of the household and may increase the incidence of social ills amongst local workforce members (e.g. substance abuse, transactional sex and commercial sex work) and result in an increase in gender-based domestic violence in AoI communities.
- As a result of predominantly male employment in unskilled labour positions, marginalisation of women may lead to an increase in transactional or commercial sex as a means to support and augment livelihoods.

- In addition to this, improper financial management by the male heads of households may result in a decrease in food security and result in worsening malnutrition, specifically in those households who are dependent on procuring basic foodstuffs rather than partaking in subsistence livelihood activities.
- The impacts related to social maladies will be further exacerbated by PIIM and the erosion of existing social structures.
- Due to the short-term duration of the Project's construction phase, it is unlikely that socio-economic conditions in the AoI will sustainably improve as a direct result of Project employment to the extent that NCD will develop in local communities. The impact of employment as it relates to NCDs is therefore considered to be negligible during construction and not rated. However, this may change if the socio-economic circumstances in the AoI improve through, for example, payment of royalties with NCDs having the potential to surpass communicable disease in the overall burden of disease in future.

In addition to the impacts related to Project employment, there will also be the expectation that the Project will support a full range of social development and community investment programmes, irrespective of the role that the County and National government should play in this role. The local communities do not necessarily have insight into the actual scale and planned activities of the Project, which will potentially support these false expectations.

The impact has negative direction, moderate consequence over the short term, regional distribution with a peak during construction. As the likelihood of this impact is probable, it concludes as an impact with **Moderate (negative)** significance during both construction and operations and requires specific mitigation throughout the project life.

In addition to this, during the construction phase, TKBV will develop and implement awareness and education programmes with a focus on the local workforce, covering social conduct (e.g. gender-based violence, drug and alcohol misuse), financial management and basic workplace wellness programmes that are culturally acceptable. These programmes will be adapted based on monitoring and maintained throughout operations. Whilst Project-interventions during operations are anticipated to reduce, the later stages of construction when many of the local workforce will be demobilised and during the initial period of operations will be key stages for maintaining and monitoring mitigation and then adapting measures accordingly.

Opportunities to support local economic development and other entrepreneurial activities, with a specific focus on empowerment of women and girls will be evaluated as part of the Project social investment strategy. This includes alternative livelihoods programmes and skills development/ training of the local communities.

TKBV will ensure the development and implementation of Contractor Non-Technical Risk Management Plans to ensure continued, verifiable compliance by all Project contractors to all of the relevant Project social management measures and standards.

The results in a residual rating during construction of **Minor (negative),** reducing to **Negligible** significance for operations, if programmes and policies are successfully implemented and maintained.

7.9.11.10 Social Capital and Conflict

Two impact categories have been identified in relation to social capital and conflict:

- Inter-ethnic conflict; and
- Community cohesion within Turkana and West Pokot Counties.

Inter-Ethnic Conflict

Turkana and neighbouring pastoralist Counties in Kenya have well-known histories of conflict and violence, often associated with cattle raiding. While this conflict preceded the arrival of current oil-related activities, it forms the backdrop for the Project.

During Golder's initial fieldwork in July 2016, there were indications of relative calm in comparison to previous years. During a period from March to October 2016 security monitoring registered few violence incidents. From November 2016, there was an increased in violent incidents and this trend has steadied. The overall situation is variable, but not dangerous as the period around 2015. The 10 years leading up to 2015 has seen a gradual shift in patterns of livestock raiding and attacks. While cattle raids still occur, the commercialisation of livestock theft, in which individuals, and not communities, benefit from raiding, emerged. Politicians, businessmen and other elites are alleged to be supporting and profiting from commercialised raiding, something that is believed to be eroding the authority of Traditional Leaders.

A total of 106 security incidents have been registered in Turkana and West Pokot during the reporting period August 2018 – July 2019 with incidents in Turkana accounting for 85% of these.

The source of potential impact for this topic is the transport of materials during construction and operation to the Project infrastructure areas which will be undertaken by trucks along set access road routes. These vehicles will move through areas of relative insecurity and require additional security measures from the Project. Security will also be continued and expanded to guarded stations at wellpads and other Project infrastructure.

The Project will impact upon the conflict in complex ways that are difficult to track. Fieldwork outlined numerous potential triggers for renewed violence, including disagreements over natural resource use, land disputes and accusations across ethnic lines of banditry along the A1 highway that connects Turkana and West Pokot Counties. The finalisation of the decision on the source of Project water coming from West Pokot cements a lingering feeling among Pokot residents that they should share equally in Project benefits. During construction, particularly as vehicles move from West Pokot into Turkana, residents along the contested border will have steady reminders about the development of oil and this has the possibility to further debates about County boundaries, job distribution and revenue sharing.

In the past, inter-ethnic conflict has been linked to cattle raiding and the practice has been linked to naturally occurring changes such as climate change and periodic drought. However, with the launch of the Project, private sector activities are likely to draw more attention and blame for violence.

The overall consequence of this negative impact is assessed at the highest level. The complexity of the issue, coupled with the possibility of violent conflict that can quickly spill over into areas outside the Project area, make this impact topic extremely difficult to manage.

The impact on inter-ethnic conflict is negative by direction and the consequence is high. The geographic extent of change is predicted to be national (beyond Turkana and West Pokot) and the duration is medium-term, i.e. throughout construction and operations. The overall impact significance prior to mitigation is **Major (negative)** for construction and operations**.**

TKBV will maintain a corporate Human Rights Policy (2017) that states its commitment to implement the UN Guiding Principles on Business and Human Rights and the VPSHR. This policy is available online and applies to all who work for or on behalf of TKBV.

A key VPSHR commitment in this process is that all TKBV business units include and evaluation of the potential likelihood, severity and operation impact of:

- Crime;
- Civil unrest/disorder;
- Terrorism;
- Kidnap/Piracy;
- Threat of armed conflict or war (local/national/international);
- Disgruntled employee; and
- Risks to communities resulting from our business's security arrangements in areas of operation.

TKBV will maintain its existing VPSHR Implementation Guideline (2019) throughout the life of the Project. The Implementation Guideline frames the approach to realising its commitment and identifies seven key themes related to respecting human rights:

- Identification and management of security and human rights risks;
- Managing the Relationship with Public Security Forces;
- Managing Private Security;
- Stakeholder Management;
- Management System Integration of the voluntary principles;
- Assurance; and
- Investigation and Reporting.

Throughout the life of the project, TKBV will continue is regular monitoring of security incidents, which cover vandalism, crime, cattle raiding and inter-communal clashes. This data informs security personnel and includes close cooperation with public security forces.

TKBV is committed to instating a cross-functional team inclusive of stakeholders, which will be engaged to define mitigation activities designed to reduce the impacts arising from each security risk, security controls and countermeasures to reduce prevailing risks and provide layered protection around critical or sensitive activities, response activities aligned to escalation alert levels for security related incidents and resources required to implement security controls and response activities. TKBV will be responsible for updating risk registers or assessments where the risks or vulnerability result in changes to the risk profile.

The risk assessment will be used to identify potential impacts and risks to communities resulting from TKBV's security arrangements in support of the activity. In cases where impacts are identified, a cross-functional team will be engaged to:

- Review risk assessments to understand the level of security risk facing the Company and the community;
- Prepare a Stakeholder Analysis to identify, understand and consider the concerns, interests and relationships of stakeholders;
- Work with stakeholders to develop mitigation activities designed to reduce the impacts arising from security arrangements;

- Determine training needs analysis for contracted security provider and TKBV employees;
- Review licensing and authority of private and public security resources to be engaged; and
- Develop and implement a complaints and grievances mechanism commensurate with the risk rating, and document through the TKBV Incident Reporting System.

Training records and performance against key performance indicators will be documented by private security service providers, and formally assessed by the TKBV managers on a periodic basis.

Public security forces, as a general rule, will only be used where there is no alternative and limited to provide general area security outside of TKBV sites and respond to security incidents in accordance with their jurisdiction.

Security incidents are monitored within Turkana and the whole country. Monthly reporting highlights trends in relation to security, brief descriptions of incidents and information that can be used to mitigate security risks.

All employees and visitors receive specific security briefing as part of their induction and orientation process, including:

- An overview of local security risks and controls;
- Personal security responsibilities and reporting requirements; and
- Detail of relevant response actions for security incidents.

Refresher training is provided to all employees at least annually throughout the project or when risk levels are elevated.

While few of the mitigation commitments above are directly related to inter-ethnic conflict, they attempt to make sure employees, contractors and visitors to TKBV facilities are informed as much as possible about security risks. Following construction phase, all commitments will be monitored and with engagement (which picks up qualitative and unanticipated changes) adapted as necessary for operations. If accompanied by the engagement commitments relating to the implementation of the CDPs, the residual impact is expected to be **Minor (negative)** for both construction and operations.

Community Cohesion Within Turkana and West Pokot County

There are no quantitative baseline indicators to assess community cohesion. The impact topic is important, however, as any Project of this size will inevitably change community cohesion when large-scale industry is introduced to a rural environment that has largely relied only on subsistence pastoralism and household, small-scale agriculture.

The impact topic is also important given the high expectations about community benefits. Even at the earliest stages, fieldwork highlighted common beliefs of unfairness and that a given community had not benefitted as much as the neighbouring one. Misunderstandings about employment and why many jobs are given to skilled workers from outside the area of influence can create jealously that has the potential to create community conflict. Many research interviews confirmed the broad expectation that local employment will be generated by industrial development. However, the number of jobs and definition of "*local*" is understood very differently across the AoI with a persistent view that jobs will be allocated in exchange for land access and other Project related impacts. This more transactional approach, used in early exploration and appraisal stages of the Project, will not be scalable.

Even prior to the Project starting, key informants and other leaders have described growing tension between youth and elders, as well as a gradual shift away from overall respect toward elders and traditional livelihoods. If left unaddressed, misunderstandings about the oil industry have the potential to negatively affect Turkana and West Pokot. This has and will continue to lead to grievances and to an overall deterioration of community cohesion which need comprehensive management and engagement during construction, which should be adapted and maintained at an appropriate level through operations based on monitoring and engagement outcomes.

The impact on community cohesion is negative by direction. The consequence is moderate. The geographic extent of change is local and the duration is medium-term, i.e. throughout construction and operations. The overall impact significance prior to mitigation is **Moderate (negative)** for both construction and operations

The impact related to community cohesion is linked to high expectations. There is no one solution that can address these expectations and any solutions used will need to adapt as PAP expectations change.

TKBV will seek to address high expectations through its on-going stakeholder engagement campaigns. Specific campaigns will be created, as needed, to establish and distribute key messages so that all observers believe in the procedural fairness of TKBV's activities. At this time, it is not possible to predict the topics of these information campaigns, but it is certain that information campaigns will cut across all physical, biological and social topics described in the impact assessment.

Since 2015, TKBV has adopted an information management system to capture the results of stakeholder meetings and allow for better analysis to verify the effectiveness of environmental and social management. This system will be used to monitor and track potential problems among local communities. As needed, new information campaigns will be created to correct misunderstandings and address other unanticipated impacts that are identified through continued engagement. Engagement commitments are expected to be an early warning system for impacts that negatively affect community cohesion.

While difficult to predict, the engagement commitments described above, if implemented comprehensively at construction and maintained at an appropriate level throughout operations, are expected to minimise the chance of this negative impact occurring making the residual impact **Minor (negative)** for both construction and operations**.**

7.9.11.11 Construction Impact Assessment

The construction phase impact assessment pre-mitigation and post mitigation impact evaluations linked to the preceding text are presented in Table 7.9-5.

Table 7.9-5: Construction Impact Assessment

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Project-induced influx and in-migration	Economic opportunities linked to a multi-billion investment Indirect effect of increased salaried employment and procurement	Major (negative)	■ Develop and implement an Influx Management Plan, which will be shared with authorities in Turkana and West Pokot Counties. ■ Verify effective indicators to monitor population growth within Influx Management Plan. ■ Confirm monitoring "*hot spots*" where data on indicators will be collected. ■ Revise human resource documents to reduce incentives for in-migration. ■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). ■ Operate all construction accommodation as "*closed camps*". ■ Disclose all local labour needs and recruitment information, including contractor information. ■ Conduct a stakeholder engagement campaign to explain construction employment and local content opportunities, as well as the procedures that people must follow to obtain employment. ■ Establish a working group, to be led by TKBV, with representatives of National and County government, and civil society.	Minor (negative)
Infrastructure	Additional infrastructure and activities	Minor (positive)	■ Agree infrastructure investments as part of the CDPs, aligned to County Integrated Development Plans. ■ Establish an engagement process headed by leadership at the County and Sub-county level, including representatives of government departments, private sector, NGOs and potentially religious institutions. ■ Identify key performance indicators that help to monitor performance. ■ TKBV will work with County Governments to encourage sustainable use of community offtake water points on the water pipeline to discourage overgrazing at water off take points, and record issues as part of the grievance mechanism	Moderate (positive)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Taxes and payments	Tax and other payments linked to Project	Moderate (positive)	■ Continue to disclose taxes in Annual Reports. ■ Conduct periodic engagement on key social management plans, including all CDPs, with relevant County-level board of trustees[24] charged with overseeing profits.	Moderate (positive)
Contractor employment	Contractor managed construction and employment opportunities	Minor (positive)	■ Agree to a revised and updated National Content planning approach. ■ Revise definitions related to "*local*" and "*local-local*" administrative units in the context of Community Development Plans. ■ Develop HR Contractor Standard, forming minimum requirements for all contractors to follow. ■ Promote the TKBV Code of Ethical Conduct (The Code), specifically as it related to the principle of "*zero tolerance*" for any form of discrimination. ■ Continue using Contractor Non-technical Risk Management Policy. ■ Adhere to TKBV Human Rights Policy. ■ Track Contractor Employment data by gender.	Moderate (positive)
Business opportunities and local content	Procurement opportunities linked to the Project	Minor (positive)	■ Develop TKBV approved Local Content Plan including procedures for local procurement. ■ Agree to a revised and updated National Content planning approach; including KPI for monitoring changes in business opportunities and local content performance. ■ Organise workshops and other engagement to inform companies about procurement requirements and how to qualify for tendering processes. ■ Within CDPs, set out commitments for local business capacity building. ■ Identify key performance indicators that help to monitor changes in business opportunities and local content performance.	Moderate (positive)

[24] A County-level board of trustees is described in the Petroleum Act as the body that will oversee the utilisation of funds "*for the benefit of present and future generations*".

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Inflation	Indirect effect of increased salaried employment and procurement	Moderate (negative)	■ Select and monitor prices periodically for standard "*basket of goods*" in hotspot areas, as well as in control area. ■ Collect data similar to NDMA monthly surveys on socio-economic indicators. ■ Within CDPs set out of key social programmes to support PAP to develop sustainable skills that can help manage potential changes on the supply and demand of goods.	Minor (negative)
Long term loss of community land	Land acquisition to develop the facilities required for the Project	Major (negative)	■ Compensation, as determined under Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. ■ Any gaps between the Government-led land acquisition and IFC PS5 will be addressed as part of the LRP.	Minor (negative)
Temporary restriction on land use, notably pastoral grazing and settlement access, during construction	Temporary land restrictions on land use to develop the facilities required for the Project	Major (negative)	■ Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are impacted. ■ Compensation, as determined under Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. ■ Any gaps between government-led land acquisition and IFC PS5 will be addressed as part of the LRP.	Minor (negative)
Long term restrictions on settlement along the wayleave (6 m wide) of the water pipeline route	Land acquisition to develop the facilities required for the Project	Minor (negative)	■ Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are impacted. ■ Compensation, as determined under the Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. ■ Any gaps between government-led land acquisition and IFC PS5 will be addressed as part of the LRP.	Negligible

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Loss of occupied homesteads (physical displacement)	Land acquisition to develop the facilities required for the Project	Major (negative)	■ Compensation, as determined under the Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. ■ Any gaps between government-led land acquisition and IFC PS5 will be addressed as part of the LRP.	Minor (negative)
Loss of household structures other than homesteads, e.g. animal shelters or dug water holes	Land acquisition to develop the facilities required for the Project	Minor (negative)	■ Compensation, as determined under the Kenyan Law which recognises such structures, to be provided as part of the Government-led statutory land acquisition process. ■ Any gaps between government-led land acquisition and IFC PS5 will be addressed as part of the LRP.	Negligible
Loss of business structures - shops	Land acquisition to develop the facilities required for the Project	Minor (negative)	■ Compensation, as determined under the Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. ■ Any gaps between government-led land acquisition and IFC PS5 will be addressed as part of the LRP.	Negligible
Temporary loss of access to or use of TKBV community water tanks	Temporary land restrictions on land use to develop the facilities required for the Project	Moderate (negative)	■ Engage with PAP and authorities in helping to identify suitable alternative sources of water.	Negligible
Increased travel / walking distances to community assets or TKBV water tanks	Land acquisition to develop the facilities required for the Project	Minor (negative)	■ Engage with PAP and authorities in helping to identify suitable alternative sources of water.	Negligible

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Impacts on livelihoods due to loss of communal land (economic displacement)	Land acquisition to develop the facilities required for the Project	Moderate (negative)	■ Any livelihood impacts not addressed as part of the Government-led statutory process will be managed as part of the LRP. ■ Engage with PAP to develop LRPs and CDPs, which will be created with authorities in Turkana and West Pokot Counties. Subject to agreement with the PAP, the LRPs and CDPs will deliver livelihood restoration and community benefits, including support to: ■ Skills development; ■ Micro business support; and ■ Livestock grazing improvements.	Negligible
Impacts on Graves	Land acquisition to develop the facilities required for the Project	Major (negative)	■ TKBV will implement consultation with affected communities and site guardians. ■ Micro alignment of the interconnecting network within the RoW will be used to avoid direct impact to graves, where feasible. Where this is not feasible, graves will have to be relocated in consultation with site guardians and affected communities. ■ The CFP will detail steps for identifying unrecorded graves within the development footprint prior to construction. ■ Compensation, as provided under Kenyan Law which recognises graves and the costs of rituals required to relocate graves, to be provided as part of the Government-led statutory land acquisition process. ■ Engage with the community to agree procedures for demarcation (e.g. demarcation and communication of 'no go' sensitive locations and mapping and communication of cultural heritage 'constraints') or, in the highly exceptional circumstances (follow up by consultation with site guardians and affected communities), relocation and reburial of graves. ■ Provide details of grave relocation, compensation and assistance in an LRP.	Minor (negative)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Impacts on Vulnerable Persons	Land acquisition to develop the facilities required for the Project	Moderate (negative)	■ Provide supplementary activities to identify vulnerable persons or provide assistance to ensure that they are no more adversely affected by resettlement than others. ■ Provide details of vulnerable persons support in an LRP.	Minor (negative)
Sexually transmitted infections	Introduction of outside workforce, financial incentives for vulnerable persons, and transport for Project construction	Major (negative)	■ Develop and implement CHSSMP ■ Develop an HIV Policy and Programme. ■ Develop and implement "*95-95-95*" strategy, which sets targets for awareness, treatment and demonstrating performance in viral suppression. ■ Operate all construction accommodation as "*closed camps*". ■ Train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). ■ Develop and implement TMP, specifically linked to the identification and management of transport rest stops. ■ Develop and implement Influx Management Plan, which will be created with authorities in Turkana and West Pokot Counties. ■ Monitor key performance indicators through a CHIS. ■ Support specific Health Systems Strengthening activities (to be implemented by a third party) in areas at higher risk for HIV transmission due to Project impacts. ■ Maintain Medical Fitness to Work Specification and Procedures. ■ Develop and implement Contractor Non-Technical Risk Management Plans, used to manage contractor performance.	Minor (negative)
Vector related diseases	Alteration of the physical environment	Moderate (negative)	■ Approve and implement a Malaria Management Plan. ■ Implement strict source reduction environmental controls around construction sites, to be set out in the CEMP. ■ Monitor key performance indicators through a CHIS.	Minor (negative)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Communicable diseases	Introduction of outside workforce and transport for Project construction	Major (negative)	■ Implement camp cleanliness and hygiene standards. ■ Operate all construction accommodation as *"closed camps"*. ■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). ■ Maintain Medical Fitness to Work Specification and Procedures. ■ Approve and maintain effective waste management procedures, as per Waste Management Plan. ■ Align food hygiene programmes with good industry practice standards. ■ Implement TB Management Programme, linked to the HIV Programme, that will be created in collaboration with authorities in Turkana and West Pokot Counties. ■ Approve and implement Infectious Disease Health Management Plan. ■ Monitor key performance indicators through a CHIS.	Minor (negative)
Zoonotic diseases	Waste from Project activities	Moderate (negative)	■ Develop and implement Pest Control Plan for landfill and other Project facilities.	Negligible
Accidents and injuries	Transport for Project construction	Major (negative)	■ Maintain the Safe and Sustainable Operations Policy. ■ Develop and implement TMP, specifically for the management of emergencies or accidents. ■ Conduct a stakeholder engagement campaign on road safety for construction activities within the immediate area of influence. ■ Develop and implement a CHSSMP, specifically access control measures. ■ Monitor key performance indicators through a CHIS.	Moderate (negative)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Change in access to education	Infrastructure affecting movement of pastoralists, indirect impact of in-migration	Minor (positive)	■ Based on previous social investment related to education, develop to be more comprehensive and approve a strategy, which will be created with authorities in Turkana and West Pokot Counties. ■ Stakeholder engagement to help verify effective indicators to monitor access to education.	Moderate (positive)
Crime, commercial sex work and other nuisances from growth	Indirect effect of increased salaried employment and procurement	Moderate (negative)	■ Support information campaigns that seek to identify and provide support for key social maladies (e.g., gender-based violence, drug and alcohol abuse). ■ Develop and implement Contractor Non-Technical Risk Management Plans, used to manage contractor performance. ■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code).	Minor (negative)
Inter-ethnic conflict	Project operating in region with history of inter-ethnic violence and raiding	Major (negative)	■ Maintain Human Rights Policy. ■ Maintain VPSHR Implementation Guideline. ■ Maintain Incident Reporting System for monitoring of security incidents. ■ Maintain risk assessments to identify potential impacts and risks to communities. ■ Continue training for all employees and visitors during induction.	Minor (negative)
Community cohesion within Turkana and West Pokot County	Introduction of outside workforce	Moderate (negative)	■ Maintain information management system, described in more detail in the SEP (Annex II). ■ Maintain regular community engagement outreach to address rumour and other misunderstandings identified through regular engagement.	Minor (negative)

7.9.11.12 Operational Phase Impact Assessment

Impacts associated to the operations phase are presented in Table 7.9-5. Many of the mitigations will be the same or a continuation of those in the construction phase, some though being less-resource intensive. The Table below highlights which commitments will continue beyond construction.

Table 7.9-6: Operations Impact Assessment

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Project-induced influx and in-migration	Economic opportunities linked to a multi-billion investment Indirect effect of increased salaried employment and procurement	Moderate (negative)	■ Maintain an Influx Management Plan and continue to coordinate appropriately with authorities in Turkana and West Pokot Counties. ■ Verify effective indicators to monitor population growth within Influx Management Plan. ■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). ■ Operate all worker accommodation as "*closed camps*". ■ Disclose all local labour needs and recruitment information, including contractor information. ■ Conduct a stakeholder engagement campaign to explain the operational employment and local content opportunities, as well as the procedures that people must follow to obtain employment. ■ Maintain a working group, to be led by TKBV, with representatives of National and County government, and civil society.	Minor (negative)
Infrastructure	Additional infrastructure and activities	Minor (positive)	■ Continue infrastructure investments as part of the CDPs, aligned to County Integrated Development Plans. ■ Maintain an engagement process headed by leadership at the County and Sub-county level, including representatives of government departments, private sector, NGOs and potentially religious institutions. ■ Develop and maintain key performance indicators that help to monitor operational performance. ■ TKBV will work with County Governments to encourage sustainable use of community offtake water points on the water pipeline to discourage overgrazing at water off take points, and record issues as part of the grievance mechanism	Moderate (positive)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Taxes and payments	Tax and other payments linked to Project	Moderate (positive)	■ Continue to disclose taxes in Annual Reports. ■ Conduct periodic engagement on key social management plans, including all Community Development Plans, with relevant County-level board of trusteescharged with overseeing profits.	Major (positive)
Contractor employment	Contractor managed construction and employment opportunities	Minor (positive)	■ Maintain Human Resources Contractor Standard, forming minimum requirements for all contractors to follow. ■ Promote the TKBV Code of Ethical Conduct (The Code), specifically as it related to the principle of "*zero tolerance*" for any form of discrimination. ■ Continue using Contractor Non-technical Risk Management Policy. ■ Continue using Human Rights Policy, which upholds the core commitments of the ILO that make up the basis of IFC PS2 on Labour and Working Conditions. ■ Track Contractor Employment data by gender.	Moderate (positive)
Business opportunities and local content	Procurement opportunities linked to the Project	Minor (positive)	■ Continue using existing Contractor Procedures for Local Procurement. ■ Update and maintain the National Content Plan; including KPI for monitoring changes in business opportunities and local content performance. ■ Within CDPs, update and maintain commitments for local business capacity building. ■ Update and maintain key performance indicators that help to monitor changes in business opportunities and local content performance.	Moderate (positive)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Inflation	Indirect effect of increased salaried employment and procurement	Minor (negative)	▪ Monitoring from construction and inform ongoing management and mitigation for operations. ▪ Review the need to monitor prices and collect of data similar to NDMA monthly surveys throughout operations. Monitoring will continue during the initial period of operations, thereafter alternative monitoring may be sought based on the review ▪ Within CDPs, adapt key social programmes (from those proposed during construction stage) to support affected people to develop skills that can help them to react to any potential changes on the supply and demand of goods	Minor (negative)
Loss of occupied homesteads (physical displacement)	Land acquisition to develop the facilities required for the Project	Moderate (negative)	▪ Successful implementation of the RAP and continued application of the LRPs.	Negligible
Impacts on livelihoods due to loss of communal land (economic displacement)	Land acquisition to develop the facilities required for the Project	Moderate (negative)	Maintain commitments in LRP and CDPs which will continue to deliver livelihood restoration and community benefits, including support to: ▪ Skills development. ▪ Micro business support; and ▪ Livestock grazing improvements.	Negligible
Sexually transmitted infections	Introduction of outside workforce, financial incentives for vulnerable persons, and transport during operations	Major (negative)	Prior to operations all commitments in the following plans will be reviewed, in light of construction phase monitoring. Relevant commitments will extend into operations and the following will apply: ▪ Community Health, Safety and Security Management Plan. ▪ HIV Policy and Programme. ▪ "*95-95-95*" strategy, which sets targets for awareness, treatment and demonstrating performance in viral suppression. ▪ Operate all worker accommodation as "closed camps".	Minor (negative)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
			■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). ■ TMP specifically linked to the identification and management of transport rest stops. ■ Maintain an Influx Management Plan and continue to coordinate with authorities in Turkana and West Pokot Counties. ■ Monitor key performance indicators through a CHIS. ■ Support of Health Systems Strengthening activities, to be implemented by a third party. ■ Medical Fitness to Work Specification and Procedures. ■ Contractor Non-Technical Risk Management Plans, used to manage contractor performance.	
Vector related diseases	Alteration of the physical environment	Moderate (negative)	Prior to operations all commitments in the following plans will be reviewed, in light of construction phase monitoring. Relevant commitments will extend into operations and the following will apply: ■ Maintain Malaria Management Plan. ■ Implement strict source reduction environmental controls around construction sites, to be set out in the OEMP. ■ Monitor key performance indicators through a CHIS.	Minor (negative)
Communicable diseases	Introduction of outside workforce and transport during operations	Major (negative)	Prior to operations all commitments in the following plans will be reviewed, in light of construction phase monitoring. Relevant commitments will extend into operations and the following will apply: ■ Maintain camp cleanliness and hygiene standards. ■ Operate all worker accommodation as “closed camps”. ■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). ■ Maintain Medical Fitness to Work Specification and Procedures. ■ Maintain effective waste management procedures, as per Waste Management Plan.	Minor (negative)

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
			■ Maintain food hygiene programmes with good industry practice standards. ■ Implement TB Management Programme, linked to the HIV Programme, that will be created in collaboration with authorities in Turkana and West Pokot Counties. ■ Maintain Infectious Disease Health Management Plan. ■ Monitor key performance indicators through a CHIS.	
Zoonotic diseases	Waste from Project activities	Moderate (negative)	■ Maintain Pest Control Plan for landfill and other Project facilities.	Negligible
Accidents and injuries	Transport during operations	Moderate (negative)	■ Maintain the Safe and Sustainable Operations Policy. ■ Maintain TMP, specifically for the management of emergencies or accidents. ■ Revisit stakeholder engagement campaign on road safety for operational activities within the immediate area of influence. ■ Maintain CHSSMP specifically access control measures. ■ Monitor key performance indicators through a CHIS.	Moderate (negative)
Change in access to education	Infrastructure affecting movement of pastoralists, indirect impact of in-migration	Minor (positive)	■ Review and maintain strategy related to education, which will be created with authorities in Turkana and West Pokot Counties. ■ Continued stakeholder engagement and monitor against effective indicators for access to education.	Moderate (positive)
Crime, commercial sex work and other nuisances from growth	Indirect effect of increased salaried employment and procurement	Moderate (negative)	■ Support information campaigns that seek to identify and provide support for key social maladies (e.g., gender-based violence, drug and alcohol abuse). ■ Continue using Contractor Non-technical Risk Management Policy. ■ Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code).	Negligible

Impact Topic	Source of Potential Impact	Impact Significance	Mitigation	Residual Impact Significance
Inter-ethnic conflict	Project operating in region with history of inter-ethnic violence and raiding	Major (negative)	■ Maintain Human Rights Policy. ■ Maintain VPSHR Implementation Guideline. ■ Maintain Incident Reporting System for monitoring of security incidents. ■ Maintain risk assessments to identify potential impacts and risks to communities. ■ Continue training for all employees and visitors during induction.	Minor (negative)
Community cohesion within Turkana and West Pokot County	Introduction of outside workforce	Moderate (negative)	■ Maintain information management system, described in more detail in the SEP (Annex II). ■ Maintain regular community engagement outreach to address rumour and other misunderstandings identified through regular engagement.	Minor (negative)

7.9.11.13 Decommissioning

Five years prior to the planned 'End of Project', a Decommissioning Plan will be developed for agreement with the appropriate authorities. It will include measures to help manage the legacy issues associated to the Project and mitigate the impacts of the transition of the Project operations to no Project. It will include general and specific mitigation measures relating to all social related policy and procedure and transition plans for ownership of social initiatives in the AoI.

7.9.12 Summary of Mitigation

Most of the socio-economic impacts will be experienced during the construction phase of the Project and some of these will continue during the operational phase. It is envisaged that mitigation measures for operational impacts will be similar to those identified for construction and it is unlikely that additional mitigation will be required during operations. Towards the end of the construction phase, commitments will be reviewed to determine if continuation is reasonable during the operational phase. This review will be based on construction phase monitoring.

As previously stated, the SEP (Annex II) and grievance mechanisms are key for all social mitigations. The SEP (Annex II) is a live document, that will be updated to reflect how the social mitigations relate to information disclosure and consultation. This procedural mitigation commitment serves a core purpose to identify as soon as possible unforeseen impacts and includes a detailed description of the grievance mechanism, a multi-tiered system for review and resolution of registered grievances.

The complex issue of Project-induced influx during both construction and operation is managed in four areas: monitoring, reducing incentives for uncontrolled migration, managing worker integration with local communities, and engagement, all of which will be summarised in an Influx Management Plan. Firstly, TKBV will work with government to verify existing information and to confirm the most effective indicators to monitor population growth. Through Human Resources processes, recruitment documents will reinforce key principles:

- Restricting informal hiring, often referred to as "*at the gate*" hiring;
- Establishing clear procedures for hiring unskilled and low skilled workers, those more likely to travel to the Project location in search of employment;
- Establishing explicit definitions for "local" or "*local-local"* hiring criteria; and
- Revising all recruitment procedures in line with external engagement practice outline in the SEP (Annex II).

With the implementation of the Influx Management Plan during the construction phase, it is envisaged that there will be a reduction in influx. Therefore, measures will continue into the operational phase but will be less resource intensive.

Worker interaction will be managed through the existing Code of Ethical Conduct (Code) and worker interaction with the local population will be minimised by maintaining "*closed camps*", limiting access to non-workers. This will also apply to temporary camps needed for construction activities. During the operation phase, it is envisaged that there will be a lower labour demand, which should result in a reduction in worker interaction with local residents. Specific stakeholder engagement campaigns will be designed to explain the employment and local content opportunities, including their duration, as well as the procedures that people must follow to get employment. All work related to influx will be managed in coordination with a working group specifically focused on managing the aspect of Project-induced influx.

Another cross-cutting mitigation plan is the CDP, which will be developed in each County and expected to be successfully implemented throughout the life of the project. The CDPs will provide a framework under which the Project impacts and benefits will be addressed. The CDP process will also provide a vehicle for community consultation and involvement in the management of the overall Project impacts and benefits. Each CDP will incorporate agreements related to water access, impact management, benefits related to local content and shared infrastructure commitments, such as water and power. They will be managed through an engagement process headed by leadership at the County and Sub-county level and be completed after the FID. TKBV will also include the County-level board of trustees, required as part of the Petroleum Act, in the management of the CDPs.

To manage potential negative impacts of taxes and other payments made to Government, TKBV will continue to adhere to the Accounting Directive (2013/34/EU) and disclose payments made to governments in Annual Reports.

Benefits related to employment and business opportunities will be managed through a series of procedures and plans. Key existing and planned documents include:

- National Content Plan;
- Contractor’s Local Content Plan;
- Human Resources Contractor Standard;
- Contractor Procedures for Local Procurement and Local Recruitment;
- Contractor Non-technical Risk Management Policy; and
- Human Rights Policy.

The impacts related to inflation are difficult to isolate and manage. TKBV will seek to better understand inflation through selecting and monitoring prices for standard “*basket of goods*” and building on the current monitoring activities of the NDMA. Monitoring will be maintained throughout construction and inform ongoing management and mitigation for operations. TKBV will set out within CDPs the key social programmes to support affected people to develop skills that can help them to react to any potential changes on the supply and demand of goods.

It is envisaged that land impacts would be felt and mitigated during the construction phase and would not extent into operations. Land impacts, while still formalising key roles and responsibilities are guided by two key commitments. Firstly, compensation, as determined under the Kenyan Law, will be provided as part of the Government-led statutory land acquisition process. Secondly, any gaps between government-led land acquisition and IFC PS5 will be addressed as part of the LRP. The implementation of the LRP and CDPs will continue during the operational phase, in order to mitigate the impacts on livelihoods and livelihood restoration.

Impacts related to community health and safety are managed through a series of procedures and plans. These are expected to be implemented during construction and maintained throughout operations. Project interventions in the series of plans and programmes will be revised to be relative to the operational impacts and informed by construction phase monitoring. Key among those documents are:

- CHSSMP;
- Safe and Sustainable Operations Policy;
- HIV Policy and Programme;
- Malaria Management Plan;
- TB Management Programme; and
- TMP.

TKBV will adopt a "*95-95-95*" strategy, which sets targets for awareness, treatment and demonstrating performance in viral suppression to combat HIV/AIDs and it will also monitor key performance indicators for health through a CHIS. There will be support for specific Health Systems Strengthening activities. As part of impact mitigation and benefit enhancement related to education, TKBV will develop a strategy for educational support, which will be created in partnership with authorities in Turkana and West Pokot Counties, NGO/development agencies.

To manage the complex impacts and issues related to security, mitigation includes ongoing adherence to the VPSHR throughout the life of the Project, as well as regular monitoring through an Incident Reporting System for monitoring of security incidents.

To manage impacts on graves, the Project will implement consultation with affected communities and site guardians. The Project will also engage with the community to agree procedures for demarcation (e.g. demarcation and communication of 'no go' sensitive locations and mapping and communication of cultural heritage 'constraints') or, in the highly exceptional circumstances (follow up by consultation with site guardians and affected communities), relocation and reburial of graves. Details of compensation will be provided in an LRP. Micro-alignment of the interconnecting network within the RoW will be used to avoid direct impacts to graves, where feasible. The EPC contractor, in liaison with TKBV, will implement CFP by an on-site Clerk of Works, which will include information regarding processes to be followed. These measures to mitigate impacts on graves will be applied during the construction phase. Assuming effective implementation of the mitigations measures proposed, the impact on graves would not extent into operations.

7.9.13 Summary of Residual Impacts

With the proposed mitigation, only one residual impact (for Accidents and Injuries) is predicted to be moderate negative. All other residual impacts are expected to be minor negative or negligible, with many expected to be positive. Moderate or high positive impacts include transparent tax payments, employment and business opportunities. With participatory management of the proposed CDPs, benefit enhancement should also create improved socio-economic conditions in relation to infrastructure and livelihoods.

Key issues such as Project-induced influx and in-migration, inflation, permanent loss of land resulting in economic displacement, and security are complex issues that are influenced by a range of factors, not all of which fall under the control of TKBV and contractors. These impacts represent the highest pre-mitigation impact significance and will warrant close attention during the ongoing monitoring and engagement procedures and to monitor the implementation of planned mitigation.

7.10 Cultural Heritage

7.10.1 Introduction

The potential impacts on cultural heritage as a result of the Project have been determined using a phased qualitative assessment methodology, as outlined here:

- Cultural heritage receptors with the potential to be impacted by the Project are identified and ascribed an ‘importance’ value, ranging from ‘low’ to ‘very high’. Further detail is provided in Section 7.10.3;
- The ‘magnitude’ of any impacts resulting from the Project, ranging from ‘negligible’ to ‘high’, on the identified receptors are established (assuming any specified inherent mitigation is in place). Further detail is provided in Section 7.10.4;
- A comparison of the receptor importance and the impact magnitude is used to calculate the impact significance (based on the matrix presented in Table 7.10-3, Section 7.10.6);
- Where required, a mitigation strategy is proposed, with the impact significance re-assessed (assuming both inherent mitigation and proposed mitigation is in place) to ascertain the residual impacts of the Project.

A description of Tangible, Intangible and Living Cultural Heritage is presented in Section 6.13.

7.10.2 Area of Influence

Cultural heritage impacts have the potential to occur within the Social AoI, which is presented in Section 5.0. Not all cultural heritage receptors within the Social AoI are expected to be impacted by the Project. It is considered that impacts on intangible cultural heritage could occur throughout the Social AoI, but that the potential of the Project to impact upon tangible cultural heritage receptors (including living cultural heritage and archaeology) is limited to within 500 m of Project infrastructure.

7.10.3 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.10-1[25] has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.10-1: Criteria for Determining Importance of Receptors for Cultural Heritage

Receptor Importance	Example Cultural Heritage Receptors
Very high	Receptors of international importance with significant cultural/archaeological value. Receptors that cannot be moved or are non-replicable. Receptors that are ‘critical’[26]. Examples include sacred trees.
High	Receptors of national or regional importance with significant cultural value. Non-replicable receptors that are not critical, or cultural sites that are potentially replicable and that could be moved in highly exceptional circumstances (in consultation with site guardians and the affected communities). Examples include graves and burials, intangible cultural practices specific to northern Kenya and archaeological settlement sites.
Medium	Receptors of local importance with significant cultural value. Receptors that are common and potentially replicable and that can be moved in exceptional circumstances

[25] An expanded definition of the importance criteria for living cultural heritage, intangible cultural heritage and archaeological receptors is presented in Annex I.

[26] ‘Critical’ cultural heritage consists of one or both of the following types of cultural heritage: (i) the internationally recognised heritage of communities who use, or have used within living memory, the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designations’ (IFC, 2012a).

Receptor Importance	Example Cultural Heritage Receptors
	(in consultation with site guardians and the effected communities). Examples include intangible practices widely observed in Kenya.
Low	Receptors of limited local importance and cultural value. Receptors that are defunct and/or have little or no historic value. Receptors that are common and/or replicable and that can be moved or destroyed (in consultation with site guardians and the affected communities). Examples include isolated archaeological findspots and traditional land use sites.

7.10.4 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential adverse impact has then been classified between 'negligible' and 'high', as described in Table 7.10-2[27]. There is also potential for beneficial impacts to occur. Where these are identified, there is no distinction made between magnitudes of impact; they are simply reported as beneficial impacts.

For cultural heritage, potential impacts are considered to be either direct or indirect. These are defined as:

- **Direct impacts**: Impacts that result from a direct interaction between a project activity and a receptor (e.g., destruction of a receptor through ground disturbance/compaction or severance of access to a receptor by project-related infrastructure); and
- **Indirect impacts**: Impacts that result from a project activity where the interaction with a receptor is through a secondary pathway, such as noise emissions or emissions to air, or impacts that affect the setting in which a receptor is experienced (e.g., increased noise levels or a visual change affecting the way in which a receptor can be used or dust deposition/ground vibration resulting in damage or a loss of amenity at a receptor). Impacts resulting from socio-economic changes are also considered to be indirect.

To robustly assess indirect impacts, cultural heritage receptors have been factored into the analyses for noise and vibration, air quality and landscape and visual, with the combined results of these assessments evaluated to complete a holistic qualitative analysis of the impacts upon cultural heritage. Where indirect impacts from these sources occur, the residual impacts (i.e. post-mitigation) have been used in order to avoid 'double counting' the impact. The results of the social impact assessment have also been considered to reflect indirect socio-economic impacts on cultural heritage receptors, as well as linkages with ecosystem services.

In determining the magnitude of any impacts, consideration has been given to both the duration and frequency of impacts, as well as to whether the impact is temporary or permanent. A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

[27] An expanded definition of the magnitude criteria for living cultural heritage, intangible cultural heritage and archaeological receptors is presented in Annex I.

Table 7.10-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Anticipated impact on tangible or intangible cultural heritage receptors is severe. It is considered that the receptor will be wholly changed so that cultural functions and processes are significantly limited or lost entirely.	Anticipated impact on tangible or intangible cultural heritage receptors results in beneficial consequences (e.g. improved access that facilitates the sustainable use of the receptor or dissemination of published research).
Medium	Anticipated impact on tangible or intangible cultural heritage receptors is moderate. It is considered that the receptor will be changed resulting in temporary or permanent modifications to cultural functions and processes.	
Low	Anticipated impact on tangible or intangible cultural heritage receptors is slight – considered to be of 'nuisance' value. Impact can be temporary or permanent but does not result in any modification of receptor use.	
Negligible	No significant predicted change from baseline for tangible or intangible cultural heritage receptors.	

7.10.5 Key Guidance and Standards

The cultural heritage impact assessment has been completed in accordance with Kenyan legislation and international guidance. The National Museums and Heritage Act (2006) is the key Kenyan legislation pertinent to the cultural heritage impact assessment. The Protection of Traditional Knowledge and Cultural Expressions Act (2016) is also relevant and has been given due consideration.

To meet good practice, the impact assessment has also been completed in compliance with IFC PS8: Cultural Heritage (2012a) (including accompanying guidance - Guidance Note 8: Cultural Heritage (2012b)).

7.10.6 Receptors of Interest and Importance

With reference to the results of the baseline study and the expected sources of impacts described in Section 7.10.7, archaeological, living cultural heritage and intangible cultural heritage assets have all been considered for inclusion as receptors in the impact analysis. The criteria for selecting receptors were:

- All living cultural heritage assets and archaeological assets (excluding findspots and isolated surface scatters – see explanatory note below) that are located within the proposed footprint of the Project (to account for potential direct impacts during construction);
- All living cultural heritage assets and archaeological assets (excluding findspots and isolated surface scatters – see explanatory note below) that are located within 500 m of the proposed footprint of the Project (to account for potential indirect impacts during both construction and operational phases); and
- Intangible cultural heritage assets within the Social AoI (to account for potential direct and indirect impacts during both construction and operational phases).

Regarding archaeological findspots and isolated surface scatters, survey work completed during the baseline study indicates that there is a consistent density and distribution of surface archaeological remains (i.e. findspots and surface scatters) throughout the region. It is considered, therefore, that the potential for archaeological remains to be present on the surface is uniformly high across the AoI. As such, identified findspots and isolated surface scatters have not been considered individually as part of the impact assessment. Instead, archaeological surface remains are considered more generally as a single receptor, with the assumption that archaeological remains are present within the Project footprint.

Receptors included within the impact analysis are presented in in Table 7.10-3, and the locations of tangible receptors are depicted in Figure 7.10-1 to Figure 7.10-3. Consideration has also been given to the potential for unidentified living cultural heritage assets, particularly sacred trees and graves, that could exist within the make-up water pipeline RoW.

Table 7.10-3: Receptors and Importance

Receptor	Importance	Comment
Living cultural heritage – Sacred Trees[28]	Very high	Receptor that cannot be moved or replicated. Receptors identified include one sacred tree within 500 m of Project infrastructure (CH-046).
Living cultural heritage – Graves and Burial Sites	High	Receptor that is potentially replicable and could be moved in highly exceptional circumstances (in consultation with site guardians and the affected communities). Receptors identified include twelve graves or burials within 500 m of Project infrastructure (CH-044, -045, -052, -059, -068, -090, -097, -102, -103, -105, -106, and -107).
Living cultural heritage – Traditional Land Use Sites (Charcoal Making Sites and Irrigation Dams)	Low	Receptors of limited local value and cultural significance. Receptors identified include four traditional land use sites within 500 m of Project infrastructure (CH-054, -055, -056, and -104).
Intangible cultural heritage – Turkana culture (history, society and belief system)	High	Asset of national importance with significant cultural value. Endemic to Turkana County (and therefore 'rare') and widely representative of Turkana people.
Intangible cultural heritage – West Pokot culture (history, society and belief system)	High	Asset of national importance with significant cultural value. Endemic to West Pokot County (and therefore 'rare') and widely representative of Pokot people.
Intangible cultural heritage – nomadic pastoralism	High	Asset of national importance with significant cultural value. Widely representative of population in northern Kenya.
Intangible cultural heritage – environmental subsistence	Medium	Asset with social, historic, scientific and environmental value that is representative of populations across Kenya.

[28] The term 'sacred' has been used in this assessment to refer to trees of cultural significance that are used by local communities for a range of purposes, including meetings (of elders and other community groups), initiations, celebrations and ceremonies. These locations have significant historical and traditional associations, but do not necessarily have religious associations (e.g. the trees are not viewed as deities).

Receptor	Importance	Comment
Archaeological - potential settlement sites	High (potential)	If sub-surface archaeological remains are present, assets have the potential to be nationally significant, and represent features that are relatively understudied in the region. Three archaeological assets within 500 m of Project infrastructure have been identified as having greater potential for sub-surface archaeological remains to be associated with them (AR-105, AR-109, and the cluster of surface scatters to the north-east of the Ngamia area).
Archaeological - Surface Remains (Findspots and Isolated Surface Scatters)	Low	Assets with limited further research potential (with representative sampling already completed during survey). Relative abundance of material within AoI (in particular, lithics and pottery) that will remain unimpacted.

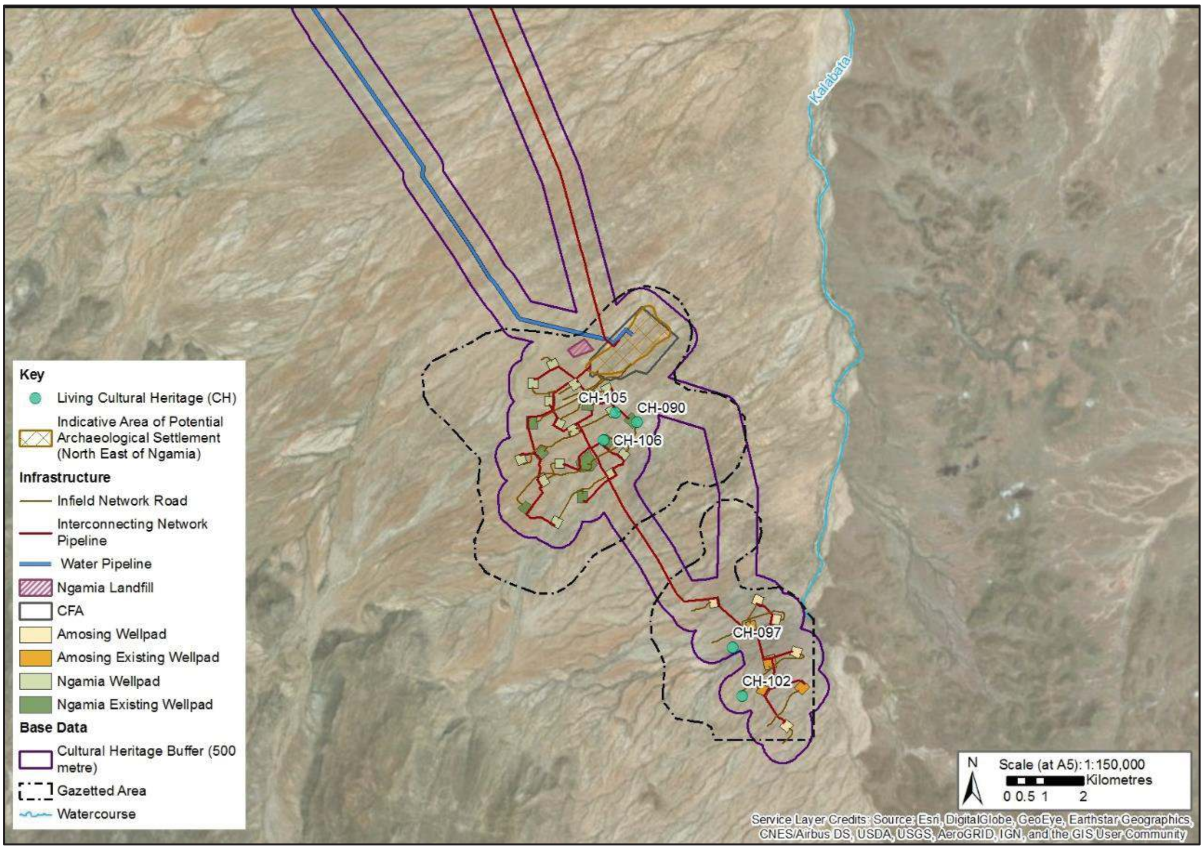

Figure 7.10-1: Cultural Heritage Receptors (Ngamia and Amosing)

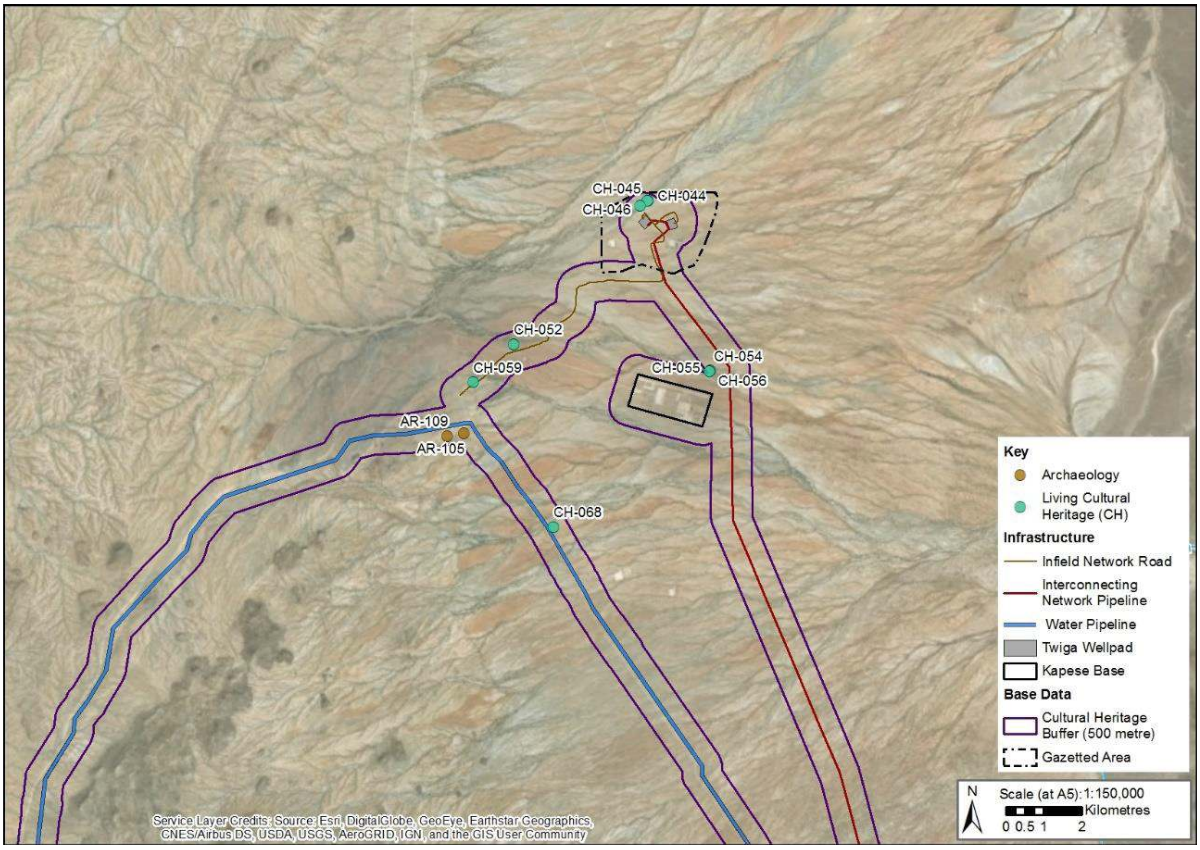

Figure 7.10-2: Cultural Heritage Receptors (Twiga)

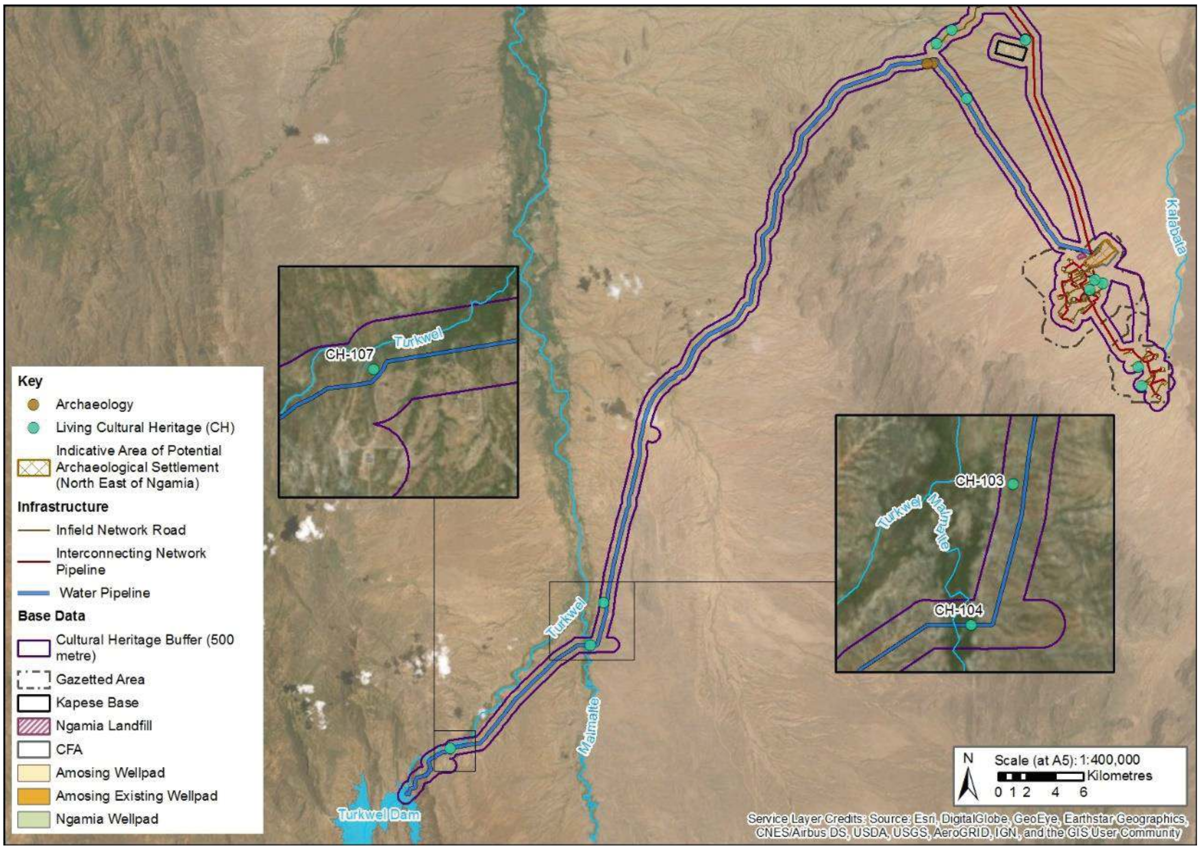

Figure 7.10-3: Cultural Heritage Receptors (Water Pipeline)

7.10.7 Sources of Impacts

Sources of impact resulting from the Project relevant to cultural heritage have been identified through a review of the Project Description (Section 6.13) and the identified receptors. It is expected that the Project will result in changes to both the physical and socio-economic landscape, which will result in direct and indirect impacts to cultural heritage receptors during both the construction and operational phases of the Project.

7.10.7.1 Construction Phase

There are aspects of the Project that have been identified as having the potential to impact cultural heritage receptors during the construction phase.

The potential sources of impact and routes by which they could impact cultural heritage during construction are:

- Ground disturbance and other changes to the land surface as a result of site preparation and construction works, including ground clearance, scrub removal, surface levelling and compaction, and fence installation, as well as intrusive excavation activities and the laying of foundations. This could result in cultural heritage receptors being displaced, damaged or destroyed, both above and below the ground surface. Changes to the land surface could also result in the severance of access to cultural heritage assets or the modification of intangible practices;
- Change in environmental conditions as a result of noise and vibration, emissions to air and visual changes, which could result in impacts on the setting of cultural heritage assets or the modification of intangible practices. Vibration and dust emissions also have the potential to physically damage cultural heritage assets; and
- Change in socio-economic conditions, particularly through changes in land ownership, demographics and employment, which could impact intangible cultural heritage.

7.10.7.2 Operational Phase

There are aspects of the Project that have been identified as having the potential to impact cultural heritage receptors during the operational phase. The potential sources of impact and routes by which they could impact cultural heritage during the operational phase include:

- Change in environmental conditions as a result of noise and vibration, emissions to air, and visual changes, which could result in impacts on the setting of cultural heritage assets or the modification of intangible practices. Vibration and dust emissions also have the potential to damage cultural heritage assets; and
- Change in socio-economic conditions, particularly through changes in demographics and employment, which could impact intangible cultural heritage.

To avoid under-representing the magnitude of impact during construction or ‘double-counting’ the impact during the operational phase, changes to the land surface that could result in severance of access to cultural heritage assets or the modification of intangible practices, which would initially occur during construction and then persist throughout the operational phase, are only considered during construction. The duration of any impacts continuing throughout the operational phase is accounted for in the impact magnitude during construction.

7.10.7.3 Climate Change

Climate change is not considered relevant to this section of the ESIA.

7.10.8 Incorporated Environmental Measures

The Project has been designed and planned to incorporate a range of incorporated environmental measures that provide inherent mitigation to avoid potential impacts or reduce their magnitude. The design measures relevant to cultural heritage are described below. Incorporated environmental measures to manage air quality, noise and vibration, visual, and socio-economic impacts, which may reduce or avoid indirect impacts to cultural heritage assets, are described in those relevant chapters.

7.10.8.1 Design Measures

Incorporated environmental design measures pertaining to cultural heritage include:

- Where possible, the Project makes use of land that has previously been developed, thereby reducing the amount of land where direct impacts to cultural heritage assets can occur.
- Speed limits along roads will not exceed national speed limits and will be set with consideration to their use by other road users, including those associated with nearby cultural heritage receptors.

7.10.8.2 Good International Industry Practice

There are no relevant GIIP measures specific to cultural heritage which can be incorporated into the Project. This impact assessment has been completed and mitigation proposed in accordance with IFC PS8: Cultural Heritage (2012a) (including accompanying guidance - Guidance Note 8: Cultural Heritage (2012b)).

7.10.9 Considerations from Stakeholder Engagement (TBC)

The following list of issues were captured during the EOPS and LLCOP consultation meetings and should only be used as a reference on this specific subsection. A relevant list of issues will be provided following the Project ESIA consultations.

- Stakeholders suggested considering intangible cultural heritage as part of ESIA.
- Concerns on loss of traditional cultural practices due to influx and expectations on locals to get an employment opportunity at the project (e.g. individuals abandoning pastoralism to enrol in business opportunities).
- Concern of presence of sacred sites, graveyards or shrines around project infrastructure.
- Questions about mitigation plans for burial sites being disturbed during project construction stage.

7.10.10 Impact Classification

Taking into account the baseline cultural heritage conditions (Section 6.13), the relevant incorporated environmental measures (Section 7.10.8), and the potential sources of impact (Section 7.10.7) determined from the Project Description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is accompanied by a table where the potential sources of impact and relevant additional mitigation applicable to each receptor are summarised. The magnitude and significance of each impact linkage is assigned following the method presented in Section 7.10.1.

7.10.10.1 Construction

The results of the construction phase impact assessment with respect to cultural heritage are described below. Those impacts where additional mitigation is proposed are presented in Table 7.10-4.

One critical mitigation commitment applicable to all impacts on living cultural heritage and intangible cultural heritage receptors is TKBV's continuation of its stakeholder engagement work, as defined in the Project SEP. This cross-cutting plan sets out the Project's commitments in relation to information disclosure and consultation. It also sets out the engagement methods and events that are intended to be used to maximise participation and that are appropriate for a given stakeholder group's needs and preferences.

This procedural mitigation commitment serves a core purpose of identifying, as soon as possible, any unforeseen impacts and any appropriate site-specific mitigation that could be applied. The SEP describes relevant Kenyan regulations and international standards that apply to the Project. It also highlights past engagement efforts prior to the beginning of the Project, the approach to stakeholder identification, future engagement programme and the roles and responsibilities for implementing the SEP.

The final section of the SEP is a detailed description of the grievance mechanism, a multi-tiered system for review and resolution of registered grievances. Implementation of the SEP and effective responses to grievances is essential in managing all impacts to living and intangible cultural heritage.

Ground Disturbance/Change in Land Surface

It is expected that ground disturbance will result in direct impacts at living cultural heritage, intangible cultural heritage and archaeological receptors within the AoI.

Archaeological remains, particularly lithic and pottery artefacts, are assumed to be present on the ground surface throughout the Project footprint and it is predicted that these will be disturbed and removed as a result of construction activities. Without mitigation, a high magnitude impact is expected on a low value receptor, resulting in a minor impact significance. The volume of individual artefacts that are likely to be impacted makes mitigation through collection unfeasible. Without an established archival resource or research objective, collection of remains would not be an effective form of mitigation. Instead, it is recommended that the CHMP includes an appropriate Chance Finds Procedure with an established protocol, to be agreed with the NMK and administered by an on-site Clerk of Works, that will define the steps to be taken if surface remains are encountered. Suggested steps include noting the types of material encountered and where (e.g. the section of water pipeline or a specific well-pad) and, if possible, moving the artefacts outside the area of disturbance (leaving them on the surface). It is also recommended that construction staff are informed, as part of their general induction, about the archaeological remains that are likely to be encountered in the landscape and what they should do in line with the CHMP. It should be made explicitly clear that these remains have no monetary value to avoid looting. With the described mitigation in place, the impact magnitude would reduce to medium, but the residual impact significance on this receptor remains **Minor**. A representative sample of archaeological remains was collected during baseline survey. It is considered that working with NMK to find an appropriate archive for these remains, and potentially supporting further research (e.g. funding for obtaining and publicising the result of Obsidian Hydration Dating or X-Ray Fluorescence Analysis of obsidian pieces) could result in a **Beneficial Impact Significance**.

One potential archaeological settlement site, the cluster of surface scatters to the north-east of the Ngamia area, is located within the proposed CFA footprint. A high magnitude impact on this potentially high value receptor is expected during the construction of the CFA, resulting in a potentially major impact significance, if subsurface archaeological remains are present. It is proposed that further archaeological investigation of the area be completed to better understand the subsurface archaeology in this location. The exact scope of this investigation would need to be agreed and completed in conjunction with NMK, but likely actions include a series of test pits to record the presence/absence of subsurface archaeological remains or potential archaeological supervision and recording of surface stripping. If subsurface remains are present, the proposed archaeological investigation would reduce the impact magnitude to low, thereby lowering the residual impact significance to **Minor**. If no archaeological remains are present, there is no receptor and no impact is expected.

Direct ground disturbance is expected to impact two graves/burials[29] – CH-059, located within the interconnecting network RoW near the C46, and CH-105, located within a proposed well-pad at Ngamia. Unmitigated direct disturbance of this high value receptor is a high magnitude impact, resulting in a major impact significance. Consultation with affected communities and site guardians will be required to effectively mitigate this impact. Micro-alignment of the interconnecting network within the RoW around CH-059 will be used to avoid direct impacts to the grave. The well-pad at CH-105 cannot be re-aligned, and so exhumation and reburial will be required. Further details for the statutory process for relocating graves are provided in the Social assessment. With this mitigation in place, a medium magnitude impact is expected, resulting in a **Moderate** impact significance.

The Chance Finds Procedure, to be administered by an on-site Clerk of Works, will also include information regarding processes to be followed for any unrecorded graves that may exist within the Project footprint. An integral part of this will be continued consultation with communities to identify previously unrecorded burials, as well as any burials that have occurred since baseline data collection was undertaken.

A low value traditional land use site (CH-104; a site with recent evidence of charcoal making activity) is located within the make-up water pipeline RoW and will likely be disturbed during construction, resulting in a **Minor** impact significance. No mitigation is proposed for this impact and it is not considered further.

There is also potential for unidentified living cultural heritage assets to exist within the Project footprint, particularly along the make-up water pipeline RoW where mapping of assets was not completed. From baseline KIIs, it is understood that the types of living cultural heritage assets associated with communities along this route are similar to those mapped around the wellfield areas. Without mitigation, there is potential for high magnitude impacts on very high (sacred trees) and high (graves and burials) value receptors, resulting in a major impact significance. To mitigate for this uncertainty, it is proposed that further consultation is undertaken with communities along the pipeline route and living cultural heritage receptors are mapped. Where sacred trees are recorded within the Project footprint, micro-alignment of the route within the RoW will be undertaken for avoidance. If avoidance is not possible further consultation with the community/site guardian will be undertaken regarding the possible translocation of sites and associated cultural practices. An assessment of the ability to re-align around graves and burials will be made if identified within the RoW, with exhumation and reinternment the alternative form of mitigation. This would reduce the impact significance to **Moderate**.

The change in ground surface as a result of construction also has the potential to impact intangible cultural heritage within the AoI. The loss of land available to traditional communities is addressed in detail in the social assessment, but at a broader scale it has the potential to impact on high value intangible cultural heritage, including traditional practices and beliefs (e.g. Turkana and West Pokot culture and nomadic pastoralism). It is not expected that these traditional practices or beliefs will be stopped or be prevented within the AoI as a result of a change in land surface within the Project footprint, but modification of behaviours is likely. It is predicted that there will be a medium magnitude impact on Turkana culture and a low magnitude impact on West Pokot culture, due to the relative proportion and type of infrastructure located within each County, with a medium magnitude impact on nomadic pastoralism in general. These will result in **Moderate** impact significances for Turkana culture and nomadic pastoralism, and a **Minor** impact significance for West Pokot culture. The key mitigation associated with this impact is detailed in the social assessment (in particular the land section), with consideration of PAP in the LRP and CDPs. It is also recommended that there is continued community consultation in order to listen to community concerns and support the sustainability of traditional practices. Staff will be informed during their induction of the intangible cultural heritage present in the AoI. These mitigation measures are expected to reduce the impact magnitude from medium to low for Turkana culture and nomadic pastoralism. The impact cannot be entirely avoided however, and so the low magnitude impact on West Pokot

[29] Two other graves/burials (CH-090 and CH-106) are located within existing wellpads and so no impact is expected.

culture is predicted to continue (albeit reduced). A residual **Minor** impact significance is predicted for all three receptors.

The impact of changes on land surface with regards to specific resources for environmental subsistence is addressed within the ecosystem services assessment. The general practice of environmental subsistence as intangible cultural heritage is considered in a broader sense here. The loss of available land and resources to use for environmental subsistence within the Project footprint is not likely to stop or prevent the practice across the AoI and it is considered the practice of opportunistic foraging of available resources will continue unmodified. Therefore, a low magnitude impact is predicted, resulting in a **Minor** impact significance.

It is proposed that continued community consultation in accordance with the SEP is undertaken in order to listen to community concerns and support the sustainability of traditional practices. Mapping of alternative resources and provision of continued access to the areas between Project infrastructure for opportunistic foraging will reduce the impact. Mitigation measures detailed in the social assessment, as well as supporting the sustainability of traditional subsistence practices and the transfer of traditional knowledge and skills[30], will also seek to reduce the impact on traditional practices. A residual **Minor** impact significance is expected with mitigation in place, as a low magnitude impact is still likely.

Change in Environmental Conditions

Emissions to air are expected to result in an impact at one living cultural heritage receptor, a sacred tree (CH-046) near Twiga, as a result of construction dust. The level of dust deposition has the potential to impact the tree and could result in a modification of the receptor's use as a meeting location. This is considered to be a medium magnitude impact on a very high value receptor, resulting in a major impact significance. To mitigate this impact, it is proposed that the local community (Lomokomar) is consulted to establish if there are any reasonable measures that could be implemented. Dust monitoring should be undertaken to better understand the quantity of dust being deposited, which would inform the need for physical intervention (e.g. netting could be erected between the dust source and the receptor to inhibit dust dispersion). It is considered that this will reduce the impact magnitude to negligible, resulting in a **Minor** impact significance.

All other emissions to air are expected to result in negligible magnitude impacts, with **Negligible** impact significance. No mitigation is proposed for these negligible impacts and they are not considered further.

Of the cultural heritage receptors identified, it is considered that only noise emissions have the potential to impact the use of sacred trees (including CH-046 near Twiga and any sacred trees that may exist along the make-up water pipeline). The setting or use of other receptors will remain unchanged by a change in noise level. Construction noise and well drilling is predicted to result in noise levels at Twiga and along the water pipeline route that are less than the recorded baseline level at Ngamia and within 3 dB of the recorded baseline at Amosing (i.e. a negligible impact for noise). The use of sacred trees at Ngamia and Amosing is unaffected by the baseline noise level and so a negligible magnitude impact on cultural heritage receptors at Twiga and along the make-up water pipeline route is predicted, resulting in **Minor** impact significance.

Noise impacts are not considered further in the impact classification, but it is recommended that consultation with local people, in accordance with the SEP, is continued to help understand and manage, through reasonable measures, changes in noise levels at sacred trees. The EPC contractor will work with TKBV to produce and implement a communication plan involving relevant Traditional Leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure. It is also recommended that noise monitoring will be undertaken by the EPC contractor during construction at CH-046 to ensure predicted

[30] These mitigation proposals seek to preserve traditional knowledge and skills. They are not intended to inhibit access to alternative livelihoods or greater food security.

noise levels are not being exceeded. If sacred trees are identified along the water pipeline, the need for community consultation and monitoring (of dust or noise) will be considered on a case-by-case basis.

Visual changes during construction, related primarily to construction activities and equipment, are expected to cause a low magnitude impact on a very high value sacred tree (CH-046), resulting in a moderate impact significance. Consultation with the local community (Lomokomar) will be undertaken to identify if there are any reasonable mitigation measures that could be implemented to reduce the impact of visual changes during construction. It is proposed that the EPC contractor will work with TKBV to produce and implement a communication plan involving relevant Traditional Leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure. A residual **Moderate** impact significance is predicted.

Change in Socio-Economic Conditions

Intangible cultural heritage, particularly Turkana and West Pokot culture and nomadic pastoralism, are likely to be impacted by socio-economic changes, such as changes in demographics and employment. Impacts resulting from these changes are considered in detail in the social assessment, but the impact on intangible cultural heritage at a broad level is presented here. Socio-economic changes have the potential to reduce the number of people continuing these traditional practices (e.g. as they seek alternative job opportunities), and exposure to other cultures is likely to influence traditional belief systems. Whilst there is likely to be a consequent reduction in the number of people holding these beliefs and employing traditional practices, it is considered that these elements of intangible cultural heritage will continue unmodified within the AoI during construction. As such, a low magnitude impact is predicted, resulting in a minor significance impact.

The key mitigations to address these impacts are detailed in the social assessment (e.g. Influx Management Plan and LRP). It is also recommended that there is continued community consultation in order to listen to community concerns and support the sustainability of traditional practices. Staff will be informed during their induction of the intangible cultural heritage recorded in the AoI and their responsibilities in relation to it. Whilst it is expected that these mitigation measures will reduce the impact, it is not possible to entirely avoid the impact and so a residual low magnitude impact is predicted, with a residual **Minor** impact significance.

The impact of changes in socio-economic conditions is predicted to have a negligible magnitude impact upon the practice of environmental subsistence, resulting in a **Negligible** impact significance.

Table 7.10-4: Construction Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Archaeological - Surface Remains (Low)	Ground disturb-ance/Change in land surface within Project footprint	High Direct – permanent	Minor	Staff induction and use of Chance Find Procedure developed in conjunction with NMK (detailed in CHMP). CHMP to be produced and agreed prior to construction. *(Consultation between TKBV and NMK to identify appropriate archive for collected samples and potential support for obtaining and publishing results of analytical research of obsidian samples.)*	Medium -	Minor (Beneficial)
Archaeological - Potential Settlement Sites (High – potential)	Ground disturb-ance/Change in land surface within Project footprint	High Direct – permanent	Major	Pre-construction archaeological investigation within CFA footprint, to be agreed and completed in conjunction with TKBV and NMK.	Low	Minor
Living cultural heritage – Sacred Trees (Very High)	Ground disturb-ance/Change in land surface if receptors located within make-up water pipeline RoW	High Direct – permanent	Major	Pre-construction community liaison and mapping exercise to record the locations of sacred trees along make-up water pipeline. Once mapped, avoidance will be undertaken by micro-alignment. If avoidance is not possible further consultation with the community/site guardian will be undertaken regarding the possible translocation of sites and associated cultural practices. Further detail to be included in the CHMP.	Negligible	Minor
	Change in environ-mental condition as a result of constr-uction dust, which could impact tree health at CH-046.	Medium Indirect – short-term – temporary	Major	Pre-construction consultation by TKBV with affected community (Lomokomar) to identify reasonable measures that could be implemented. (e.g. undertake a dust monitoring programme during construction to record level of dust deposition at receptor, which will inform the need	Negligible	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				for potential erection of netting between the well-pad and receptor to inhibit dust deposition).		
	Change in environmental conditions as a result of visual changes to setting from construction activities	Low Indirect – short-term – temporary	Moderate	Pre-construction consultation by TKBV with affected community (Lomokomar) to identify reasonable measures that could be implemented. The EPC contractor will work with TKBV to develop and implement a communication plan involving relevant Traditional Leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure.	Low	Moderate
Living cultural heritage – Graves and Burials (High)	Ground disturb-ance/Change in land surface	High Direct – permanent	Major	Micro-alignment of interconnecting network within RoW to avoid receptor (CH-059). Exhumation and relocation of burial in consultation with site guardians and affected communities (CH-105). This is to be completed by TKBV prior to construction. CFP will detail steps for identifying unrecorded graves within the development footprint prior to construction and the process to be followed. Community liaison and mapping exercise to record the locations of graves and burials along make-up water pipeline RoW. Once mapped, micro-alignment or exhumation will be completed if required. Further detail to be included in the CHMP.	Medium	Moderate

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Intangible cultural heritage – Turkana culture and nomadic pastoralism (High)	Ground disturb-ance/ Change in land surface	Medium Direct – permanent	Moderate	Mitigation measures presented in the Social assessment (e.g. LRP and CDP). Community consultation and liaison by TKBV, in accordance with the SEP, to listen to and address community concerns and develop and mechanism to support the sustainability of traditional practices.	Low	Minor
	Change in socio-economic conditions	Low Indirect – long-term – temporary	Minor	Mitigation measures presented in the Social assessment (e.g. Influx management Plan, LRP and CDP). Community consultation and liaison by TKBV, in accordance with the SEP, to listen to and address community concerns and develop and mechanism to support the sustainability of traditional practices.	Low	Minor
Intangible cultural heritage – West Pokot culture (High)	Ground disturb-ance/ Change in land surface	Low Direct – permanent	Minor	Mitigation measures presented in the Social assessment (e.g. LRP and CDP). Community consultation and liaison by TKBV, in accordance with the SEP, to listen to and address community concerns and develop a mechanism to support the sustainability of traditional practices.	Low	Minor
	Change in socio-economic conditions	Low Indirect – long-term – temporary	Minor	Mitigation measures presented in the Social assessment (e.g. Influx management Plan, LRP and CDP). Community consultation and liaison by TKBV, in accordance with the SEP, to listen to and address community concerns and develop a mechanism	Low	Minor

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				to support the sustainability of traditional practices.		
Intangible cultural heritage – Environmental subsistence (Medium)	Ground disturbance/Change in land surface	Low Indirect – long-term – temporary	Minor	Community consultation and liaison by TKBV, in accordance with the SEP, to map and provide continued access to natural resources. TKBV to support the sustainability of traditional subsistence practices, specifically the transfer of traditional knowledge and skills.	Low	Minor

7.10.10.2 Operational Phase

The results of the operational phase impact assessment with respect to cultural heritage are described below. Those impacts where mitigation is proposed are presented in Table 7.10-5.

Change in Environmental Conditions

No impacts to cultural heritage receptors are predicted as a result of air or noise emissions during operation.

Visual impacts on cultural heritage receptors during the operational phase will be limited to the OHTL, which are expected to cause low magnitude visual impacts at a sacred tree (CH-046) and have the potential to cause impacts at unidentified living cultural receptors that may exist along the make-up water pipeline RoW. This will result in **Moderate** impact significances at these receptors (assuming, as a worst-case, that very high value sacred trees are located along the water pipeline). TKBV will develop communication plans to engage traditional leaders to protect the continued and sustainable use of sacred trees.

Change in Socio-Economic Conditions

Impacts as a result of changes in socio-economic conditions during operation are expected to be a continuation of those described construction. A continuation of the mitigation proposed during construction is required to mitigate for operational phase impacts.

Table 7.10-5: Operational Phase Impact Assessment

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact Significance	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Living cultural heritage – Sacred Trees (Very High)	Change in environmental conditions as a result of visual changes to setting from the OHTL.	Low Indirect – long-term – permanent	Moderate	TKBV will develop and implement communication plans to engage traditional leaders and local administrative leaders to protect the continued and sustainable use of sacred trees.	Low	Moderate
Intangible cultural heritage – Turkana culture, West Pokot culture and nomadic pastoralism (High)	Change in socio-economic conditions	Low Indirect – long-term – temporary	Minor	Mitigation measures presented in the Social assessment (e.g. Influx management Plan, LRP and CDP). Community consultation and liaison by TKBV, in accordance with the SEP, to listen to and address community concerns and support the sustainability of traditional practices.	Low	Minor

7.10.10.3 Decommissioning

Decommissioning refers to the dismantling, decontamination and removal of process equipment and facility structures and any appropriate remediation. Five years prior to the planned 'End of Project', a Decommissioning Plan will be developed for agreement with the appropriate authorities.

The likely decommissioning activities would be focused on:

- Production and injection wells with corresponding well-pads;
- The interconnecting network;
- Surface facilities in the CFA; and
- Other outfield infrastructure.

A qualitative assessment of the likely impacts of decommissioning activities on cultural heritage is presented here. Likely impacts from decommissioning activities are expected to be limited to living and intangible cultural heritage receptors.

No further direct ground disturbance is predicted, but the physical decommissioning of Project infrastructure is expected to result in noise and air emissions equivalent to, or less than, those produced during construction. As such, similar indirect impacts upon sacred trees, as predicted during construction, might reasonably be expected to occur. Equally, similar mitigation measures could reasonably be expected to reduce this.

The removal of Project infrastructure and reinstatement of the land is expected to reverse some of the visual effects at living cultural heritage receptors, although the likely retention and transfer of the OHTL to another operator is expected to result in long-term visual impacts on the setting of living cultural heritage receptors.

The reinstatement of land will also allow intangible practices, such as nomadic pastoralism, to resume in areas within the Project footprint in the long-term. The legacy of the Project post-decommissioning in terms of socio-economic changes and their impact on intangible cultural heritage cannot be predicted at this stage.

7.10.11 Summary of Mitigation

The following mitigation is proposed to address impacts on cultural heritage:

- Continued community consultation in accordance with the SEP;
- Staff induction to include information on the different cultural heritage receptors recorded within the AoI and the proposed mitigation strategy;
- Preparation of a CHMP, including an appropriate Chance Find Procedure, to detail the steps that should be taken if archaeological remains are identified, as well as good practice measures to avoid inadvertent damage to identified cultural heritage receptors (e.g. demarcation and communication of '*No Go*' sensitive locations, such as burial locations, and mapping and communication of cultural heritage 'constraints'). The Chance Find Procedure will also include steps for identifying graves and burial sites and will include a process for assessing the impacts and appropriate mitigation;
- Further archaeological investigation within the CFA area to determine the presence/absence of sub-surface archaeological remains, with a suitable sampling and recording mechanism agreed with the NMK if remains are identified;
- In collaboration with the NMK, identify a suitable archive for archaeological samples recovered during baseline survey and provide support for further research;

- Micro-alignment of the interconnecting network RoW in the vicinity of a burial near the C46 (CH-059). Exhumation and reinternment, in consultation with affected communities and site guardians, of a burial within a proposed well-pad (CH-105);
- TKBV to consult with the community of Lomokomar to discuss potential air quality and visual impacts and to identify any preferred, reasonable mitigation strategies. Suggested measures include undertaking dust monitoring at CH-046, the results of which would be used to inform the need for the erection of netting to inhibit dust deposition;
- TKBV to consult with the community of Lomokomar to discuss the predicted change in noise level and identify any reasonable measures that could be implemented. It is suggested noise monitoring is undertaken by the EPC contractor during construction at CH-046 to monitor whether predicted noise levels are being exceeded;
- Supporting the sustainability of traditional subsistence practices and the transfer of traditional knowledge and skills;
- The EPC contractor will work with TKBV to produce and implement a communication plan involving relevant Traditional Leaders to inform local communities of the Project construction schedule and encourage avoidance or minimal exposure;
- TKBV will develop and implement communication plans to engage traditional leaders to protect the continued and sustainable use of sacred trees; and
- Consultation with communities along the make-up water pipeline and mapping of living cultural heritage receptors in this area. If receptors are identified, then measures such as micro-alignment and exhumation of burials will be applied to reduce impacts.

A number of mitigation measures referenced in this assessment, specifically regarding impacts to intangible cultural heritage or impacts resulting from socio-economic changes induced by the Project, are presented in greater details in the social assessment, including the LRP, CDP and the Influx Management Plan.

7.10.12 Summary of Residual Impacts

Two moderate residual impacts are predicted during construction, with all other residual impacts being minor or negligible. One residual moderate impact is predicted as a result of visual changes on the setting of a sacred tree (CH-046), where there is no feasible mitigation to reduce the impact magnitude (low). The other residual moderate impact during construction is on graves and burial sites that will have to exhumed and reburied.

One residual moderate impact is also predicted during the operational phase. This is a result of visual impacts on the setting of a sacred tree (CH-046) from the long-term presence of the OHTL. As during construction, there is no feasible mitigation to reduce the impact magnitude (low).

7.11 Emergency, Accidental and Non-routine Events

7.11.1 Introduction

This section details the *emergency, accidental and non-routine events* risk assessment and includes an evaluation of natural and industrial hazards and the probability of their occurrence in order to assess the risks to the Project and from the Project to public safety.

7.11.2 Hazards to be Considered

The following sections describe the natural and industrial hazards considered in this assessment and provides an indication of how they will be assessed, including whether they have been scoped in or out of the assessment. Where hazards have been scoped out of the assessment, GIIP will be implemented and will be included in the relevant management and emergency plans and procedures.

7.11.2.1 Natural Hazard Scenarios

- Natural seismic activity (earthquakes) which may lead to loss of containment or flowline integrity (potential for contamination via surface water or groundwater pathways) and to vibration-sensitive built structures or equipment which may lead to operational failure – **scoped in** to be addressed with procedures in an Emergency Preparedness Response Plan;
- Heavy rainfall, high wind speeds, flooding or other extreme weather leading to damage to containment structures or storage of hazardous, combustible or explosive materials – **scoped out** due to the potential low resulting impact and low frequency and intensity; in addition, the basis of design for the facilities has taken account of weather and climatic factors. Although scoped out, the response to such an unplanned event will be covered in an Emergency Preparedness Response Plan;
- Lightning strikes causing fires and damage to project infrastructure, for example, the enclosed ground flare, IWMF flare, GTGs, WHRUs storage tanks and pumps – **scoped out** due to the potential low resulting impact and expected low frequency and intensity. Although scoped out, the response to such an unplanned event will be covered in an Emergency Preparedness Response Plan; and
- Dust storms which may lead to damage to site infrastructure and potential operational failure – **scoped out** due to the potential low resulting impact and expected low frequency and intensity; in addition, the basis of design for the facilities has taken account of weather and climatic factors. This will form part of management of natural hazards in this environment.

7.11.2.2 Industrial Hazard Scenarios

- Perforation or rupture of an oil storage tank leading to leakage which may lead to a spill of production fluid onto land **- scoped in** to be addressed in the OEMP and with procedures in the oil spill response section of an Emergency Preparedness Response Plan;
- Perforation or rupture of a flowline leading to leakage which may lead to a spill of production fluid onto land or at a river/lugga crossing **- scoped in** to be addressed in the OEMP and with procedures in the oil spill response section of an Emergency Preparedness Response Plan;
- A structural or mechanical failure of vehicle or plant which may lead to a collision resulting in damage to the flowline or containment structures – **scoped out** due to the potential low resulting impact and expected low frequency due to the flowlines being buried. The response to such an unplanned event will be covered in an Emergency Preparedness Response Plan;
- Road traffic accidents on access roads which may lead to a spillage of hazardous materials, injury or death of human or ecological receptors **- scoped in** to be addressed in the TMP, OEMP and the Emergency Preparedness Response Plan;

- Road traffic accidents on public roads which may lead to a spillage of hazardous materials, injury or death of human or ecological receptors or damage to public infrastructure **- scoped in**, to be addressed in the TMP, OEMP and the Emergency Preparedness Response Plan;
- Uncontrolled releases of waste materials into the environment **- scoped out** due to the potential low resulting impact and likelihood of occurrence due to the adoption of measures detailed in the CEMP and OEMP;
- Induced seismicity due to well testing/ oil production which may lead to loss of containment or flowline integrity (potential for contamination via surface water or groundwater pathways) and to vibration-sensitive built structures or equipment which may lead to operational failure – **scoped in** to be addressed with procedures in an Emergency Preparedness Response Plan;
- Accidental discharges from systems that are normally isolated e.g. evaporation ponds leading to uncontrolled leaks and spills- **scoped out** due to potential low resulting impact and expected low frequency and likelihood of occurrence due to system design;
- Well casing/cement integrity failure and down hole collisions during drilling interventions and production – **scoped in** to be addressed in the OEMP and with procedures in the oil spill response section of an Emergency Preparedness Response Plan;
- Blow outs from generators, explosions or integrity failure resulting in emergency releases of gas from wells or the CPF - **scoped in** to be addressed with procedures in an Emergency Preparedness Response Plan;
- Failure of loss of integrity of the wellpad pit liners leading to accidental discharge of cuttings (oil based) and drilling muds/waste – **scoped out** due to potential low resulting impact and expected low frequency due to system design.
- Fire within the CFA leading to spread into surrounding areas and potential risk of explosion- **scoped out** due to Emergency Preparedness and Response Plan which will be produced by EPC contractor for the construction period and TBKV for the operational period;
- Dropped object or mechanical impact during drilling potentially resulting in a loss of containment of well fluid- **scoped out** due to expected low frequency due to operating procedures;
- Spillage of chemicals or fuel which could lead to changes in water quality- **scoped out** due to the potential low resulting impact and expected low frequency and likelihood of occurrence. This will be addressed in OEMP and an Emergency Preparedness Response Plan;
- Release of nitrates from blasting could result in residue being transported towards the groundwater with recharge- **scoped out** due to the potential low resulting impact and expected low frequency. This will be addressed in OEMP and an Emergency Preparedness Response Plan;
- Damage to sanitation tanks and pipework leading to wastewater discharge to local watercourses or groundwater - **scoped out** due to potential low resulting impact and expected low frequency due to system design.
- Injury and potential mortality of biodiversity receptors resulting from entrapment in open trenches - **scoped out** as this will be addressed in the BMP;
- Discharge of firefighting water could result in impacts to local water quality – **scoped out** due to anticipated low frequency of the event. This will be addressed in the Emergency Preparedness Response Plan.

7.11.2.3 Quantitative Risk Assessment

A Quantitative Risk Assessment (QRA) is a formal and systematic risk analysis approach to quantifying the risks associated with the operation of an engineering process (i.e. operation of the CPF). A QRA is an essential tool to support the understanding of exposure of risk to employees, the environment, company assets and its reputation. A QRA also helps to make cost effective decisions and manages the risks for the entire asset lifecycle.

Objectives for a QRA study include:

- To identify the hazards associated with a facility;
- To determine the potential frequencies and consequences of the identified hazards;
- To determine the system availability of the protection systems; and
- To quantify the risks associated with a facility (e.g. Risk Contours, Individual Risk Per Annum (IRPA), Potential Loss of Life (PLL) and F-N Plots to estimate numbers of potential fatalities).

Although a coarse QRA was undertaken as part of FEED, a detailed QRA study will be developed for the CPF as part of the detailed engineering design and appropriate mitigation and management options will be implemented depending on the results so that the facility meets GIIP in this regard.

7.11.3 Legislative Context

According to paragraphs 67 and 68 of the Petroleum Act 2019:

- A contractor and any other participant in upstream petroleum operations shall, at all times maintain efficient measures for emergency preparedness with a view to dealing with incidents which may lead to loss of life or personal injury, pollution or damage to property.
- The contractor shall ensure that the measures taken to prevent or reduce harmful effects, include measures to ensure that the environment is restored as much as possible to its original condition prior to commencement of operations.
- The contractor shall initiate and maintain emergency preparedness measures to prevent and mitigate against any hazards occurring within facilities and shall at all times have contingency plans to deal with such emergencies.
- The contractor shall place facilities at the disposal of the relevant authorities for emergency and security drills and shall, where necessary, participate in such drills.
- The contractor shall take all reasonable measures to:
  - Identify the hazards and evaluate the risks associated with any work performed in the course of upstream petroleum operations carried out under the license which constitute a hazard to the health of persons employed for the purposes of that work and the steps to be taken to comply with the provisions of this Act and Regulations made herein; and
  - As far as practicable, prevent the exposure of the persons referred to in paragraph (a) to the hazards.
- As far as is practicable, the contractor shall involve the Authority, NEMA, the Council of Governors, and the relevant local communities in the preparation of emergency preparedness measures.

In addition to the Petroleum Act and national ESIA requirements which specify that the environmental and social management measures emerging from the assessment process should incorporate measures for "*emergency preparedness and response*".

IFC PS1, Assessment and Management of Environmental and Social Risks and Impacts (2012) outlines the requirement for an ESMP which incorporates emergency preparedness and response. In order to formulate the ESMP, this risk assessment is required to identify which, if any, risks there are regarding emergency preparedness and response.

7.11.4 Assessment Methodology

For each of the hazards listed in Section 7.11.2, a consequence rating and its probability of occurring have been assigned according to the definitions given in Figure 7.11-1. Hazard consequence and probability are then combined to give the risk level of each hazard (Table 7.11-1).

7.11.4.1 Natural Hazards

Natural hazards have been qualitatively assessed and the risk rating and proposed method of management and response is presented in Section 7.11.2.1. These consider hazards which have the potential to impact soils, water, air, human health, ecosystems and biodiversity.

7.11.4.2 Industrial Hazards

Industrial hazards have been qualitatively assessed and the risk rating and proposed method of management and response is presented in Section 7.11.5.

Emergency, Accidental and Non-routine Events- RISKS AND ASSOCIATED CONSEQUENCES			CONSEQUENCE				
			INSIGNIFICANT	MINOR	MODERATE	HIGH	MAJOR
Environment			Lasting days or less; limited to very small area; no environmentally sensitive receptors	Lasting weeks; limited to small area; no environmentally sensitive receptors	Lasting months; impact on an extended area (kilometres); area with some environmental sensitivity	Lasting years; impact on an extended area (kilometres); environmently sensitive habitat	Permanent impact; affects a whole basin or region; highly sensitive habitats
Reputation / Stakeholder / public			awareness/ concern from specific individuals; Minor disturbance of local culture/ social structures	concern/ complaints from certain groups/ organizations; Some reversible impacts on local population.	Isolated complaints from community members/ stakeholders; reversible impacts on local population.	local/ regional public concern and reactions; irreversible impacts on local population (health, property)	national/ international public attention and repercussions; irreversible impacts on local/regional population (fatality)
PROBABILITY			RISK RATING				
ALMOST CERTAIN		The unwanted event occurs in order of one or more times per year & is likely to reoccur within 1year	M	M	H	H	H
LIKELY		The unwanted event occurs less than once per year & is likely to reoccur within 5 years	M	M	M	H	H
POSSIBLE		The unwanted event can occur during the life of the porject & is unlikely to reoccur with any more frequency that every 10 years	L	M	M	M	H
UNLIKELY		The unwanted event is unlikley to occur during the lifetime of the project & is unlikely to reoccur with any more frequency that every 25 years	L	L	M	M	H
RARE		The unwanted event has never been known to occur in the business: or it is highly unlikely that it will occur within 25 years	L	L	L	M	M

	Risk Level	GUIDELINES FOR RISK MATRIX
	H - High	A high risk exists, appropriate mitigation strategy to be devised immediately.
	M - Medium	A moderate risk, appropriate mitigation strategy to be devised as part of the normal management process.
	L - Low	A low risk,A5:H18 monitor risk, no further mitigation required.

Figure 7.11-1: Risk Matrix For the Assessment of Emergency, Accidental and Non-Routine Event

7.11.5 Risk Assessment

Table 7.11-1: Risk Assessment of Emergency, Accidental and Non-Routine Events

Haz No.	Hazard	Consequence	Receptor	Consequence rating	Probability	Risk	Mitigation measures	Relevant Management Plan
Natural Hazards								
1	Natural seismicity (earthquakes) on built structures, flowlines, vibration-sensitive built structures or equipment.	Damage to flowlines or containment structures for storage of materials.	Soil, surface water and/or groundwater contamination	Moderate	Rare	Low	Spill response kits should be available at well-pads and the CFA and used as soon as possible following an event.	■ Emergency Preparedness Response Plan ■ OEMP
Industrial hazards								
2	Failure or rupture of a storage tank	Leakage and spill of production fluid onto land	Soil, shallow groundwater	Moderate	Rare	Low	Spill response kits should be available at well-pads and the CFA and used as soon as possible following an event.	■ Emergency Preparedness Response Plan ■ OEMP
3	Perforation or rupture of a flowline or spillage due to poor working practices	Leakage and spill of production fluid onto land or at a river/ lugga crossing.	Soil, surface water, shallow groundwater	Moderate	Rare	Low	Flowlines will be buried. Due to the waxy properties of the oil, if there are any breaks to the flowlines it is likely that the oil will solidify quickly (crude is solid below 57°C). Spill response kits should be available at well-pads and the CFA and used as soon as possible following an event.	■ Emergency Preparedness Response Plan ■ Water Management Plan ■ Environmental Monitoring Plan

Haz No.	Hazard	Consequence	Receptor	Consequence rating	Probability	Risk	Mitigation measures	Relevant Management Plan
4	Road traffic accidents on access roads	Spillage of hazardous materials, injury or death	Soil, surface water, shallow groundwater, Human or ecological receptors	Moderate	Likely	Medium	Project speed limits will be adhered to Education programme for drivers and passengers Compliance with the Kenyan Road Traffic Act	▪ TMP ▪ OEMP ▪ Emergency Preparedness Response Plan
5	Road traffic accidents on public roads	Spillage of hazardous materials, damage to public infrastructure, injury or death	Soil, surface water, shallow groundwater, Human or ecological receptors, public infrastructure	High	Likely	High	National and Project speed limits will be adhered to Education programme for drivers and passengers Community awareness programme for traffic awareness Compliance with the Kenyan Road Traffic Act	▪ TMP ▪ OEMP ▪ Emergency Preparedness Response Plan
6	Induced seismicity due to well testing/ oil production.	Loss of containment leading to leakage and a spill of production fluid	Soil, surface water, shallow groundwater	Moderate	Rare	Low	Flowlines will be buried. Due to the waxy properties of the oil, if there are any breaks to the flowlines it is likely that the oil will solidify quickly (crude is solid below 57°C). Spill response kits should be available at wellpad and the CFA and used as soon as possible following an event.	▪ Emergency Preparedness Response Plan ▪ Water Management Plan ▪ Environmental Monitoring Plan

Haz No.	Hazard	Consequence	Receptor	Consequence rating	Probability	Risk	Mitigation measures	Relevant Management Plan
7	Well casing/cement integrity failure and down hole collisions during drilling and production.	Loss of containment and leakage of production fluids.	Soil, surface water, shallow groundwater	Moderate	Rare	Low	Due to the waxy properties of the oil, if there are any breaks to the flowlines it is likely that the oil will solidify quickly (crude is solid below 57°C). Spill response kits should be available at wellpad and the CFA and used as soon as possible following an event.	▪ Emergency Preparedness Response Plan ▪ Water Management Plan ▪ Environmental Monitoring Plan

7.11.6 Conclusion

This *emergency, accidental and non-routine events* assessment includes an evaluation of natural and industrial hazards and the probability of their occurrence to assess the risk of unplanned natural and industrial events which could cause environmental or social impacts by adversely affecting the environment or public safety. A qualitative assessment of natural and industrial events has been undertaken.

The risk associated with the unplanned events ranges from Low to High, depending on the consequence and probability of occurrence. The following management plans are required to respond to the unplanned events detailed in this assessment:

- Emergency Preparedness Response Plan;
- Oil Spill Contingency Plan;
- CEMP, including Waste Management, Traffic Management, Water Management and Hazardous Materials Management; and
- OEMP, including Waste Management, Traffic Management, Water Management and Hazardous Materials Management.

In addition, a full QRA will be undertaken as part of the detailed design of the facilities and appropriate mitigation and management options will be implemented depending on the results so that the facility meets GIIP in this regard.

8.0 CUMULATIVE IMPACTS

8.1 Introduction

Cumulative impacts, as defined by the IFC (IFC 2013), are those that may result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing or reasonably defined planned developments, at the time the risks and impact identification process is undertaken. While a standalone activity may itself result in an impact that is not significant, when combined with other impacts (significant or not significant) in the same geographical area and occurring simultaneously, it may result in a significant cumulative impact. Understanding of the impacts of planned developments varies, with some planned projects well understood, both spatially and temporally, whilst for others there is only limited information available. The IFC Good Practice Handbook on Cumulative Impacts Assessment (CIA) (IFC, 2015b) suggests that government and regional planners have ultimate responsibility for CIAs, so a broader scale assessment was not considered appropriate for this Project ESIA.

8.2 Assessment Method

The CIA identifies areas where the cumulative impacts of the Project and anticipated future developments may occur. The assessment methodology involves:

- Defining the spatial and temporal scope of the assessment within which other planned developments need to be considered;
- Identification of defined or foreseeable Associated Facilities and third-party projects;
- Identifying groups of receptors[1] that have environmental and social attributes that may be important to assessing risks;
- Identify how new activities and developments may generate impacts that could act cumulatively, together with potential combined effects;
- Assess the impact of any potential combined effects of the Project with the Associated Facilities and third-party projects on the identified receptors; and
- Where relevant, outline mitigation and management strategies to address any potential cumulative impacts.

Cumulative impacts from existing projects and developments have not been included in this assessment, as they have been considered in the ESIA through the inclusion and consideration of the baseline environment. The EOPS will not operate simultaneously with the Project but the baseline conditions considered in the ESIA include EOPS operation.

8.3 Spatial and Temporal Scope

The cumulative assessment focuses on developments located within the Project AoI (as illustrated in Figure 8.3-1) which have the potential for combined impacts with the Project. It considers known proposed associated facilities and third-party project developments that will likely be constructed and subsequently operated within the lifespan of the Project.

While most potential cumulative effects may manifest locally, some effects (e.g. socio-economic) may extend beyond the AoI. Third-party project activities located outside of Kenya have been scoped out of this CIA, due

[1] Termed “Valued Environmental and Social Components (VECs)” (IFC, 2013). The term ‘receptor(s)’ is used for the purposes of this assessment, rather than VECs, in order to maintain consistency throughout the ESIA.

to their distance from the Project. Any components or activities of these third-party projects which are likely to occur in the AoI, for example routes used by construction vehicles and materials, have been included.

The temporal scope of this CIA includes the construction period which is 66 months (the maximum anticipated construction period) although the majority of the Project infrastructure (CFA/CPF) will be constructed within the first 36 months, and the 25 year operational life of the Project.

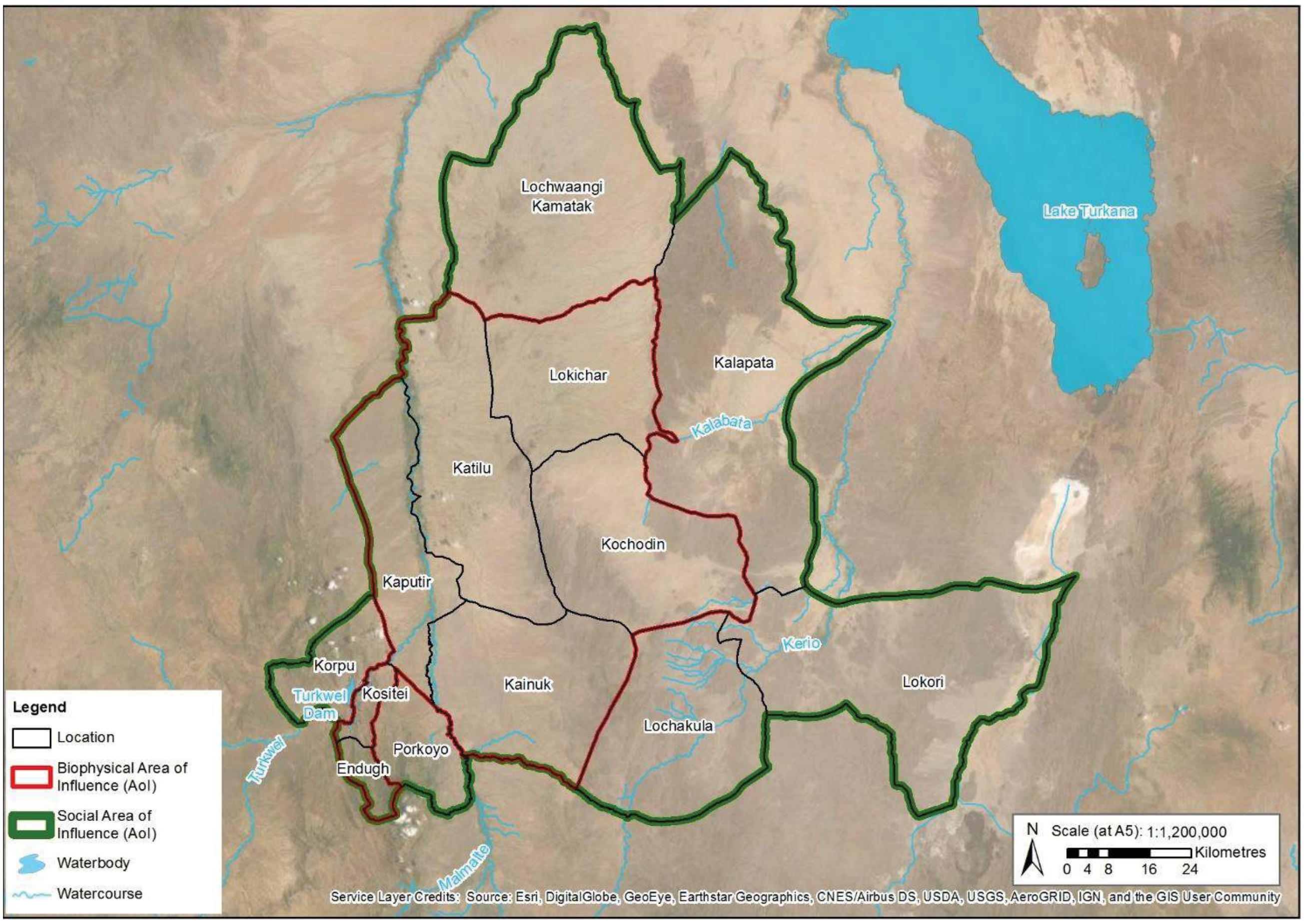

Figure 8.3-1: Project AoI

8.4 Scoping of the CIA and Identification of Other Developments

Associated Project facilities and third-party projects have been identified and defined using publicly available information, including but not limited to the following sources:

- Publicly available third-party project specific ESIA documents;
- Turkana County Annual Development Plan 2019 - 2020;
- Turkana County Annual Development Plan 2020 - 2020;
- West Pokot County Annual Development Plan 2017- 2018;
- Kenya Vision 2030;
- LAPSSET Corridor Development Project Strategic Environmental Assessment 2017; and
- Kenya National Highways Authority (KeNHA) website.

These documents and sources have been reviewed to identify current or planned third-party projects within the AoI which may combine with the Project to generate cumulative impacts. The following projects have been identified in the AoI and a justification for their inclusion into or scoping out of the CIA is provided below.

8.4.1 Associated Project Facilities

Associated facilities are facilities that are not funded as part of the Project and that would not have been constructed or expanded if the Project did not exist and without which the project would not be viable (IFC, 2012b).

Project impacts relating to the use of these facilities have been included within the impact analysis in the ESIA and TKBV have committed to exert influence on the operators of these associated facilities to adopt potential mitigation measures, identified through this ESIA. Nevertheless, all of these associated Project facilities are outlined below and are also considered in this CIA, as there are elements of the construction and operation of these facilities which are outwith TKBV influence.

8.4.1.1 Lokichar to Lamu Crude Oil Pipeline (LLCOP)

The LLCOP Project is proposed to transport stabilised crude oil from the South Lokichar Basin Upstream processing facilities along an 824 km long pipeline to a storage and load-out facility at a new port in Lamu. The pipeline will form an integral part of the LAPSSET Corridor. The LAPSSET Corridor is considered as a Third-Party Project in Section 8.4.2.1.

The following components of the LLCOP are anticipated to have potential cumulative effects due to their location within the AoI or the nature of the activities:

- The construction and operation of the LEF which is located within the CFA;
- The construction and operation of the pumping stations associated with the pipeline, of which none are located within the biophysical AoI and two are located within the social AoI;
- Safety aspects relating to the operation of the sections of the roads in the AoI;
- The construction of the section of the oil pipeline located within the AoI. This is approximately 30 km for the biophysical AoI and 90 km for the social AoI. As the pipeline is buried, any impacts relating to the direct operational phase of the pipeline (excluding supporting infrastructure) have been scoped out of the assessment;
- The construction and operation of any electricity/power transmission and connectivity infrastructure located within the AoI;
- Construction water supply for the section of the LLCOP and associated infrastructure located within the AoI;
- The construction and operation of accommodation camps for construction of the LLCOP in the AoI. The exact location of the accommodation camp is yet to be defined but it will be located within Turkana;
- Waste disposal facilities for the construction and operational aspects of the LLCOP located within the AoI; and
- Population Influx and social and health related aspects during construction of LLCOP in the AoI.

8.4.1.2 Off-Site Overhead Transmission Lines

To provide Power for the Project, construction and installation of the following off-site OHTLs will be required and undertaken by the relevant Kenyan electricity company, which is currently the Kenya Electricity Transmission Company (KETRACO).

- A 220kV Turkwel – Lokichar – Lodwar – Lokichoggio transmission line and a new 220kV substation adjacent to the CPF; and
- A 66kV transmission line from Kainuk Substation to the Make-up Water abstraction facilities and new transformer station.

8.4.1.3 Construction Materials Route

The Project will require significant quantities of material to be transported to Site during each phase of the Project. The main planned supply route for imported material is from the Port at Mombasa along the A109 dual carriageway to Nairobi, along the A104 single carriageway and then along the A1 to the Project Site. These are all national roads which remain the responsibility of the GoK.

A traffic screening has been undertaken in the ESIA for the estimated number of construction vehicles which will be using the network. Traffic emissions are screened and assessed based on the estimated vehicle trips generated by an individual project in isolation. Within the screening criteria baseline traffic numbers and other projects are not considered in the calculations (detailed in Section 7.1.10.1 and 7.2.10.1 of this ESIA).

8.4.1.4 Rest stops

Rest stops will be required at a number of locations along the construction materials transport route from Mombasa to the Project. These locations are yet to be defined, but they will be existing rest stop locations which will be audited by TKBV.

8.4.1.5 Water off-takes

TKBV will make provisions for community water off-take points allowing County water service providers to access the non-potable water. These providers will be responsible for the treatment of water to ensure it meets drinking water standards, and the distribution to surrounding community water points. CWRUAs will be formed in collaboration with the County Government’s Department of Water Services, and WRA. The CWRUA’s will be responsible for the management and operations of the supply schemes.

8.4.1.6 Kapese camp and airstrip upgrade works

The camp and airstrip at Kapese are currently leased by TKBV and several upgrades will be required to support the airstrip operations. The airstrip design will be upgraded to make it suitable for Code C aircraft. The airstrip will most probably be upgraded to be approximately 2 km long and 23 m wide. Existing buildings will be upgraded and the existing runway will be resurfaced with a bituminous surface dressing or equivalent. Drainage will be designed to ensure no change in discharge from these areas during rainfall events up to a 1 in 100-year return period.

8.4.1.7 Borrow Pits

Construction aggregate will be sourced from either new off-site quarries or existing borrow pits. The EPC contractor will be responsible for the provision of aggregates. The locations for new off-site quarries are not yet determined but for logistical reasons it is assumed that they will be located within the AoI. The provision of aggregate will be subject to appropriate Kenyan regulatory and environmental permitting process (outside the scope of this ESIA).

8.4.2 Third-Party Projects

8.4.2.1 LAPSSET Corridor Development Project

The LAPSSET Corridor is a linear multi-spoke land corridor identified by the GoK for strategic development as part of the Vision 2030 process and is a major initiative for Kenya and the East African region.

Land required for the LAPSSET Corridor will be acquired by the GoK (NLC, supported by Ministry of Lands and Physical Planning) by compulsory acquisition under the terms of the Land Act (2012) and transferred to the LCDA.

The entire LAPSSET Corridor spans over 2,000 km in length and is comprised of two core elements:

- A 500 m wide Infrastructure Corridor, which will accommodate the LLCOP, new roads, a railway, and utilities (water and OHTLs); and
- A 50 km wide Economic Corridor spanning either sides of the Infrastructure Corridor, where industrial developments will be situated.

The LAPSSET Corridor will comprise the following key components:

- Roads;
- Standard Gauge Railway (SGR);
- Oil pipeline and associated stations;
- LEF which is located within the Project CPF
- Electricity/Power Transmission;
- Fibre Optic Connectivity;
- Water Supply;
- 32 Berth sea port at Lamu;
- International Airports;
- Resort Cities; and
- High Grand Falls Dam.

Due to the Project being intrinsically linked to sections of the infrastructure for the LLCOP and the likely close alignment of the construction periods for certain components, this development is likely to generate cumulative impacts.

8.4.2.2 Tilenga Project

The Tilenga project includes the development of six oil fields which are located within western Uganda, close to Lake Albert. The project will incorporate wellpads, wells and buried pipelines and infrastructure with water sourced from Lake Albert. Due to the distance from the Project, cumulative impacts from the operations phase of the Tilenga project are not anticipated and are therefore screened out of this CIA. To construct the Tilenga project, construction materials will be moved by road from the Port at Mombasa towards Eldoret, then into Uganda. Part of the transport route is the same as for the Project, therefore cumulative impacts from road traffic are considered in this CIA, all other construction impacts are screened out of the assessment.

8.4.2.3 Kingfisher Oil Development

The Kingfisher Oil Project includes the development of oil fields which are located within western Uganda, close to Lake Albert. The project will incorporate wellpads, wells and buried pipelines and infrastructure with water sourced from Lake Albert. Due to the distance from the Project, cumulative impacts from the operations phase of the Kingfisher Project are not anticipated and are therefore screened out of this CIA. To construct and operate the Kingfisher Project, materials will be moved by road using the P2 and R7 roads in Kenya. Part of the transport route is the same as for the Project, therefore cumulative impacts from road traffic are considered in this CIA, all other construction impacts are screened out of the assessment.

8.4.2.4 Turkana Proposed Mega-Dams

The Turkana Draft Annual Development Plan (ADP) 2020 - 2021 outlines that four mega-dams are proposed in Turkana with proposed locations at Kotome, Letea, Kalemngorok and Napeitom. The dams will be developed by Turkana Government in partnership with other development partners. The dams will be developed as a form of water harvesting for use by pastoralists. The ESIAs for these proposed developments are reportedly due to be undertaken in the coming year. All the proposed dams are in Turkana County with Kalemngorok located the closest to the Project. Due to the current development stage of these projects there is no information on the likely residual impacts. As the ESIAs for these projects are yet to be undertaken, the Project should be included in the CIA of these four ESIAs, and they are not assessed in this CIA.

8.5 Identification of Receptors

The receptors identified within each technical chapter in Section 7 of this ESIA remain relevant to the cumulative assessment, including physical, biological or social for example PAP, areas of cultural importance, watercourses, flora and fauna, depending on the technical discipline. These are summarised in Table 8.5-1.

Table 8.5-1: Cumulative Impact Assessment - Receptors

Technical Discipline	Receptor(s)
Air Quality	PAP (transient or permanent), and flora.
Noise and Vibration	PAP (transient or permanent), the Turkwel Dam and fauna.
Water Quantity and Quality	Kalabata, Malmalte and Turkel Rivers, seasonal rivers and ephemeral streams/drainage luggas, Tukwel Reservoir, shallow and deep groundwater aquifers, and PAP (transient or permanent).
Soils, Terrain, Geology and Seismicity	Soils (Cambisols, Fluvisols, Lixisols, and Regosols).
Landscape and Visual	Landscape receptors (e.g. Protected Areas and landscape character areas), and visual impact receptors (PAP).
Biodiversity, Ecology and Protected Areas	Habitats and species.
Ecosystem Services	Cultivated and wild food, medicinal plants, grazing, biomass fuel, wood and fibre, freshwater and regulation of water flows, cultural sites, and educational and spiritual values.
Social	PAP
Cultural Heritage	Tangible living cultural heritage (e.g. sacred trees, graves), intangible cultural heritage, and archaeology.

Through the social engagement work undertaken to date, there have been environmental concerns raised by stakeholders. These include:

- Water – general concerns regarding treatment, and water access as well as the possible impacts of Project-related abstraction on flows in the Turkwel River and resultant effects on livelihoods;
- Pollution/waste – concerns regarding the provisions for waste management and the establishment of Waste Management Facilities;
- Air – concerns relating to pollution as a result of Project-related flaring activity and dust from Project vehicles; and
- Biodiversity – general concerns regarding the overall biological sensitivity of the area and specific concern on the consumption of wastewater by birds.

8.6 Project Residual Impacts

The residual impacts of the Project are summarised below for each technical discipline and are referenced in the CIA sections below.

8.6.1 Air Quality

For the construction phase, minor residual impacts are anticipated on communities of *Euphorbia turkanensis*, and minor to negligible residual impacts are anticipated on areas of the Nasolot NR, PAP and transient receptors from construction dust within 250 m of Project related infrastructure.

For the operational phase, minor residual impacts are anticipated on PAP and transient receptors located within a defined area around the CFA (detailed in Section 7.1) where $PM_{2.5}$ concentrations are predicted which are greater than the relevant AQS.

8.6.2 Noise & Vibration

For the construction phase, minor residual noise impacts are anticipated on PAP and transient human receptors from the construction of Project components within 210 m of the CFA, 210 m of Ngamia wellpads and infield flowlines, 395 m of Amosing wellpads and infield flowlines, 800 m of Twiga wellpads and infield flowlines, 210 m of the landfill and 800 m of the water pipeline RoW .

For the operational phase, minor residual impacts are anticipated on transient human receptors within 100 m of the CFA fence-line, up to 36 m from wellpad fence-lines (depending upon the field and wellpad), 400 m from the Turkwel Dam pumps and 36 m from the landfill fence-line if the transient receptors were to remain in the area for more than 24 hours. No residual impacts from vibration are anticipated for either the construction or operational phase.

8.6.3 Water Quantity

For the construction phase, minor residual impacts are anticipated on the Kalabata River from the Project abstraction of groundwater from boreholes for the initial construction period. Minor to negligible residual impacts are anticipated on seasonal rivers/ streams and drainage luggas from water discharges, construction activities near or within water courses and the abstraction of groundwater from boreholes for the initial construction period. Minor impacts are anticipated on the Turkwel Reservoir and groundwater - shallow aquifers, from abstraction of groundwater from boreholes for the initial construction period. Minor residual impacts are anticipated on human residences downstream of the proposed Project infrastructure during construction relating to the flood risk due to the presence of the Project infrastructure.

For the operational phase, minor residual impacts are anticipated on the Turkwel Reservoir due to continued water abstraction.

8.6.4 Water Quality

For the construction phase, minor residual impacts are anticipated on the Kalabata River, the Malmalte River, the Turkwel River, seasonal rivers/streams and drainage luggas and the Turkwel Reservoir (along the ridge where the pontoon intake is proposed) from construction activities near or within the watercourses/bodies. Minor residual impacts are also anticipated on the Kalabata River, seasonal rivers/streams and drainage luggas and groundwater (shallow aquifers) from discharges/releases from waste storage and disposal activities.

For the operational phase, minor residual impacts are anticipated on the Kalabata River, seasonal rivers/streams and drainage luggas and groundwater (shallow aquifers) from discharges/releases from waste storage and disposal activities.

8.6.5 Soils, Terrain, Geology & Seismicity

For the construction phase, minor residual impacts are anticipated on agricultural land potential (cambisols and fluvisols) from ground disturbance leading to increased erosion risk on the Water Pipeline RoW near the Turkwel Reservoir, short-term loss of agricultural land capability and topsoil handling and storage.

For the operational phase, negligible residual impacts are anticipated from transport of heavy equipment and traffic, these impacts are limited in extent and would be expected to recover over a short period following application of the soil management plan.

8.6.6 Landscape and Visual

For the construction phase, minor residual landscape impacts are anticipated on the Nasolot NR and the Pellow Community Conservancy from works associated with the buried water pipeline and temporary infrastructure. Minor to negligible visual impacts are anticipated on PAP from construction activities including the clearance and removal of vegetation and soils.

For the operational phase, minor to negligible residual visual impacts are anticipated on PAP from the location of above ground infrastructure. No significant residual landscape impacts are anticipated.

8.6.7 Biodiversity, Ecology and Protected Areas

For the construction phase, minor residual biodiversity impacts are anticipated on the Nasolot NR, the South Turkana NR and the Pellow Community Conservancy. Additionally, for riparian forest communities along the Malmalte River, rocky ridge habitats, some acacia bushlands and thickets and colonies of *Euphorbia turkanensis* minor residual impacts are predicted.

Minor residual impacts to mammal SoCC, bird SoCC and fish from factors including land take, sensory disturbance (noise and light), increased access, invasive species, direct mortality and influx are likewise predicted. Moderate residual impacts are anticipated on elephants from loss of critical habitat, habitat severance and increased human-wildlife conflict. Moderate residual impacts are also anticipated on leopard and striped hyaena from sensory disturbance, persecution and direct mortality; vultures from direct mortality due to OHTL, sensory disturbance and loss of critical habitat due to the potential dewatering of the Kalabata River. The Turkana toad and the Omophron ground beetle will be moderately residually impacted from direct mortality, attraction to lights and loss of critical habitat due to the potential dewatering of the Kalabata River. The demarcation of critical habitat on construction plans will include ‘No-Go’ areas, and the identification of any seasonal or temporal constraints during both construction and operational phases of the Project.

For the operational phase, minor residual biodiversity impacts are anticipated on riparian forest communities along the Malmalte River and rocky ridge habitats. Equally, elephants, leopard, striped hyaena, bird SoCC, range- restricted fish species, the Turkana toad and the Omophron ground beetle will be impacted from factors including edge impacts, sensory disturbance (noise and light) , increased access, direct mortality and attraction to water and light sources. Moderate residual impacts are also anticipated on vultures from direct mortality due to OHTL and flares.

8.6.8 Ecosystem Services

For the construction phase, minor residual ecosystem services impacts are anticipated on the availability of grazing/ browsing for livestock, medicinal plants and freshwater from changes to land use and a reduction in availability. Moderate residual impacts are anticipated on cultural sites and spiritual values from the loss and disturbance of sacred sites and changes to landscape aesthetics.

For the operational phase, minor residual ecosystem services impacts are anticipated on the availability of wild foods, medicinal plants, biomass fuels and wood and fibre from influx of people and livestock. Moderate residual impacts are anticipated on the availability of grazing/browsing for livestock, cultural sites and spiritual values due to the influx of people and livestock and the presence of the Project in the landscape.

8.6.9 Social

For both the construction and operational phases of the Project there are a number of minor to major positive residual social impacts which are anticipated. These include, but are not limited to, additional infrastructure, payments of taxes, employment and procurement opportunities and improved access to education.

For the construction and operational phases, minor negative residual social impacts are anticipated on the following:

- Population induced influx;
- Inflation as an indirect effect of increased salaried employment;
- Temporary land restrictions;
- Loss of homesteads and graves through land-take;
- Increase in sexually transmitted infections and communicable disease from the introduction of external workforce;
- Increase in vector related disease from alteration to the environment;
- Increase in zoonotic disease if Project wastes are not effectively managed;
- Transport related accident and injury;
- Increases in crime and commercial sex work; and
- Inter-ethnic conflict and community cohesion between Turkana and West Pokot.

8.6.10 Cultural Heritage

For the construction phase, minor cultural heritage residual impacts are anticipated on potential archaeological settlement sites, Turkana culture and nomadic pastoralism, West Pokot culture and environmental subsistence due to ground disturbance and changes in visual setting and socio- economic conditions. Moderate residual impacts are anticipated on sacred trees and graves and burials from ground disturbance, dust generated during construction, visual impacts and land disturbance.

For the operational phase, minor residual impacts are anticipated on Turkana culture, West Pokot culture and nomadic pastoralism from changes in socio- economic conditions. Moderate residual cultural heritage impacts are anticipated on sacred trees from visual changes due to the presence of OHTL.

8.7 Assessment of Other Developments

Known and proposed Project associated facilities and third- party projects, located within Kenya and specifically within the AoI have been identified in Section 8.4.2. The likely cumulative impacts of these associated facilities or third-party projects with the Project are detailed in the following section.

8.7.1 Associated Facilities

8.7.1.1 LLCOP

The ESIA completed for LLCOP (Golder, 2019c) identified the following potential residual (negative) impacts associated with the development:

- Potential decline in air quality through LLCOP station emissions (generator exhaust);
- Noise and vibration impacts associated with heavy construction equipment / traffic noise, which may have implications on local communities;
- Water management impacts during construction and operational phases in relation to the maintenance of drainage patterns, water availability and the discharge of wastewater;
- Ground disturbance resulting in increased soil erosion risk and loss of agricultural land capability;
- The temporary impingement of ecological connectivity and habitat severance during the construction phase and potential road collision impacts on protected species;
- Potential impacts on marine flora and fauna from accidental spillages or releases from Project related tanker vessels. For sea turtles, marine mammals and fish, there is also risk of vessel collision. These potential impacts will be managed through an Emergency Preparedness and Response Plan, invasive species management, a no hunting or fishing policy, monitoring of mangrove restoration and procedural controls in adherence with GIIP;
- Minor residual impacts during construction and operation associated with the partial loss/damage to key landscape characteristics in the immediate setting of the Project Stations in areas of predominantly low-lying scattered scrub;
- Potential project–related ground disturbance (e.g. vegetation clearing, soil stripping, stockpiling) impacting on cultural heritage sites which have yet to be identified pre-construction;
- Impacts on traffic volumes and composition, particularly during construction;
- Community health and safety impacts associated with influx of workers including increased risk of HIV/AIDS and STIs;
- Potential impacts on employment and temporary competition for labour; and
- Potential impacts on ecosystem services associated with vegetation clearance, population influx, loss of land and resources, disruption to pastoral access to grazing/browsing resources and freshwater (fishing) and marine (fishing and mangroves) environments.

8.7.1.1.1 Potential Cumulative Impacts

Residual Impacts from the Project leading to potential cumulative impacts with the LLCOP project are anticipated during the construction and operational phases:

- Potential decline in air quality through combined construction dust emissions - the construction of the CFA (including the LEF) has been included in the Project construction dust assessment and therefore the mitigation avoidance areas defined in Section 8.6.1 consider cumulative impacts. There is also the potential for the construction of the most northern section of the LLCOP to generate cumulative dust impacts with the Project. The project proponents should engage to plan construction programmes so any concurrent work in the same location (within 250 m of each project) are minimised as far as practicable. Where concurrent work is required, the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities.

- Potential decline in air quality from traffic emissions - a traffic screening for the impact of exhaust emissions on air quality has been undertaken for the Project and LLCOP. For both projects, the anticipated vehicle numbers are below the screening criteria and therefore detailed assessments have not been undertaken. Screening and assessment of air quality impacts from traffic consider the change in traffic associated with a development, with each proposed development assessed individually. Therefore, the cumulative impacts from traffic, with regards to air quality, are no greater than predicted for the Project (not-significant).
- Potential decline in air quality through operational exhaust emissions associated with the generator located at the LEF and the operation of the CFA - This has been considered in the ADM for the Project and included in the results and associated mitigation. Therefore, the cumulative impacts from emissions to air from the LEF operation, are no greater than the maximum predicted residual impact for the Project which is a minor within the area around the CFA as defined in Section 7.1.
- Noise impacts from construction of LEF - The assessment of the Project construction noise considers the construction of the LEF which is located within the CFA and therefore the mitigation avoidance areas defined in Section 8.6.2 consider cumulative impacts. The project proponents should engage to plan construction programmes so any concurrent work in the same location are minimised as far as practicable. Where concurrent work is required then the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities. If these mitigation measures are implemented alongside GIIP, the residual cumulative impacts are no greater than predicted for the Project.
- Noise impacts from the construction of the pipeline – cumulative noise impacts may occur if construction of the Project and the northern section of the LLCOP occur at the same time. Where concurrent work is required then project proponents should work together to identify additional measures and controls to limit the activities significance and duration. If these mitigation measures are implemented alongside GIIP, the residual cumulative impacts are no greater than predicted for the Project.
- Noise impacts from the operation of the LEF - the operation of the LEF is included in the Project assessment of operational noise, therefore cumulative impacts of operational noise have already been considered and mitigated as detailed in Section 8.6.2. The residual cumulative impact significance is anticipated to be minor. LLCOP Pumping Station 1 is located approximately 35 km from the LEF, therefore cumulative noise impacts with the Project are not anticipated and therefore screened out of this assessment as not significant.
- Biodiversity impacts during construction - cumulative biodiversity impacts may occur when construction of the two projects occurs simultaneously in the same area. Due to the location of the Project, cumulative impacts are not anticipated in the sensitive biodiversity areas along the water pipeline route for example the Nasolot NR, the Pellow Community Conservancy and the Malmalte River, as there is no LLCOP infrastructure located in these areas. As such, habitat disturbance and severance are unlikely in sensitive habitats including critical habitats from a cumulative context and the residual cumulative impacts are no greater than predicted for the Project. Biodiversity impacts from operation of LLCOP and the Project ,once the LLCOP is installed and the pipeline corridor restored, cumulative impacts on terrestrial biodiversity during operation will reduce. However, terrestrial biodiversity impacts are likely to include minor disturbance and changes to fauna and flora species receptors as a result of increases in noise and light

around LLCOP stations during operation. It should be noted that the closest LLCOP station, outside of the LEF, is situated approximately 35 km from the Project within the Social AoI but outside of the Physical AoI. Mitigation, compensation and enhancements to habitats and species as committed to in Section 7.7 will minimise cumulative impacts and the residual cumulative impacts are anticipated to be no greater than predicted for the Project.

- Community health and safety and security impacts associated with construction and operational phases – cumulative impacts are anticipated associated with the influx of people and workers relating to both projects. The cumulative impacts of the projects may include increased risk of HIV/AIDS and STIs. Alongside the mitigation measures identified for each project including closed camps, engagement campaigns and HIV and health plans and policies, the Project proponents should work together to align proposed measures and identify if any additional measures and controls are required to limit significance. If these mitigation measures are implemented alongside GIIP, the residual cumulative impact significance is anticipated to be no greater than predicted for the Project.
- Project construction wastes – Construction wastes will be managed by the EPC contractor in accordance with the relevant Kenyan and international requirements and the Project Waste Management Plan. Non-degradable construction wastes from the LLCOP in the AoI will be disposed of in the Project's engineered landfill and have been allocated for in the landfill design. The engineered landfill has been designed and specified to include LLCOP wastes, therefore cumulative impacts are considered.

8.7.1.2 Off-Site Overhead Transmission Lines

An ESIA[2] was submitted in August 2017 for the Turkwel – Lokichar – Lodwar 220kV transmission line project. Residual negative impacts associated with the development include construction noise and dust, management of demolition wastes, oil spills relating to construction plant and vegetation disturbance. Operational impacts may also include mortality of birds through electrocution or direct impacts with OHTL. Section 7.7 (Biodiversity) considers the cumulative impacts of the off-site OHTLs in more detail.

8.7.1.2.1 Potential Cumulative Impacts

Depending on the construction schedule, there is a possibility that the OHTLs could be constructed at the same time as Project infrastructure which may result in cumulative impacts relating to dust, noise and biodiversity. Where dust and noise impacts may occur, these will be temporary as they will be confined to the construction phase and cumulative impacts will only occur in the areas of residual impact defined in Sections 8.6.1 and 8.6.2. Where any cumulative impacts occur GIIP and Project-specific mitigation measures will be applied. Where cumulative impacts occur regarding biodiversity, TKBV are committed to engage with the OHTL operator to discuss optimal OHTL routing and the incorporation of bird-friendly measures into the OHTL design. TKBV are also committed to try and encourage the implementation of a mitigation and monitoring plan to assess the effectiveness of any mitigation measures relating to birds. Following adoption of these mitigation measures the cumulative impact significance is anticipated to be no greater than for the Project.

8.7.1.3 Construction Route Rest Stops

Rest stops will be required at several locations along the construction materials transport route from Mombasa to the Project. These locations are not yet defined, but they will be existing rest stop locations which will be frequently audited by TKBV. The increased use of existing rest stops could increase the risk of HIV/AIDS and STIs due to the potential increase in availability of sex workers.

[2] Environmental and Social Impact Study Report for the proposed Turkwel- Lokichar- Lodwar high voltage transmission line project in Turkana County, Tingori Consultancy Limited, 2017

8.7.1.3.1 Potential Cumulative Impacts

Cumulative social impacts will be managed and mitigated through the same strict implementation of company policies and strategies described in Section 7.9. These policies will be applicable for both TKBV employees, contractors and sub- contractors and will include but not be limited to the Influx Management Plan, the Tullow Code of Ethical Conduct, a Community Health, Safety and Security Management Plan, an HIV Policy and Programme and a Transport Management Plan. Following these mitigation measures the cumulative impact significance is anticipated to be no greater than for the Project.

8.7.1.4 Water Off-Takes

A moderate (positive) residual impact is anticipated due to the provision of water off-take points, although there is the potential for negative impacts relating to overgrazing around water points and influx of people into the vicinity of the water supply, if the CWRUAs do not effectively manage the off-takes.

8.7.1.4.1 Potential Cumulative Impacts

Potential cumulative impacts may include population influx to be close to a permanent and secure water supply, inter-ethnic conflict due to the locations of the water offtakes and impacts on ecosystem services relating to availability of grazing/browsing for livestock if the number of animals increase (relating to influx). TKBV are committed to encourage sustainable use of water points to discourage overgrazing and record issues as part of the grievance mechanism to manage any cumulative impacts. Following these mitigation measures, the cumulative impact significance is anticipated to be no greater than for the Project.

8.7.1.5 Kapese Camp and Airstrip Upgrade Works

Impacts from the upgrade/construction works will include dust, noise and biodiversity. Dust and noise will be generated from the works undertaken at the airstrip, although these will only be temporary during the construction/ upgrade activities (as referenced in Sectiom 7.1, Air Quality and 7.2, Noise and Vibration). Biodiversity impacts may include sensory disturbance, land take and direct mortality (Section 7.7).

8.7.1.5.1 Potential Cumulative Impacts

Depending on the construction schedule, there is a possibility that the upgrade works could occur at the same time as the construction of Project infrastructure which may result in cumulative impacts relating to dust, noise and biodiversity. Where dust and noise impacts may occur, these will be temporary as they will be confined to the construction phase and cumulative impacts will only occur in the areas of residual impact defined in sections 8.6.1 and 8.6.2. Specifically, for noise, TKBV are committed to encourage the owners of the airstrip to consider temporary relocation or livelihood restoration of impacted receptors within 210 m of the Kapese airstrip during any upgrade work. The operation of the airstrip is not assumed to generate any additional residual noise impacts (compared to current operations) and therefore there will be no cumulative operational impacts. Where any cumulative impacts occur GIIP and Project specific mitigation measures will be applied. Following these mitigation measures the cumulative impact significance is anticipated to be no greater than for the Project.

8.7.1.6 Borrow Pits

Impacts associated with the development of borrow pits and the extraction of material will likely include dust, noise and biodiversity impacts. The borrow pits will not be developed in areas of archaeological importance, therefore cultural heritage impacts are not anticipated. Biodiversity impacts may include sensory disturbance, land take and direct mortality, depending on the borrow pit locations. As a further mitigation, NEMA requires separate Project Reports for borrow pits. The EPC contractor will therefore be required to prepare site Specific Project Reports and submit them to NEMA once the location of the borrow pits has been identified.

8.7.1.6.1 Potential Cumulative Impacts

Where dust and noise impacts may occur, these will be temporary and cumulative impacts will only occur in the areas of residual impact defined in sections 8.6.1 and 8.6.2. If the borrow pits are developed outside of these defined areas, no cumulative dust or noise impacts would be anticipated. The Project BCoW will engage with the borrow pit contractor/developer to discourage their development in sensitive biodiversity areas. Where any cumulative impacts occur GIIP and Project specific mitigation measures will be applied. Following these mitigation measures the cumulative impact significance is anticipated to be no greater than for the Project.

8.7.2 Third- Party Projects

8.7.2.1 LAPSSET Corridor Development Project

8.7.2.1.1 Strategic Environmental Assessment (SEA)

The SEA completed for LAPSSET (REPCON Associates, 2017[3]) considered the cumulative impacts of the wider LAPSSET Corridor and identified the following potential impacts as those with the greatest potential to be realised as part of the strategic LAPSSET plan implementation:

- Realignment of land-use along the corridor and beyond;
- Impacts to pastoral and rangeland agriculture and land management;
- Impacts to biodiversity; and
- Impacts to water resources.

Although the project will contribute to all of these impacts in a minor or negligible way, the most significant potential impacts will be realised if any aspects of the LAPSSET corridor (excluding the LLCOP which has already been discussed in Section 8.7.1.1) are constructed concurrently with the Project. Such construction impacts may include:

- Potential decline in air quality through the combined operational vehicle exhaust emissions and emissions to air from vehicles using the LAPSSET corridor roads and railway.
- Noise and vibration impacts associated with heavy construction equipment and traffic noise may have implications on local communities.
- Terrestrial biodiversity impacts during construction include temporary impingement of ecological connectivity and habitat severance.
- Terrestrial biodiversity impacts include relatively minor disturbance and changes to fauna and flora species receptors as a result of increases in vehicular movements, noise and light around the LAPSSET corridor.
- Community health and safety impacts associated with influx of workers including increased risk of HIV/AIDS and STIs.

8.7.2.1.2 Cumulative Impacts With the Project

Residual Impacts from the Project (as detailed in Section 8.6) leading to potential cumulative impacts with the LAPSSET project are anticipated during the construction and operational phases. These may include:

- Potential decline in air quality through combined construction dust emissions and air quality related traffic emissions. Where concurrent work is required, the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities;

[3] Strategic Environmental Assessment-SEA in the LAPSSET Corridor Infrastructure Development Project (LCIDP) – Draft Report, REPCON Associates January 2017 **(LCDA, 2017)**

- Noise impacts from construction: the project proponents should engage to plan construction programmes so any concurrent work in the same location are minimised as far as practicable. Where concurrent work is required then the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities.
- Biodiversity impacts during construction - cumulative biodiversity impacts may occur when construction of two or more projects occurs simultaneously in the same area. Where concurrent work is required then the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities.
- Community health and safety and security impacts associated with construction and operational phases – cumulative impacts are anticipated associated with the influx of people and workers relating to both projects. It is proposed that the LLCOP proponent is engaged to work together to align proposed mitigation measures defined for community health and safety relating to the potential increased risk of HIV/AIDS and STIs and identify if any additional measures and controls are required to limit significance.

8.7.2.2 Tilenga Project

To construct the Tilenga project, construction materials will be moved by road from the port at Mombasa towards Eldoret, then into Uganda. The Tilenga project anticipates a low residual impact for traffic which includes air quality, noise and the increased risk of traffic collisions. Major routes through Kenya were identified as being affected although project related traffic would not be expected to significantly increase the road traffic numbers. A part of the project's mitigation, a road safety and transport management plan would be implemented.

8.7.2.2.1 Cumulative Impacts

Cumulative impacts with the Project may occur along the shared transport route, including the road from Mombasa to Eldoret. Both projects will develop and implement road safety and transport management plans to manage any potential impacts. If these mitigation measures are implemented alongside GIIP, the residual cumulative impact significance is anticipated to be no greater than predicted for the Project.

8.7.2.3 Kingfisher Oil Project

To construct the Kingfisher Oil project, construction materials will be moved by road from the port at Mombasa using the P2 and R7 roads in Kenya. Part of the transport route is the same as for the Project. The Kingfisher oil project anticipates a low residual impact for traffic and pedestrian safety on all related routes, not just those in Kenya which are scoped into this assessment. A part of the project's mitigation a road safety and transport management plan would be implemented.

8.7.2.3.1 Cumulative Impacts

Cumulative impacts with the Kingfisher Oil Project may occur along the shared transport route, including the road from Mombasa to Eldoret, as this is a shared route. Both projects will develop and implement mitigation measures and road safety and transport management plans to manage any potential impacts. If these mitigation measures are implemented alongside GIIP, the residual cumulative impact significance is anticipated to be no greater than predicted for the Project.

8.8 Summary

Cumulative impacts have been identified for areas where interactions may arise from cumulative impacts of the proposed Project and anticipated future developments. The identified potential cumulative impacts include:

- Local air quality impacts;
- Local noise impacts;
- Local biodiversity impacts;
- Local ecosystem services impacts;
- Local water resource impacts; and
- Local and regional social and community health and safety impacts.

Associated facilities and third-party projects have been identified which have the potential to generate cumulative impacts with the Project. Associated Facilities include LLCOP, OHTL, rest stops associated with the transport and delivery of construction materials to the Site, water off-take points, the Kapese airstrip upgrade works, and quarries/borrow pits. Third party projects include the LAPSSET Corridor, the Tilenga Project, the Kingfisher Oil Development and the proposed Turkana Mega dams.

Potential cumulative impacts from the Project and associated facilities have been considered for construction dust, noise, biodiversity, ecosystem services, social and health for the construction and/or operational phases. Alongside the mitigation proposed for the Project and GIIP, specific commitments to manage cumulative impacts will include the following:

- Engagement with the LLCOP project proponent to plan construction programmes so any concurrent work in the same location are minimised as far as practicable. Where concurrent work is required, the project proponents should engage to plan construction programmes so any concurrent work in the same location (within 250 m of each project) are minimised as far as practicable. Where concurrent work is required, the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities.
- Engagement with the LLCOP proponent to work together to align proposed mitigation measures defined for community health and safety relating to the potential increased risk of HIV/AIDS and STIs and identify if any additional measures and controls are required to limit significance.
- Engaging with the OHTL contractor to encourage consideration on routing and bird- friendly OHTL design measures;
- Engaging with the owners of the airstrip to consider relocation or livelihood restoration of receptors within 210 m of the Kapese airstrip during any upgrade works; and
- The Project BCoW will engage with the borrow pit contractor/developer to discourage their development in sensitive biodiversity areas and to ensure that site-specific Project reports are developed for the borrow pits and submitted to NEMA.

With the Project mitigation and these additional mitigation measures in place, the residual cumulative impacts are anticipated to be no greater than for the Project alone.

Potential cumulative impacts from the Project and the assessed third-party LAPSSET corridor project include construction phase dust, noise, biodiversity and social and health. Alongside the mitigation proposed for the Project and GIIP, where concurrent work is required then the project proponents should work together to identify additional measures and controls to limit the significance and duration of activities.

Potential cumulative impacts from the Project and the assessed third-party Tilenga and Kingfisher oil projects include traffic collision risk. All projects will develop and implement road safety and transport management plans to manage any potential impacts. If these mitigation measures are implemented alongside GIIP, the residual cumulative impact significance is anticipated to be no greater than for the Project.

It should be noted that there is the potential for other, as yet, undefined developments to be present within the Project AoI which could present cumulative impacts. These developments will be required to undertake their own ESIA and CIA to identify cumulative risks, some of which may be associated with the Project.

The mitigation measures described above identify where the Project should seek to coordinate management of the identified environmental and social risks with other developments. Ultimately, the Project will endeavour to engage with other developers concerned as well as with the relevant authorities, in order to work concurrently towards the minimisation of the cumulative impacts identified.

9.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK

9.1 Introduction

The Kenyan Environmental (Impact Assessment and Audit) Regulations (2003), requires development projects to set out "*an environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the time frame and responsibility to implement the measures".*

This chapter:

- Describes the principles of the TKBV ESMS that will be developed to meet Kenyan regulatory requirements and TKBV objectives; and
- Sets out the key impacts and mitigations defined in the ESIA in the form of an Environmental and Social Management Framework (ESMF).

9.2 Approach

The ESMF presents overarching mitigations and commitments. The ESMF will be supported by specific ESMPs which will be developed, and implemented by TKBV, or its sub-contractors.

Procedures related to construction activities will be prepared prior to the commencement of construction. Procedures related to operational activities will be prepared prior to the commencement of Project commissioning.

The implementation of the ESMP will be supported by an ESMS (which will involve interlinked TKBV and contractor management systems). The primary objective is to have a single, consistent and simple approach to the planning and management of environmental and social risks, whilst retaining flexibility to manage specific issues in the most appropriate manner.

Implementation is undertaken at a functional level, valid for all phases of the Project, as outlined in Figure 9.2-1.

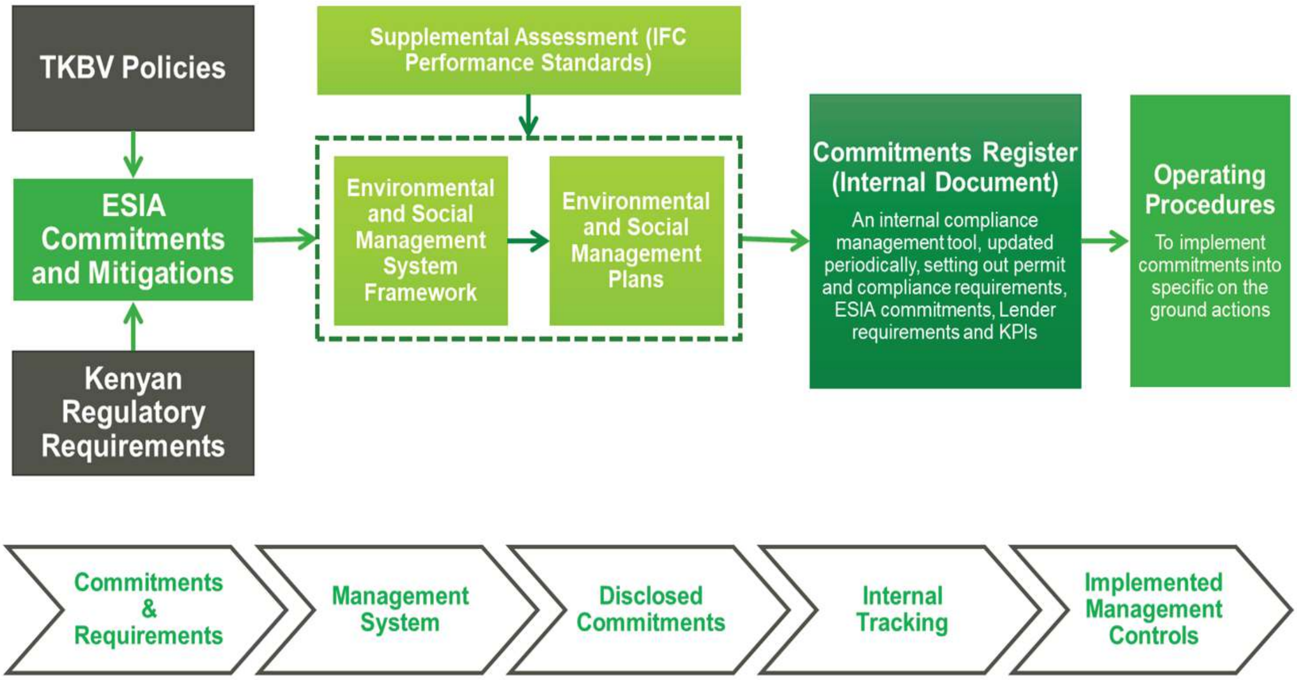

Figure 9.2-1: TKBV Implementation of ESIA Commitments and Mitigations

9.2.1 Purpose of the Management System

The Project ESMS will be based on the principle of continuous improvement and is designed to:

- Define TKBV objectives and provide a tool to meet those objectives;
- Manage environmental and social risks effectively during construction, operation and decommissioning;
- Comply with relevant Kenyan legislation and GIIP;
- Implement TKBV Policies, Procedures, Guidelines and Standards;
- Assign responsibilities to functions and personnel for Management System implementation; and
- Provide a process for identifying opportunities for improvement and to review and update the Management System.

9.3 Structure of the Management System

9.3.1 Introduction

The Project ESMS is divided into components, some of which are inter-related. Each component addresses a specific objective that enables TKBV to manage environmental and social risks. Each component sets out the minimum requirements to meet each objective and refers to implementing procedures or processes.

The Management System is designed as a continual improvement cycle and adopts the methodology of "*plan-do-check-act*". The basic structure of the Management System is set out in Figure 9.3-1.

9.3.2 Structure of the ESMS Framework

The Project ESMS Framework is implemented through:

- **Environmental and Social Management Plans** – which combines the mitigations and management controls set out in the ESIA and which will also incorporate TKBV policies and other commitments, and defines key actions and monitoring measures to comply with Project Standards; and
- **Implementing Policies and Procedures** – which set out the detailed actions and processes to be implemented by TKBV and its contractors in order to achieve commitments set out in the ESMPs.

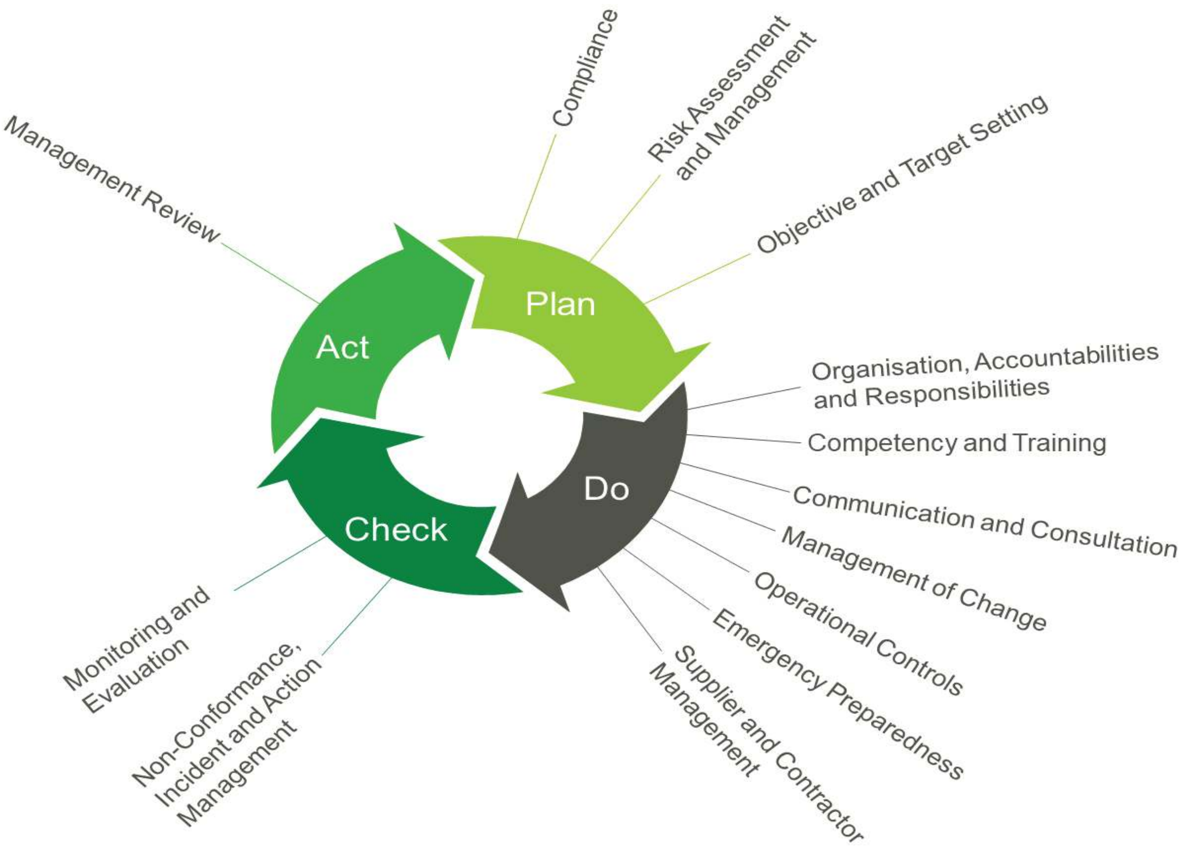

Figure 9.3-1: Indicative Management System Structure

9.4 Environmental and Social Management Plan Components

9.4.1 Introduction

The ESMF brings together the mitigations set out in the impact assessment sections of the ESIA into a single set of auditable management controls. This addresses the following topics:

- Air quality;
- Noise and vibration;
- Water quantity;
- Water quality;
- Soils, terrain, geology and seismicity;
- Landscape and visual;
- Biodiversity, ecology and protected areas
- Ecosystem services;
- Social;
- Cultural heritage;
- Waste management; and
- Emergency, accidental and non- routine events (including oil spill management).

In addition, a strategy and framework is set out for decommissioning.

The commitments, mitigations and management controls set out will be used by TKBV and contractors to develop detailed implementing procedures for construction and operations.

9.4.2 ESIA Mitigations

The mitigations set out in this ESMF are clear instructions to TKBV and its contractors regarding how management systems and working practices will be carried out, the implementation of which will be audited by TKBV and by NEMA.

9.4.3 Review and Updating of the ESMS

The ESMS will be used to implement the Environmental and Social Management Controls and will be maintained and updated to reflect the Project life cycle. The ESMS will be reviewed annually, or when significant changes deem it necessary, whichever is soonest.

9.4.4 Document Control

TKBV will be accountable for the effective implementation of the ESMS and as such must approve all revisions and updates to this document.

9.5 Roles and Responsibilities

9.5.1 Introduction – The Key Players

Organisational roles and responsibilities are as follows:

- **TKBV** – Overall responsibility for managing Project-wide commitments and mitigations. Develop and/or approve policies and procedures, monitor compliance by the EPC contractor, report compliance to NEMA and other authorities and implement and enforce corrective actions.
- **Project Management Company (PMC)** – Develop detailed management systems and procedures, define requirements for the EPC contractor involving all relevant environmental and social Management Controls and Project Standards.
- **EPC Contractor** – develop systems and procedures to implement Project Environmental and Social Requirements relevant to its scope of work; monitor and report on compliance to TKBV, implement corrective actions.
- **Drilling Contractors – there will be multiple contracts to drill and complete the wells (number to be confirmed but 3 to 5 is likely) -** develop systems and procedures to implement Project Environmental and Social Requirements relevant to its scope of work; monitor and report on compliance to TKBV, implement corrective actions.
- **O&M Contractor –** contract will be awarded during the EPC phase, tendered by the PMC. The O&M contractor will be responsible for most of the mitigations during the Operations phase and will develop systems and procedures to implement Project Environmental and Social Requirements relevant to its scope of work; monitor and report on compliance to TKBV, implement corrective actions.

9.5.2 Construction Contractors

The detailed design and construction will be undertaken by an EPC contractor. The EPC contractor, and its sub-contractors, will be required to comply with, and implement, all relevant environmental and social Management Controls and to comply with Project Standards relevant to its scope of work – together referred to as Project Environmental and Social Requirements. All commitments and requirements will be applicable to all sub-contractors employed by the EPC contractor.

The EPC contractor will:

- Use its own management systems and procedures to manage construction activities;
- Revise its management systems and procedures to ensure compliance with Project Environmental and Social Requirements, and develop bridging documentation where necessary;
- Ensure that relevant Project Environmental and Social Requirements are included in sub-contractor contracts; and
- Develop and implement appropriate performance monitoring and corrective action procedures to monitor and audit sub-contractor performance and compliance.

9.6 Role of Engagement

Engagement is one critical mitigation commitment applicable to all impact topics and integral to social management implementation, monitoring and adjustment. There are expectations from the affected communities for participation in processes to monitor Project impacts and to monitor compliance of activities undertaken by the Project.

Engagement provides the information people need to participate in the Project from an informed position. There is clear interest on the part of affected people for ongoing information on the Project, its potential impacts, and proposed socio-economic management measures.

The implementation of a consultation program, inclusive of counties and communities in the Project AoI and other stakeholder groups, throughout the construction, operation and decommissioning phases of the Project will be fundamental. During construction and operation of the Project, channels of engagement between the Project and the stakeholders will be maintained. The ESIA SEP will be updated and set out how the Project will engage with stakeholders, including the ongoing management of a grievance procedure. This cross-cutting plan sets the Project’s commitments as it relates to information disclosure and consultation. It also sets out a series of engagement methods and events that are intended to maximise participation and to be appropriate for a given stakeholder group’s needs and preferences. The SEP will ensure that the engagement process is credible and transparent and maintains simplicity in information comprehension, is as accessible as practically possible and maintains accuracy of information.

The final section of the SEP is a detailed description of the grievance mechanism, a multi-tiered system for reviewing and resolving registered grievances. Implementation of the SEP and effective response to grievances is essential in managing all impact categories. Principles of the TKBV Grievance Procedure and general approach is described in the SEP (Annex II)

9.7 Environmental & Social Management Mitigations and Management Controls

9.7.1 Introduction

The tables below set out the key aspects/impacts, mitigations, implementation timeframes and responsibilities as defined in the impact assessment section of the ESIA. These are presented for both construction (including pre-construction) and operational Project phases.

These are presented, where relevant, for each technical discipline based on the ESMF components presented in Section 9.5.

Following the tables is a section summarising the general approach to decommissioning. This will require further future development by the Project and as a result, an over-arching plan and framework is set out describing how the Project will address this issue.

Table 9.7-1: Air Quality

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
AQ-01	Air Quality	Dust from the construction of the water pipeline on *Euphorbia turkanensis* communities within a buffer around the water pipeline to be determined as a dust deposition zone during pre-construction surveys, which will include the RoW and a 250 m buffer either side of the water pipeline route RoW.	Construction	A BMP will be prepared.	PMC	Production and documented annual review of commitments and successful mitigation actions outlined in BMP.
AQ-02	Air Quality		Construction	A pre-construction survey will be undertaken to further understand and identify species distribution along the RoW and within 250 m of the water pipeline RoW route. Once mapped, suitable mitigation strategies will be proposed, if required. This may include the use of fine netting or may require translocation or propagation of cuttings of potentially affected *Euphorbia turkanensis* communities, by a BCoW, under the guidelines of the BMP.	EPC	Reporting of survey results, including numbers of *Euphorbia turkanensis* communities and their locations Documentation of measures undertaken, if mitigation is required. Verification of non-impacted numbers of *Euphorbia turkanensis* communities post construction
AQ-03	Air Quality	Dust from the construction of the water pipeline on Nasolot NR within a buffer around the water pipeline to be determined as a dust deposition zone during pre-construction surveys, which will include the RoW and a 250 m buffer either side of the water pipeline route RoW.	Construction	A pre-construction survey of plant communities within 250 m of the water pipeline RoW route that lies within the Nasolot NR Any rare species or those highly sensitive to changes in dust concentrations will be monitored and, if required, netting, translocation or propagation of cuttings of specific species may be undertaken by a BCoW, under the guidelines of the BMP.	EPC	Identification of any rare species or those highly sensitive to changes in dust, locations and input/actions to BMP to protect during construction. Verification of non-impacted numbers post construction

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
AQ-04	Air Quality	Dust from the construction of Project related infrastructure on PAP and transient receptors located within the RoW and 250 m in any direction of construction.	Construction	Produce and implement a communication plan and protocols involving relevant traditional leaders and local administrative leaders to inform local PAP of the Project construction schedule and duration.	EPC	Production of a TKBV approved communication plan. Documentation of appropriate communication of construction schedule/ duration with PAP prior to commencement of construction, along with any subsequent material changes.
AQ-05	Air Quality	Emissions of $PM_{2.5}$ for 24-hour averaging period on homesteads within the impacted $PM_{2.5}$ zone identified in the ESIA	Operation	Identification and resettlement of homesteads that are located within the $PM_{2.5}$ contour area. This will be considered as part of the LARF and LRP.	TKBV	Production of the LRP. Identification of homesteads within the $PM_{2.5}$ contour. Record of resettlement process, including all related engagement with PAP prior to commencement of construction.
AQ-06	Air Quality	Emissions of $PM_{2.5}$ for 24-hour averaging period on transient receptors within the impacted $PM_{2.5}$ zone identified in the ESIA.	Operation	Implementation of the Influx Management Plan. Develop communication plans to engage with relevant traditional leaders and local administrative leaders to inform people of the risks of staying in the area for more than 24 hours. Install signage prior to operations to inform people of the risks of staying in the area for more than 24 hours.	TKBV	Production of communication plan. Documentation of communication of risks prior to commencement of operation. Documentation of erection of signage prior to commencement of operation.

Table 9.7-2: Noise and Vibration

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
NV-01	Noise	Noise from construction of Project components on PAP within the areas of predicted high and medium magnitude identified in the ESIA.	Construction	Implement a communication plan involving relevant traditional leaders and local administrative leaders to inform PAP and pastoralists of the Project construction schedule and to encourage avoidance or minimal exposure. As a minimum the following needs to be communicated: ■ Within 0 to 75 m from the perimeter of the following, noise levels may lead to hearing impairment if exposure occurs for a 24-hour period according to the WHO Guidelines for Community Noise, 1999. ▪ The TAN wellpads ▪ The infield flowlines RoW, ▪ The CFA ▪ The landfill ▪ The water pipeline RoW ■ In the area directly outside this perimeter, noise will change due to the Project up to that similar to a car driving 100 km/hr on a blacktop road at a distance of 30 m but should not lead to any hearing impairment through sustained exposure.	EPC	Production of a TKBV approved communication plan. Documentation and communication of construction schedule/ duration and risks to traditional leaders and local administrative leaders prior to commencement of construction along with any subsequent material changes.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
NV-02	Noise	Noise from airstrip upgrade works on permanent human receptors within the areas of predicted high magnitude identified in the ESIA.	Construction	Exert influence to encourage the owners of the airstrip to consider the implementation of a communication plan involving relevant traditional leaders and local administrative leaders to inform PAP and pastoralists of the Project construction schedule and to encourage avoidance or minimal exposure. As a minimum the following needs to be communicated: ■ Within 0 to 75 m from the perimeter of the airstrip, noise levels may lead to hearing impairment if exposure occurs for a 24-hour period according to the WHO Guidelines for Community Noise, 1999. ■ In the area directly outside this perimeter noise will change due to the Project up to that similar to a car driving 100 km/hr on a blacktop road at a distance of 30 m but should not lead to any hearing impairment through sustained exposure.	TKBV	Documentation of communications with airstrip owner.
NV-04	Noise	Noise from wellpad drilling on permanent and transient human receptors within the areas of predicted high and medium magnitude identified in the ESIA	Construction	Implement a communication plan involving relevant traditional leaders and local administrative leaders to inform PAP and local pastoralists of the Project drilling schedule and to encourage avoidance.	TKBV (for drilling)	Production of TKBV approved communication plan Documentation of appropriate communication of construction schedule

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				As a minimum the following needs to be communicated: ■ In the area surrounding the wellpad fence-line (during drilling) noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.		/duration and risks to traditional leaders prior to commencement of construction along with any subsequent material changes
NV-05	Noise	CFA operations on transient human receptors.	Operation	Produce and implement a communication plan to engage relevant traditional leaders and local administrative leaders to encourage avoidance. As a minimum the following needs to be communicated: ■ In the area surrounding the CFA noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate this.	TKBV	Documentation of communication of risks to traditional leaders prior to commencement of operation. Documentation of erection of signage prior to commencement of operation.
NV-06	Noise	Noise from wellpads TW-04, AM-11, AM-19 on transient human		Produce and implement a communication plan involving relevant traditional Leaders and	TKBV	

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
		receptors within the impacted zone identified in the ESIA.		local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding wellpads TW-04, AM-11 and AM-19 noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.		
NV-07	Noise	Noise from wellpads in Amosing or Twiga (excluding TW-04, AM-11, AM-19) on transient human receptors within the impacted zone identified in the ESIA.		Produce and implement a communication plan involving relevant traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding wellpads (excluding TW-04, AM-11 and AM-19) noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure.	TKBV	

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				Signage should be put in place prior to operations, to further communicate the risks.		
NV-08	Noise	Noise from Turkwel Dam pumps on transient human receptors.	Operation	Produce and implement a communication plan involving relevant traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding the Turkwel Dam pumps noise will change due to the Project up to that similar to a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.	TKBV	Documentation of communication of risks to traditional Leaders prior to commencement of operation. Documentation of erection of signage prior to commencement of operation.
NV-09	Noise	Noise from landfill operations on transient human receptors.	Operation	Produce and implement a communication plan involving relevant traditional Leaders and local administrative leaders to encourage avoidance As a minimum the following needs to be communicated: ■ In the area surrounding the landfill noise will change due to the Project up to that similar to	TKBV	Documentation of communication of risks to traditional Leaders prior to commencement of operation. Documentation of erection of signage prior to commencement of operation.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				a normal conversation at 1 m distance (or quieter) but should not lead to any hearing impairment through sustained exposure. Signage should be put in place prior to operations, to further communicate the risks.		

Table 9.7-3: Water Quantity

ID	Topic/Aspect	Source of Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQT-01	Water Quantity	Reduced baseflow and lowered groundwater levels at the Kalabata River, seasonal rivers/streams and drainage luggas, and shallow and deep aquifers due to increased abstraction of groundwater from existing abstraction wells for initial construction water requirements.	Construction	Installation of shallow monitoring wells (<10 m deep) and shallow groundwater level monitoring before construction at potential critical habitat indicator locations identified in the BMP. The baseline will be established prior to the commencement of construction. The data should be analysed to develop water level trigger and control levels. (combined with other mitigations described under biodiversity). Once baseline is established, an action plan will be developed for the exceedance of water level and tree stress trigger levels to avoid long term stress of potential critical habitat. Actions may include targeted irrigation during groundwater abstraction Baseline (pre-application) monitoring and post-licence monitoring of levels in aforementioned shallow monitoring wells and existing abstraction well levels and yields. Requirements for both to be set in cooperation with the Regulator.	EPC	Development of baseline groundwater level ranges Identification for trigger values in the BMP, with defined procedures. Documentation of agreed monitoring requirements and reporting of monitoring results to regulator and key stakeholders.

ID	Topic/Aspect	Source of Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQT-02	Water Quantity		Construction	A communication plan for existing local water users within the predicted impacted area to identify alternative sources of water (i.e. existing bowser fed water points and reticulated wells) and to help PAP understand that hand dug wells in luggas in the zones identified may not be able to be used during the 18 month abstraction period	TKBV	Documentation of communication of alternative water supplies.
WQT-03	Water Quantity	Water discharges at seasonal rivers/streams and drainage luggas.	Construction	Adoption of a hydrotest water management philosophy (Annex I) to promote efficient water use, reuse and disposal.	EPC	Documentation and communication to key stakeholders of hydrotest planning and execution, including amounts of water abstracted, discharged and reused, plus monitoring.
WQT-04	Water Quantity	Construction activities for infrastructure development, flow lines near or within seasonal rivers/ streams and drainage luggas.	Construction	Site specific assessments (based on TKBV agreed methodology) to identify any local water users dependent on access to local water supplies, identified and communicate to PAP with regarding any potential changes in flow regime. Communication may involve redirecting the water users to other sources. Produce and implement the communication plan with local traditional Leaders.	EPC	Reporting of site assessment results. Documentation of appropriate communication with traditional Leaders and local administrative leaders prior to commencement of construction along with any subsequent material changes. Documentation of measures taken to minimise impacts on drainage regime or
WQT-05	Water Quantity	Construction activities for make-up water pipeline near or within seasonal rivers/streams and drainage.				

ID	Topic/Aspect	Source of Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				Where the lugga will be lost due to the presence of Project infrastructure within the watercourse, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment. Channels will be reinstated after trenching is complete. If this is not possible, a suitable permanent diversion will be put in place to redirect water further downstream in the same watercourse, or to another watercourse in the same catchment		hydrological/ecological assessment results.
WQT-06	Water Quantity	Abstraction of water from Turkwel Reservoir for make-up water requirements during the latter stages of the construction phase.	Construction	Monitoring of abstraction volumes and reservoir levels. An action plan will be developed (in association with KVDA) and instigated if unprecedented changes in reservoir level occur.	PMC	Reporting of monitoring results and evaluation of action required in event of unprecedented changes in reservoir level.
WQT-07	Water Quantity	Abstraction of water for make-up water requirements during the latter stages of the construction phase	Construction	Detailed design of water supply pipeline abstraction developed to allow for climate change effects on Turkwel Reservoir.	PMC	Reporting of monitoring water levels, abstraction rates. Development of action plan including water level review level, and procedures if breached. Production of climate change management plan.

ID	Topic/Aspect	Source of Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQT-08	Water Quantity	Continued abstraction from Turkwel Reservoir for make-up water requirements – including climate change.	Operation	Continued monitoring of abstraction volumes and reservoir levels and instigated of the action plan if unprecedented changes in reservoir level occur. Development and implementation of a climate change management plan (including supply security assessment to account for climate change scenarios).	TKBV	Reporting of monitoring water levels, abstraction rates. Development of action plan including water level review level, and procedures if breached. Production of climate change management plan.

Table 9.7-4: Water Quality

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQL-01	Water Quality	Construction activities near or within the Kalabata River.	Construction	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Suspended solids management/control will be implemented, where required. Temporary erosion control measures will be installed prior to earth-moving activities, where required. The amount of time trenches or other excavations will be open will be minimised.	EPC	Regular auditing of construction practices as categorised in a TKBV approved water-course works procedure. Documentation of audits. Documentation of erosion control measure installations.
WQL-02	Water Quality		Construction	Monitoring of shallow groundwater quality in the Kalabata River. Details of the monitoring programme and schedule will be defined in the ESMP.	PMC	Reporting of monitoring results.
WQL-03	Water Quality	Discharges/ releases from waste storage and disposal activities to the Kalabata River.	Construction	Produce and implement a construction waste management plan. If piling is undertaken in areas of waste storage, this will be done in a manner that reduces the potential for pathway creation between the surface and groundwater.	EPC & TKBV (for drilling)	Production of TKBV approved waste management plan. Regular auditing of construction practices. Documentation of audits.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQL-04	Water Quality	Activities near or within the Malmalte River that are associated with the construction of the water pipeline.	Construction	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Suspended solids management/control will be implemented, where required Temporary erosion control measures will be installed prior to earth-moving activities.	EPC	Regular auditing of construction practices as categorised in a TKBV approved water-course works procedure. Documentation of audits. Documentation of erosion control measure installations.
WQL-05	Water Quality	Activities near or within the Turkwel River that are associated with the construction of the water pipeline.	Construction	The amount of time trenches or other excavations will be open will be minimised.	EPC	Regular auditing of construction practices as categorised in a TKBV approved water-course works procedure. Documentation of audits. Documentation of erosion control measure installations.
WQL-06	Water Quality		Construction	Monitoring of surface water quality in sensitive environments. Details of the monitoring programme and schedule will be defined in the ESMP.	EPC	Reporting of monitoring results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQL-07	Water Quality	Construction activities near or within seasonal rivers/streams and drainage luggas.	Construction	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Where possible, there will be no construction in seasonal rivers and smaller streams/luggas when there is flow. If unavoidable, flow will be diverted (e.g. through use of coffer dams) and redirected into same watercourse further downstream. An individual dynamic risk assessment will be completed by the EPC contractor on an individual case basis. Suspended solids management/control will be implemented, where required. Temporary erosion control measures will be installed prior to earth-moving activities. The amount of time trenches or other excavations will be open will be minimised.	EPC	Regular auditing of construction practices as categorised in a TKBV approved water-course works procedure. Documentation of audits. Documentation of erosion control measure installations.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQL-08	Water Quality	Discharges/ releases from waste storage and disposal activities to seasonal rivers/streams and drainage luggas and shallow aquifers.	Construction	Produce and implement a construction waste management plan. If piling is undertaken in areas of waste storage, this will be done in a manner that reduces the potential for pathway creation between the surface and groundwater.	EPC	Production of TKBV approved waste management plan. Regular auditing of construction practices. Documentation of audits.
WQL-09	Water Quality	Construction activities near Turkwel Reservoir, specifically along the ridge where the pontoon intake is proposed.	Construction	Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment. Suspended solids management/control will be implemented, where required. Temporary erosion control measures will be installed prior to earth-moving activities in the area along the ridge where the pontoon intake is proposed. The amount of time trenches or other excavations will be open will be minimised. Monitoring of surface water quality. Details of the monitoring programme and schedule will be defined in the ESMP.	EPC	Regular auditing of construction practices as categorised in a TKBV approved water-course works procedure. Documentation of audits. Documentation of erosion control measure installations. Reporting of monitoring results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
WQL-10	Water Quality	Discharges/releases from waste storage and disposal activities to the Kalabata River or to seasonal rivers/streams and drainage luggas and shallow aquifers.	Operation	Drainage systems that are isolated from surface and groundwater will be used to capture leaks/leachate/floor water in the IWMF. Appropriately segregated drainage systems in and around IWMF.	TKBV	Audit of drainage and surface water management system. Documentation of audit.
WQL-11	Water Quality		Operation	Landfill leachate monitoring and management. Implementation of a Groundwater monitoring programme downgradient of the CFA and landfill	TKBV	Reporting of monitoring results. Implementation of action plan should guideline values in environmental monitoring plan be exceeded
WQL-12	Water Quality		Operation	There will be a surface water management system at the landfill. (e.g. drainage ditches and slope design) that will redirect rainfall run-off away from open landfill cells to reduce leachate generation rates.	TKBV	Audit of drainage and surface water management system. Documentation of audit.

Table 9.7-5: Soils

ID	Topic/Aspect	Source of Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SL-01	Soils	Ground disturbance leading to increased exposure to erosion risk on Cambisols and Fluvisols within the Water Pipeline RoW near the Turkwel Reservoir	Construction	A soil management procedure to include the following: Where relevant, soil handling on agricultural land to conserve the land use capability post-construction. Where possible undertake the work in the dry season where the opportunity for soil erosion (e.g. water and sedimentation) is limited. Where possible, works in periods of extreme rainfall will be limited, as far is it is practicable, to limit soil loss due to erosion. Dry season work to limit the potential for erosion generally to occur (see Soil Erosion). Following identification of medium to high importance soil resources during construction process, implementation of active revegetation of medium to high importance soil resources; Following construction where there is a high potential for arable land to occur; topsoil to be left in windrows for no longer than 6 months along water pipeline route. Rehabilitation plan to be developed for ‘fly camps’ Develop erosion control plan, with specific attention on high erosion	EPC	Inspection of revegetated areas. Regular auditing of construction practices. Documentation of audits. Production of TKBV approved site rehabilitation plan. Production of TKBV approved erosion and sediment control plan.

ID	Topic/Aspect	Source of Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				hazard areas that overlap with river valleys and luggas.		
SL-02	Soils		Construction	The make-up water pipeline will be inspected within the first two years following construction to identify areas of erosion and subsidence. An erosion and sediment control plan will be developed and implemented for areas requiring repair to mitigate sedimentation to nearby watercourses and protect soil quality.	EPC (year 1) and TKBV (year 2)	Reporting of pipeline inspection results. Production of TKBV approved erosion and sediment control plan.
SL-03	Soils	Ground disturbance leading to a short-term loss of agricultural land capability (including existing agricultural land and land that has the potential to be used for agriculture) of Cambisols and Fluvisols	Construction	Soils management protocols described in the CEMP.	EPC	Production and regular documented review of TKBV approved CEMP.

Table 9.7-6: Landscape and Visual

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
LV-01	Landscape	Works associated with the construction of below ground Project facilities (make-up water pipeline) and temporary infrastructure (including temporary access roads, camps, laydown areas) on the Nasolot NR and Pellow Community Conservancy.	Construction	No night-time working (dusk until dawn) during construction in areas within 100 m of the Nasolot NR or Pellow Community Conservancy unless pre-agreed with TKBV and supervised by the Project BCoW. Produce and implement a communication plan to ensure protected areas administration and users are informed of construction schedule.	EPC	Regular auditing of construction practices. Documentation of audits. Production of TKBV approved communication plan. Documentation of appropriate communication of construction schedule/ duration to traditional leaders and local administrative leaders prior to commencement of construction along with any subsequent material changes
LV-02	Visual	Works (e.g. plant mobilisation, transport, material stockpiles and lighting emissions) associated with the construction activities of wellpads, temporary flaring at wellpads and initial well drilling, as well as associated infrastructure, on permanent human receptors.	Construction	Maintain natural screening where possible as defined in the BMP.	EPC and TKBV (for drilling)	Regular auditing of construction practices. Documentation of audits.
LV-03	Visual		Construction	Implement a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities that could contribute to visual impacts.	EPC and TKBV (for drilling)	Publication of TKBV approved Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
LV-04	Visual	Works (e.g. plant mobilisation, transport, material stockpiles and lighting emissions) associated with the construction of the CFA (and CPF) and associated infrastructure on permanent human receptors.	Construction	Maintain natural screening where possible as defined in the BMP.	EPC	Regular auditing of construction practices. Documentation of audits.
LV-05	Visual		Construction	Implement a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	EPC and TKBV (for drilling)	Publication of TKBV approved Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.
LV-06	Visual	Works associated with the construction of the OHTL on permanent human receptors	Construction	Maintain natural screening where possible as defined in the BMP.	EPC	Regular auditing of construction practices. Documentation of audits.
LV-07	Visual		Construction	Implement a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	EPC	Publication of TKBV approved Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.
LV-08	Visual	Clearance/ removal of vegetation (screening elements) and soils during construction on permanent human receptors.	Construction	Maximise the retention and preservation of existing vegetation outside the fence-line in the AoI (particularly large trees), acting as natural screening of Project facilities. Measures defined in the BMP.	EPC	Regular auditing of construction practices. Documentation of audits.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
LV-09	Visual	Site activity and plant movement during construction (dust plumes, lighting emissions, material and waste storage/stockpiles) on permanent human receptors.	Construction	Vegetating stockpiles (through mixing of chippings and mulch of selected species) of material to remain on site post-construction. Dust suppression techniques to reduce dust as outlined in a CEMP. Use of lighting will be minimised and light spill controlled where possible, with restricted lighting heights. Floodlighting will be installed with cowls to minimise light spillage, as outlined in the CEMP.	EPC	Production and regular review of TKBV approved CEMP. Regular auditing of construction practices. Documentation of audits.
LV-10	Visual	Location of above ground wellpads and supporting infrastructure on permanent human receptors	Operation	Where practical, landscaping, including earth bunds, and vegetation will be maintained throughout the life of the Project to act as screening and soften visual impacts of Project infrastructure.	TKBV	Regular auditing of site condition and suitability for landscaping. Documentation of audits.
LV-11	Visual		Operation	Maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities.	TKBV	Publication of Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.
LV-12	Visual		Operation	Where impacts on receptors are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under an LRP.	TKBV	Documentation of consideration under LRP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
LV-13	Visual	Location of above ground OHTL on permanent human receptors	Operation	Maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities.	TKBV	Publication of Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.
LV-14	Visual		Operation	Where impacts on receptors are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under an LRP.	TKBV	Documentation of consideration under LRP.
LV-15	Visual	Location of above ground CFA (CPF) and supporting infrastructure (flaring at CPF and flue gas stack at IWMF) on permanent human receptors	Operation	Where practical, landscaping, including earth bunds and vegetation will be maintained throughout the life of the Project to act as screening and soften visual impact of Project infrastructure.	TKBV	Regular auditing of site condition and suitability for landscaping. Documentation of audits.
LV-16	Visual		Operation	Maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities.	TKBV	Publication of TKBV approved Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.
LV-17	Visual		Operation	Where impacts on receptors are documented under the grievance mechanism and cannot be mitigated, the receptor may be considered under an LRP.	TKBV	Documentation of consideration under LRP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
LV-18	Visual	Site activity and plant movement during operations (dust, lighting emissions) on permanent human receptors	Operation	Maintain a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities.	TKBV	Publication of Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.
LV-19	Visual		Operation	Dust suppression and light spill control.	TKBV	Publication of OEMP. Regular auditing of operational practices. Documentation of audits.

Table 9.7-7: Biodiversity, Ecology and Protected Areas

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
BI-01	Biodiversity	Land take, impingement of ecological connectivity, increased human and vehicle traffic interaction with fauna, sensory disturbance from light and noise, and introduction of pests and weeds impacting on Nasolot NR.	Construction	Development and implementation of ISMP. Management Plan for Nasolot NR to be produced. Development and implementation of BMP.	PMC	Production and documented periodic review of ISMP. Production of management plan for Nasolot NR. Production and documented periodic review of BMP
BI-02	Biodiversity		Construction	Nasolot NR boundary demarcated on construction plans and on the ground. Staff environmental inductions. Implementation of BMP. Wildlife Rescue Procedures to be developed and implemented. Implementation of ISMP. Development and implementation of vegetation rehabilitation plan.	EPC	Regular auditing of construction practices, including inspection of on-the-ground demarcation. Documentation of audits. Documentation of staff induction. Periodic review of BMP Audit of Wildlife Rescue Procedures. Periodic review of ISMP. Inspection of rehabilitated areas.
BI-03	Biodiversity	Sensory disturbance from light and noise impacting on South Turkana NR & Pellow Community Conservancy.	Construction	Development and implementation of BMP. Development and implementation of ISMP	PMC	Production and documented periodic review of BMP. Production and documented periodic review of ISMP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
BI-04	Biodiversity		Construction	South Turkana NR and Pellow Community Conservancy boundary demarcated on construction plans. Staff environmental inductions. Implementation of BMP. Implementation of ISMP. Development and implementation of vegetation rehabilitation plan	EPC and TKBV (for drilling)	Documentation of staff induction. Regular auditing of construction practices. Documentation of audits. Periodic review of BMP. Periodic review of ISMP.
BI-05	Biodiversity	Sensory disturbance from light and noise, increased human access, and introduction of pests and weeds impacting on Faidherbia - Celtis riparian forest community along the Malmalte River.	Construction	Riparian vegetation communities to be demarcated on construction plans and on the ground; Development and implementation of Influx Management Plan. Development of BMP. Development of ISMP. Rehabilitation plans (site specific) to be produced.	PMC	Production of Influx Management Plan Production and documented periodic review of BMP. Production and documented periodic review of ISMP. Production of rehabilitation plan.
BI-06	Biodiversity		Construction	Riparian vegetation communities to be demarcated on construction plans and on the ground. Inclusion of 100 m setback distances beyond the riparian vegetation boundary for the drill rig and pipe stringing. EPC engagement with the relevant authority to identify particularly sensitive No-Go areas for demarcation.	EPC	Regular auditing of construction practices, including inspection of on-the-ground demarcation and documentation of audits. Documentation of staff induction. Periodic review of BMP Periodic review of ISMP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				Staff environmental inductions. Implementation of BMP. Implementation of ISMP. Wildlife Rescue Procedures to be developed and implemented. Implementation of site rehabilitation plan.		Production of Wildlife Rescue Procedures. Inspection of rehabilitated areas.
BI-07	Biodiversity	Sensory disturbance from light and noise impacting on fauna in rocky ridges habitats	Construction	Staff environmental inductions. Environmentally significant areas will be identified as No-Go areas for EPC staff	EPC	Documentation of staff induction.
BI-08	Biodiversity	Land take, vegetation clearance, increased use by humans, and introduction of alien invasive species impacting on Northern Acacia-Commiphora bushlands and thickets.	Construction	Construction footprint to be limited and delineated Development and implementation of ISMP Rehabilitation plan to be produced.	PMC	Documentation of measures taken to reduce Project footprint. Production and documented periodic review of ISMP. Production of rehabilitation plan.
BI-09	Biodiversity		Construction	Areas beyond the Project footprint to be identified as No-Go areas for EPC staff; Implementation of ISMP. Implementation of rehabilitation plan.	EPC	Regular auditing of construction practices. Documentation of audits. Periodic review of ISMP. Inspection of rehabilitated areas.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
BI-10	Biodiversity	Clearance of vegetation, deposition of dust, introduction of invasive species, and increased exploitation/collection impacting on *E. turkanensis* and other plant SoCC.	Construction	Inclusion of *E. turkanensis* management plan in BMP.	PMC	Production and documented periodic review of BMP
BI-11	Biodiversity		Construction	Implementation of BMP. Staff environmental inductions. Spot checks of areas prior to clearing for SoCC.	EPC	Regular auditing of construction practices. Documentation of audits. Periodic review of BMP. Documentation of staff induction. Documentation of spot checks.
BI-12	Biodiversity	Disturbance due to noise and human presence, temporary loss of critical habitat and habitat severance, and increased human-wildlife conflict impacting on elephants.	Construction	Inclusion of elephant specific management plan in BMP. Implementation of influx management plan	PMC	Production and documented periodic review of BMP Production of Influx Management Plan.
BI-13	Biodiversity		Construction	Implementation of BMP. Demarcation of elephant critical habitat on construction plans and on the ground. The EPC contractor will engage with the relevant authority (with TKBV support) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as No-Go areas. Staff environmental inductions.	EPC	Regular auditing of construction practices, including inspection of on-the-ground demarcation Documentation of audits. Periodic review of BMP. Documentation of staff induction. Documentation of established communication channels and protocols.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				Communication channels to be established with KWS. Implementation of Influx Management Plan.		
BI-14	Biodiversity	Sensory disturbance, increased persecution, human-wildlife conflict, and increased vehicle traffic collisions impacting on leopard, striped hyaena and other mammal SoCC.	Construction	Inclusion of leopard and striped hyaena measures in BMP. Implementation of Influx Management Plan.	PMC	Production and documented periodic review of BMP. Production of Influx Management Plan.
BI-15	Biodiversity		Construction	Implementation of BMP. Demarcation of critical habitat on construction plans and on the ground. The EPC contractor will engage with the relevant authority (with TKBV support) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as No-Go areas. Staff environmental inductions. Establish communication channels with KWS. Wildlife Rescue Procedures to be developed and implemented. Night driving to be avoided, where possible.	EPC	Regular auditing of construction practices, including inspection of on-the-ground demarcation Documentation of audits. Periodic review of BMP. Documentation of staff induction. Production of Wildlife Rescue Procedures. Documentation of occasions when night driving required, including justification.
BI-16	Biodiversity	Sensory disturbance, increased persecution, loss of critical	Construction	Inclusion of vulture management measures in BMP.	PMC	Production and documented periodic

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
		habitat, and direct mortality from collisions with Project infrastructure impacting on vultures and other bird SoCC.		Encourage inclusion of bird-friendly measures into infield OHTL design.		review of Biodiversity Management Plan. Publication of specialist advice. Documentation of bird-friendly measures included in infield OHTL design.
BI-17	Biodiversity		Construction	Exert influence over relevant Kenyan electricity company for inclusion of bird-friendly measures into non-infield OHTL design.	TKBV	Documentation of communication with relevant Kenyan electricity company.
BI-18	Biodiversity		Construction	Implementation of BMP Demarcation of vulture critical habitat on construction plans and on the ground. Areas outside the Project footprint to be identified as No-Go areas for EPC staff. EPC staff to be educated during environmental inductions on company policies and procedures associated with environmentally significant areas and SoCC	EPC	Regular auditing of construction practices. Documentation of audits. Periodic review of BMP.
BI-19	Biodiversity		Construction	Exert influence over relevant Kenyan electricity company to evaluate route alignment of linear infrastructure to minimise impacts on vultures and other bird SoCC.	PMC	Documentation of communication with relevant Kenyan electricity company.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
BI-20	Biodiversity	Increased direct mortality, increased risk of predation, loss of critical habitat, attraction to water storage facilities, and direct persecution impacting upon Turkana toad and other herpetofauna SoCC.	Construction	Collection of additional data on Turkana toad distribution. Turkana toad monitoring (including shallow groundwater and physiological stress of trees). Development and implementation of BMP (including trigger and control levels for groundwater and physiological stress of trees). Development of ISMP.	PMC	Production of survey results. Production and documented periodic review of BMP Production and documented periodic review of ISMP.
BI-21	Biodiversity		Construction	Implementation of BMP. Demarcation of critical habitat on construction plans and on the ground. The EPC contractor will engage with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as No-Go areas. Contractor and staff environmental inductions. Night driving to be avoided, where possible. Implementation of ISMP	EPC	Regular auditing of construction practices including inspection of on-the-ground demarcation. Documentation of audits. Periodic review of BMP Documentation of staff induction. Documentation of occasions when night driving required, including justification. Periodic review of ISMP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
BI-22	Biodiversity	Direct mortality and loss of critical habitat impacting on ground beetle.	Construction	Additional monitoring of beetle distribution (including shallow groundwater and humidity monitoring of habitats). Development of BMP (including trigger and control levels for groundwater and physiological stress of trees). Development of Influx Management Plan. Development of ISMP.	PMC	Production of monitoring results. Production and documented periodic review of BMP. Production of Influx Management Plan. Production and documented periodic review of ISMP.
BI-23	Biodiversity		Construction	Implementation of BMP, ISMP and Influx Management Plan. Demarcation of critical habitat on construction plans and on the ground. The EPC contractor will engage with the relevant authority (with support from TKBV) to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as No-Go areas.	EPC	Regular auditing of construction practices including inspection of on-the-ground demarcation Documentation of audits. Periodic review of BMP
BI-24	Biodiversity	Increased fishing pressure due to population influx impacting on fish.	Construction	Implementation of Influx Management Plan. Development and implementation of ISMP.	PMC	Production of Influx Management Plan. Production and documented periodic review of ISMP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
BI-25	Biodiversity		Construction	Environmentally significant areas demarcated as No-Go areas. Implementation of ISMP.	EPC	Regular auditing of construction practices Documentation of audit. Inspection of on-the-ground demarcation. Periodic review of ISMP.
BI-26	Biodiversity	Increased human access, edge impacts, and the establishment and spread of alien invasive plant species impacting on Faidherbia - Celtis riparian forest community along the Malmalte River.	Operation	Continued implementation of ISMP. Staff environmental inductions. Implementation of vegetation and wildlife monitoring programmes.	TKBV	Regular auditing of operational practices. Documentation of audits. Periodic review of ISMP. Documentation of staff induction. Publication of monitoring results.
BI-27	Biodiversity		Operation	Continue to engage with the relevant authority to identify any seasonal or temporal constraints in Environmentally significant areas which will require demarcation as No-Go areas.	TKBV	Regular auditing of construction practices. Documentation of audit. Inspection of on-the-ground demarcation. Periodic review of Invasive Species Management Plan.
BI-28	Biodiversity	Edge impacts, the establishment and spread of alien invasive plant species, and sensory disturbance from light and noise impacting on rocky ridges habitat.	Operation	Staff environmental inductions. Continued implementation of ISMP. Where practical, use of motion sensors, cowls and timers on outside lights.	TKBV	Documentation of staff induction. Regular auditing of operational practices. Documentation of audits.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
						Periodic review of ISMP. Documentation of where motion sensors, cowls and timers are not practical, including justification.
BI-29	Biodiversity	Impacts on elephants from increased access as a result of the Project, leading to increased competition for resources, human-wildlife conflict and increased poaching.	Operation	Staff environmental inductions. Continued implementation of Influx Management Plan. Maintain established communication channels with KWS. Offer logistical support for KWS elephant monitoring.	TKBV	Documentation of staff induction. Production of Influx Management Plan. Documentation of communication with KWS.
BI-30	Biodiversity	Impacts on leopard, striped hyaena and other mammal SoCC from increased vehicle traffic and increased access as a result of the Project, leading to increased competition for resources, human-wildlife conflict and increased poaching.	Operation	Staff environmental inductions. Maintain established communication channels with KWS. Night driving to be avoided, where possible.	TKBV	Documentation of staff induction. Documentation of communication with KWS. Regular auditing of operational practices. Documentation of audits. Documentation of occasions when night driving required, including justification.
BI-31	Biodiversity	Direct mortality due to OHTLs and flares impacting on vultures and other bird SoCC.	Operation	Production and implementation of infield OHTL monitoring programme. Production and implementation of a flare start-up routine.	TKBV	Production of monitoring results. Production of flare start-up routine results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				If possible, seek to exert influence on the relevant Kenyan electricity company to implement an OHTL mitigation and monitoring programme for none-infield areas		Regular auditing of operational practices. Documentation of audits. Documentation of communication with Kenyan electricity company.
BI-32	Biodiversity	Direct mortality, attraction to water storage facilities, and persecution impacting on Turkana toad and other herpetofauna SoCC.	Operation	Turkana toad monitoring programme. Staff environmental inductions. Night driving to be avoided, where possible. Implementation of BMP.	TKBV	Production of monitoring results. Documentation of staff induction. Regular auditing of operational practices. Documentation of audits. Documentation of occasions when night driving required, including justification. Periodic review of BMP.
BI-33	Biodiversity	Direct mortality on ground beetle.	Operation	Ground beetle monitoring programme.	TKBV	Production of monitoring results.

Table 9.7-8: Ecosystem Services

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
ES-01	Ecosystem Services	Changes in land cover and associated reduction in supply of cultivated foods due to the construction of the water pipeline	Construction	Avoid beekeeping enterprises and farms where possible. Pre-construction survey to identify any cultivation areas likely to be impacted Rehabilitation of any directly affected cultivation areas immediately post-construction.	EPC	Documentation of efforts made to avoid beekeeping enterprises and farms. Records of survey. Inspection of rehabilitated areas against survey records.
ES-02	Ecosystem Services		Construction	Should cultivation areas be identified, PAP affected to be included in LRP.	TKBV	Documentation of PAPs and their inclusion in the LRP
ES-03	Ecosystem Services	Changes in land cover and associated reduction in supply of grazing/browsing for livestock due to the construction of the water pipeline, infield roads, new well pads, and the expansion of existing facilities, as well as increased demand due to population influx and reduction in capacity to supply.	Construction	PAP to be identified by survey undertaken at cut-off date and included in the LRP. Share the Influx Management Plan with Turkana and West Pokot County governments. Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are directly impacted. Review economic and social importance of livestock to pastoralist livelihoods, sustainable farming education, physical access restrictions around tanked water supply points, and appropriate livelihood restoration for inclusion of appropriate management strategies in the LRP as necessary.	TKBV	Documentation of PAP and their inclusion in the LRP. Production of Influx Management Plan. Reporting of survey results Reporting of study results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
ES-04	Ecosystem Services	Reduced wild food plant availability due to reductions in woodland/bush land cover that supports food plant/ animal species, increased demand due to population influx and reduction in capacity to supply. Reduced vegetation cover may limit wild bee's ability to produce honey.	Construction	Share the Influx Management Plan with Turkana and West Pokot County governments. Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are impacted. Undertake studies to understand baseline wild food use, and inclusion of measures to address any effects on wild food use/supply in LRP as necessary.	TKBV	Production of Influx Management Plan. Reporting of survey results. Reporting of study results.
ES-05	Ecosystem Services	Reduced availability of traditional medicines/medicinal plants due to reduction in woodland/bush vegetation cover that supports plant species used for traditional medicine, increased demand due to population influx and reduction in capacity to supply.	Construction	Share the Influx Management Plan with Turkana and West Pokot County governments. Surveys to increase understanding of use and reliance on medicinal plant use, and inclusion of measures to address any effects on medicinal plant use in LRP as necessary.	TKBV	Production of Influx Management Plan. Reporting of survey results.
ES-06	Ecosystem Services	Availability and quality of fresh water for drinking may be compromised by abstraction from groundwater, reliance on TKBV for supply to water points	Construction	Communication for existing local water users within the predicted impacted area to identify alternative sources of water (e.g. bowser fed water points and reticulated wells) and communication of changes to supply sources to local water users	TKBV	Documentation and communication of alternative water supplies.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
ES-07	Ecosystem Services	The loss or disturbance of sacred sites could occur, particularly along the route of the water pipeline.	Construction	Subject to survey work identified under Cultural heritage commitments, Contractor will avoid felling any sacred trees. Disseminate cultural heritage management plan amongst contractors and staff.	EPC	Procedure for identification of sacred trees Document and report communication of CHMP to contractors and staff.
ES-08	Ecosystem Services	Influx of people and livestock to water off-take points on grazing/browsing for livestock, wild foods, medicinal plants, biomass fuel, and wood and fibre.	Operation	Work with County Governments to encourage sustainable use of community offtake water points on the water pipeline to discourage overgrazing at water off take points, and record issues as part of the grievance mechanism	TKBV	Documentation of communication with County Governments. Maintenance of the grievance mechanism
ES-09	Ecosystem Services	Presence of Project in landscape impacting on spiritual values, and educational and inspirational values.	Operation	Establish a forum for recording grievances to identify and manage any issues beneficiaries may have. Full mitigation only possible when facility is decommissioned and rehabilitated.	TKBV	Publication of Grievance Management Procedure and documentation of its publication. Documentation of any grievances received.

Table 9.7-9: Social

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 01	Social	Project induced Influx and in-migration leading to economic opportunities Indirect effect of increased salaried employment and procurement	Construction	Develop and implement an Influx Management Plan, which will be shared with authorities in Turkana and West Pokot Counties. Verify effective indicators to monitor population growth within Influx Management Plan. Confirm monitoring "*hot spots*" where data on indicators will be collected Revise human resource documents to reduce incentives for in-migration.	TKBV	Production of agreed Influx Management Plan. Reporting of monitoring results on demographics. Documentation on local recruitment.
SOC – 02	Social		Construction	Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). Operate all construction accommodation as "*closed camps*" Disclose all local labour needs and recruitment information, including contractor information. Conduct a stakeholder engagement campaign to explain construction employment and local content opportunities, as well as the procedures that people must follow to obtain employment. Establish a working group, to be led by TKBV, with representatives of National and County government, and civil society	EPC and TKBV (for drilling)	Documentation of training on TKBV's Code of Ethical Conduct. Regular auditing of construction practices. Documentation of audits. Documentation on local recruitment. Documentation of engagement initiatives.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC - 03	Social	Additional infrastructure and activities relating to the Project	Construction	Agree infrastructure investments as part of the CDPs, aligned to County Integrated Development Plans. TKBV will work with County Governments to encourage sustainable use of community offtake water points on the water pipeline to discourage overgrazing at water off take points, and record issues as part of the grievance mechanism	TKBV	Documentation on agreed infrastructure investment. Documentation of communication with County Governments. Maintenance of the grievance mechanism
SOC – 04	Social		Construction	Establish an engagement process headed by leadership at the County and Sub-county level, including representatives of government departments, private sector, NGOs and potentially religious institutions. Identify key performance indicators that help to monitor performance.	TKBV	Documentation of engagement initiatives. Reporting of monitoring results.
SOC – 05	Social	Tax and other payments linked to Project.	Construction	Continue to disclose taxes in Annual Reports. Conduct periodic engagement on key social management plans, including all CDPs, with relevant County-level board of trustees[1] charged with overseeing profits.	TKBV	Disclosure of financial information Documentation of engagement initiatives.

[1] A County-level board of trustees is described in the Petroleum Act as the body that will oversee the utilisation of funds "for the benefit of present and future generations".

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 06	Social	Contractor managed construction and employment opportunities	Construction	Agree to a revised and updated National Content planning approach. Revise definitions related to “local” and “*local-local*” administrative units in the context of CDPs. Develop HR Contractor Standard, forming minimum requirements for all contractors to follow. Promote the TKBV Code of Ethical Conduct (The Code), specifically as it related to the principle of “*zero tolerance*” for any form of discrimination. Continue using Contractor Non-technical Risk Management Policy. Track Contractor Employment data by gender.	PMC	Documentation on agreed National Content planning approach. Revise CDPs Production of Human Resource Contractor Standard. Documentation of training on Code of Ethical Conduct. Documentation of training on Non-technical Risk Management Policy. Documentation on local recruitment.
SOC – 07	Social		Construction	Adhere to TKBV Human Rights Policy	EPC	Documentation of training on Human Rights Policy.
SOC – 08	Social	Procurement opportunities linked to the Project – business opportunities and local content	Construction	Agree to a revised and updated National Content planning approach, including KPI for monitoring changes in business opportunities and local content performance. Identify key performance indicators that help to monitor changes in business opportunities and local content performance.	PMC	Documentation on agreed National Content Plan. Documentation of audits. Reporting of monitoring results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC-09	Social		Construction	Within CDPs, set out commitments for local business capacity building.	TKBV	Documentation of audits.
SOC – 10	Social		Construction	Develop TKBV approved Local Content Plan including procedures for local procurement	EPC	Documentation of audits.
SOC – 11	Social		Construction	Organise workshops and other engagement to inform companies about procurement requirements and how to qualify for tendering processes.	TKBV	Documentation of engagement initiatives.
SOC – 12	Social	Indirect effect of increased salaried employment and procurement on inflation	Construction	Select and monitor prices periodically for standard "*basket of goods*" in hotspot areas, as well as in control area. Collect data similar to NDMA monthly surveys on socio-economic indicators. Within CDPs initiate key social programmes to support PAP to develop sustainable skills that can help manage potential changes on the supply and demand of goods.	TKBV	Reporting of monitoring results and proposed interventions.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 13	Social	Long term loss of community land due to land acquisition to develop the facilities required for the Project	Construction	Compensation, as determined under Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. Any gaps between the Government-led land acquisition and IFC PS5 (IFC, 2012f) will be addressed as part of the LRP.	TKBV	Documentation of Government-led statutory land acquisition process. Documentation of gaps and development of an LRP.
SOC – 14	Social	Temporary land restrictions on land use - notably pastoral grazing and settlement access, during construction, to develop the facilities required for the Project	Construction	Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are impacted. Compensation, as determined under Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. Any gaps between government-led land acquisition and IFC PS5 (IFC, 2012f) will be addressed as part of the LRP.	TKBV	Reporting of survey results. Survey report and compensation reports. Documentation of gaps and inclusion in the LRP.
SOC – 15	Social	Land acquisition to develop the facilities required for the Project - Long term restrictions on settlement along the wayleave (6 m wide) of the water pipeline route	Construction	Conduct additional ground-based surveys to confirm whether 22 potential homesteads identified through aerial imagery are impacted. Compensation, as determined under the Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. Any gaps between government-led land acquisition and IFC PS5 (IFC, 2012f) will be addressed as part of the LRP.	TKBV	Survey report and compensation reports. Documentation of gaps and inclusion in the LRP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 16	Social	Land acquisition to develop the facilities required for the Project - Loss of occupied homesteads (physical displacement)	Construction	Compensation, as determined under the Kenyan Law, to be provided as part of the Government-led statutory land acquisition process. Any gaps between government-led land acquisition and IFC PS5 (IFC, 2012f) will be addressed as part of the LRP.	TKBV	
SOC – 17	Social	Land acquisition to develop the facilities required for the Project - Loss of household structures other than homesteads, e.g. animal shelters or dug water holes				
SOC – 18	Social	Land acquisition to develop the facilities required for the Project - Loss of business structures - shops				
SOC - 19	Social	Temporary land restrictions on land use to develop the facilities required for the Project - Temporary loss of access to or use of TKBV community water tanks	Construction	Engage with PAP and authorities in helping to identify suitable alternative sources of water.	TKBV	Documentation of engagement initiatives.
SOC – 20	Social	Land acquisition to develop the facilities required for the Project - Increased travel/ walking distances to community assets or TKBV water tanks	Construction	Engage with PAP and authorities in helping to identify suitable alternative sources of water.	TKBV	Documentation of engagement initiatives.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 21	Social	Land acquisition to develop the facilities required for the Project - Impacts on livelihoods due to loss of communal land (economic displacement)	Construction	Any livelihood impacts not addressed as part of the Government-led statutory process will be managed as part of the LRP. Engage with PAP to develop LRPs and CDPs, which will be created with authorities in Turkana and West Pokot Counties. Subject to agreement with the PAP, the LRPs and CDPs will deliver livelihood restoration and community benefits, including support to: ■ Skills development. ■ Micro business support; and ■ Livestock grazing improvements.	TKBV	Production of LRP Documentation of engagement initiatives.
SOC – 22	Social	Land acquisition to develop the facilities required for the Project – impact on graves	Construction	Implement consultation with affected communities and site guardians.	TKBV	Documentation of engagement initiatives. Document of consultation.
SOC – 23	Social		Construction	Micro alignment of the interconnecting network within the RoW will be used to avoid direct impact to graves, where feasible. Where this is not feasible, graves will be relocated in consultation with site guardians and affected communities. The CFP will detail steps for identifying unrecorded graves within the development footprint prior to construction.	EPC	Documented review and revision of TKBV approved interconnecting network RoW route. Documentation of use of the Chance Finds Procedure as part of the CH Plan.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 24	Social		Construction	Compensation, as provided under Kenyan Law which recognises graves and the costs of rituals required to relocate graves, to be provided as part of the Government-led statutory land acquisition process. Engage with the community to agree procedures for demarcation (e.g. demarcation and communication of ‘no go’ sensitive locations and mapping and communication of cultural heritage ‘constraints’) or, in the highly exceptional circumstances (follow up by consultation with site guardians and affected communities), relocation and reburial of graves. Provide details of grave relocation, compensation and assistance in an LRP.	TKBV	Survey report and compensation reports. Documentation of engagement initiatives. Documentation of consultation and exhumation.
SOC – 25	Social	Land acquisition to develop the facilities required for the Project – impacts on vulnerable Persons	Construction	Provide supplementary activities to identify vulnerable persons or provide assistance to ensure that they are no more adversely affected by resettlement than others. Provide details of vulnerable persons support in an LRP.	TKBV	Documentation of engagement initiatives. Documentation of consultation. Production of LRP

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 26	Social	Introduction of outside workforce, financial incentives for vulnerable persons, and transport for Project construction - Sexually transmitted infections	Construction	Develop and implement CHSSMP. Develop an HIV Policy and Programme. Operate all construction accommodation as “closed camps”. Develop and implement “*95-95-95*” strategy, which sets targets for awareness, treatment and demonstrating performance in viral suppression. Develop and implement TMP, specifically linked to the identification and management of transport rest stops. Develop and implement Influx Management Plan, which will be created with authorities in Turkana and West Pokot Counties. Monitor key performance indicators through a CHIS. Develop and implement contractor Non-Technical Risk Management Plans, used to manage contractor performance.	TKBV	Production of CHSSMP. Production of HIV Policy and Programme. Production of TMP. Production of agreed Influx Management Plan. Reporting of monitoring results Documentation of audits.
SOC – 27	Social			Train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code).	EPC and TKBV (for drilling)	Documentation of training on Code of Ethical Conduct.
SOC – 28	Social			Maintain Medical Fitness to Work Specification and Procedures.	EPC and TKBV (for drilling)	Documentation of audits.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 29	Social			Support specific Health Systems Strengthening activities (to be implemented by a third party) in areas at higher risk for HIV transmission due to Project Impacts.	TKBV	Documentation of audits.
SOC – 30	Social	Alteration of the physical environment - Vector related diseases	Construction	Approve and implement a Malaria Management Plan. Monitor key performance indicators through a CHIS.	TKBV	Production of Malaria Management Plan. Reporting of monitoring results
SOC – 31	Social			Implement strict source reduction environmental controls around construction sites, to be set out in the CEMP.	EPC	Reporting of monitoring results.
SOC – 32	Social	Introduction of outside workforce and transport for Project construction - Communicable diseases		Implement camp cleanliness and hygiene standards. Operate all construction accommodation as "*closed camps*". Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). Maintain Medical Fitness to Work Specification and Procedures. Approve and maintain effective waste management procedures, as per Waste Management Plan. Align food hygiene programmes with good industry practice standards.	EPC and TKBV (for drilling)	Regular auditing of construction practices. Documentation of training on Code of Ethical Conduct. Production of waste management plan. Documentation of audits. Reporting of monitoring results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 33	Social			Implement TB Management Programme, linked to the HIV Programme, that will be created in collaboration with authorities in Turkana and West Pokot Counties. Approve and implement Infectious Disease Health Management Plan. Monitor key performance indicators through a CHIS.	TKBV	Production of Infectious Disease Health Management Plan. Regular auditing of construction practices. Reporting of monitoring results.
SOC – 34	Social	Waste from Project activities – Zoonotic diseases	Construction	Develop and implement Pest Control Plan for landfill and other Project facilities.	EPC	Production of TKBV approved Pest Control Plan. Reporting of monitoring results.
SOC – 35	Social	Transport for Project construction - Accidents and injuries	Construction	Develop and implement TMP, specifically for the management of emergencies or accidents. Develop and implement a CHSSMP, specifically access control measures. Implement the Safe and Sustainable Operations Policy.	EPC and TKBV (for drilling)	Production of TKBV approved TMP Production of TKBV approved Community Health, Safety and Security Management Plan. Documentation of audits. Reporting of monitoring results.
SOC – 36	Social		Construction	Conduct a stakeholder engagement campaign on road safety for construction activities within the immediate area of influence. Monitor key performance indicators through a CHIS.	EPC and TKBV (for drilling)	Documentation of engagement initiatives. Reporting of monitoring results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 37	Social	Infrastructure affecting movement of pastoralists, indirect impact of in-migration - Change in access to education	Construction	Based on previous social investment related to education, develop to be more comprehensive and approve a strategy, which will be created with authorities in Turkana and West Pokot Counties.	TKBV	Documentation of engagement initiatives. Documentation of consultation.
SOC – 38	Social		Construction	Stakeholder engagement to help verify effective indicators to monitor access to education.	TKBV	Documentation of engagement initiatives.
SOC – 39	Social	Indirect effect of increased salaried employment and procurement - Crime, commercial sex work and other nuisances from growth	Construction	Support information campaigns that seek to identify and provide support for key social maladies (e.g., gender-based violence, drug and alcohol abuse). Develop and implement Contractor Non-Technical Risk Management Plans, used to manage contractor performance	TKBV	Documentation of engagement initiatives. Documentation of consultation.
SOC – 40	Social		Construction	Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code).	EPC and TKBV (for drilling)	Documentation of training on Code of Ethical Conduct.
SOC – 41	Social	Project operating in region with history of inter-ethnic violence and raiding - Inter-ethnic conflict	Construction	Maintain Human Rights Policy. Maintain Voluntary Principles for Security and Human Rights (VPSHR) Implementation Guideline. Maintain Incident Reporting System for monitoring of security incidents.	EPC and TKBV (for drilling)	Documentation of audits. Reporting of monitoring results.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				Maintain risk assessments to identify potential impacts and risks to communities. Continue training for all employees and visitors during induction.		
SOC – 42	Social	Introduction of outside workforce - Community cohesion within Turkana and West Pokot County	Construction	Maintain information management system, described in more detail in the SEP (Annex II). Maintain regular community engagement outreach to address rumour and other misunderstandings identified through regular engagement.	TKBV	Documentation of audits. Documentation of engagement initiatives.
SOC – 43	Social	Economic opportunities linked to a multi-billion investment Indirect effect of increased salaried employment and procurement - Project-induced influx and in-migration	Operation	Maintain an Influx Management Plan and continue to coordinate with authorities in Turkana and West Pokot Counties. Verify effective indicators to monitor population growth within Influx Management Plan. Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). Disclose all local labour needs and recruitment information, including contractor information. Conduct a stakeholder engagement campaign to explain the operational employment and local content opportunities, as well as the	TKBV	Review Influx Management Plan. Reporting of monitoring results on demographics. Documentation of training on Code of Ethical Conduct. Documentation of audits. Documentation on local recruitment. Documentation of engagement initiatives.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				procedures that people must follow to obtain employment.		
SOC – 44	Social		Operation	Operate all worker accommodation as "*closed camps*".	TKBV	Regular auditing of operation practices.
SOC – 45	Social		Operation	Maintain a working group, to be led by the Project, with representatives of National and County government, and civil society.	TKBV	Documentation of engagement initiatives.
SOC –46	Social	Additional infrastructure and activities - Infrastructure	Operation	Continue infrastructure investments as part of the CDPs, aligned to County Integrated Development Plans. Maintain an engagement process headed by leadership at the County and Sub-county level, including representatives of government departments, private sector, NGOs and potentially religious institutions. Develop and maintain key performance indicators that help to monitor operational performance. Work with County Governments to encourage sustainable use of community offtake water points on the water pipeline to discourage overgrazing at water off take points, and record issues as part of the grievance mechanism	TKBV	Documentation on agreed infrastructure investment. Documentation of engagement initiatives. Reporting of monitoring results. Documentation of communication with County Governments. Maintenance of the grievance mechanism

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 47	Social	Tax and other payments linked to Project - Taxes and payments	Operation	Continue to disclose taxes in Annual Reports. Conduct periodic engagement on key social management plans, including all Community Development Plans, with relevant County-level board of trustees[2] charged with overseeing profits.	TKBV	Documentation of audits. Documentation of engagement initiatives.
SOC – 48	Social	Contractor or third-party workers during operations - employment	Operation	Maintain Human Resources Contractor Standard, forming minimum requirements for all contractors to follow. Promote the TKBV Code of Ethical Conduct (The Code), specifically as it related to the principle of “zero tolerance” for any form of discrimination. Track Contractor Employment data by gender. Continue using Contractor Non-technical Risk Management Policy. Continue using Human Rights Policy, which upholds the core commitments of the ILO that make up the basis of IFC PS2 on Labour and Working Conditions (IFC, 2012e).	TKBV	Documentation on agreed National Content Plan. Documentation on local recruitment. Production of Human Resource Contractor Standard. Documentation of training on Code of Ethical Conduct. Documentation on local recruitment. Documentation of training on Non-technical Risk Management Policy. Documentation of training on Human Rights Policy.

[2] A County-level board of trustees is described in the Petroleum Act as the body that will oversee the utilisation of funds “for the benefit of present and future generations”.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 49	Social	Procurement opportunities linked to the Project - Business opportunities and local content	Operation	Continue using existing Contractor Procedures for Local Procurement.	TKBV	Documentation of audits.
SOC – 50	Social		Operation	Update and maintain a National Content Plan, including KPI for monitoring changes in business opportunities and local content performance. Within CDPs, update and maintain commitments for local business capacity building. Update and maintain key performance indicators that help to monitor changes in business opportunities and local content performance.	TKBV	Documentation of audits. Review Community Development Plan Reporting of monitoring results.
SOC – 51	Social	Indirect effect of increased salaried employment and procurement - Inflation	Operation	Monitoring from construction and inform ongoing management and mitigation for operations. Review the need to monitor prices and collect of data similar to NDMA monthly surveys throughout operations. Monitoring will continue during the initial period of operations, thereafter alternative monitoring may be sought based on the review. Within CDPs, maintain or adapt key social programmes (from those implemented during the construction phase) to support PAP to develop sustainable skills that can help manage any potential changes on	TKBV	Reporting of monitoring results. Reporting of monitoring results and proposed interventions.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				the supply and demand of goods during operations.		
SOC – 52	Social	Land acquisition to develop the facilities required for the Project - Loss of occupied homesteads (physical displacement)	Operation	Successful implementation of the RAP and continued application of the LRPs.	TKBV	Maintain reporting on LRP related activities.
SOC – 53	Social	Land acquisition to develop the facilities required for the Project- Impacts on livelihoods due to loss of communal land (economic displacement)	Operation	Maintain commitments in LRP and CDPs which will continue to deliver livelihood restoration and community benefits, including support to: ■ Skills development. ■ Micro business support; and ■ Livestock grazing improvements.	TKBV	Maintain reporting on LRP related activities. Documentation of engagement initiatives.
SOC – 54	Social	Introduction of outside workforce, financial incentives for vulnerable persons, and transport for Project construction - Sexually transmitted infections	Operation	Prior to operations all commitments in the following plans will be reviewed, in light of construction phase monitoring. Relevant commitments will extend into operations and the following will apply: ■ Community Health, Safety and Security Management Plan. ■ HIV Policy and Programme. ■ "*95-95-95*" strategy, which sets targets for awareness, treatment and demonstrating performance in viral suppression.	TKBV	Documentation of audits.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				■ Operate all worker accommodation as "*closed camps*" ■ TMP specifically linked to the identification and management of transport rest stops. ■ Support of Health Systems Strengthening activities, to be implemented by a third party. ■ Medical Fitness to Work Specification and Procedures. ■ Contractor Non-Technical Risk Management Plans, used to manage contractor performance.		
SOC – 55	Social		Operation	Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). Maintain an Influx Management Plan and continue to coordinate with authorities in Turkana and West Pokot Counties. Monitor key performance indicators through a CHIS.	TKBV	Documentation of training on Code of Ethical Conduct. Review Influx Management Plan. Reporting of monitoring results
SOC – 56	Social	Alteration of the physical environment - Vector related diseases	Operation	Maintain Malaria Management Plan. Monitor key performance indicators through a CHIS.	TKBV	Review Malaria Management Plan. Reporting of monitoring results

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 57	Social		Operation	Implement strict source reduction environmental controls around operational sites, to be set out in the OEMP.	TKBV	Reporting of monitoring results.
SOC – 58	Social	Introduction of outside workforce and transport for Project construction - Communicable diseases	Operation	Maintain camp cleanliness and hygiene standards. Operate all worker accommodation as “closed camps”. Maintain food hygiene programmes with good industry practice standards.	TKBV	Regular auditing of operation practices. Documentation of audits.
SOC – 59	Social		Operation	Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code). Maintain effective waste management procedures, as per Waste Management Plan. Implement TB Management Programme, linked to the HIV Programme, that will be coordinated with authorities in Turkana and West Pokot Counties. Maintain Infectious Disease Health Management Plan.	TKBV	Documentation of training on Code of Ethical Conduct. Regular auditing of operation practices. Documentation of audits.
SOC – 60	Social		Operation	Maintain Medical Fitness to Work Specification and Procedures. Monitor key performance indicators through a CHIS.	TKBV	Documentation of audits. Reporting of monitoring results

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
SOC – 61	Social	Waste from Project activities - Zoonotic diseases	Operation	Maintain Pest Control Plan for landfill and other Project facilities.	TKBV	Documentation of audits.
SOC – 62	Social	Transport for Project construction - Accidents and injuries	Operation	Maintain the Safe and Sustainable Operations Policy. Revisit stakeholder engagement campaign on road safety for operational activities within the immediate area of influence. Monitor key performance indicators through a CHIS.	TKBV	Documentation of audits. Documentation of engagement initiatives. Reporting of monitoring results.
SOC – 63	Social		Operation	Maintain TMP, specifically for the management of emergencies or accidents. Maintain CHSSMP, specifically access control measures.	TKBV	Documentation of audits.
SOC – 64	Social	Infrastructure affecting movement of pastoralists, indirect impact of in-migration - Change in access to education	Operation	Review and maintain strategy related to education, which will be coordinated with authorities in Turkana and West Pokot Counties. Continued stakeholder engagement and monitor against effective indicators for access to education.	TKBV	Documentation of engagement initiatives. Documentation of consultation.
SOC – 65	Social	Indirect effect of increased salaried employment and procurement - Crime, commercial sex work and other nuisances from growth	Operation	Support information campaigns that seek to identify and provide support for key social maladies (e.g., gender-based violence, drug and alcohol abuse).	TKBV	Documentation of engagement initiatives. Documentation of consultation.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				Continue using Contractor Non-technical Risk Management Policy.		
SOC – 66	Social		Operation	Maintain and train all employees and contractor workers in the TKBV Code of Ethical Conduct (The Code).	TKBV	Documentation of training on Code of Ethical Conduct.
SOC – 67	Social	Project operating in region with history of inter-ethnic violence and raiding - Inter-ethnic conflict	Operation	Maintain Human Rights Policy. Maintain VPSHR Implementation Guideline. Maintain Incident Reporting System for monitoring of security incidents. Maintain risk assessments to identify potential impacts and risks to communities.	TKBV	Documentation of audits.
SOC – 68	Social		Operation	Continue training for all employees and visitors during induction.	TKBV	Reporting of monitoring results.
SOC – 69	Social	Introduction of outside workforce - Community cohesion within Turkana and West Pokot County	Operation	Maintain information management system, described in more detail in the SEP (Annex II). Maintain regular community engagement outreach to address rumour and other misunderstandings identified through regular engagement.	TKBV	Documentation of audits. Documentation of engagement initiatives.

Table 9.7-10: Cultural Heritage

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
CH-01	Cultural Heritage	Ground disturbance/change in land surface within Project footprint on archaeological surface remains	Construction	CHMP to be produced and agreed prior to construction.	PMC	Production of CHMP.
CH-02	Cultural Heritage		Construction	Staff induction as per the CHMP. Use of Chance Find Procedure, developed in conjunction with NMK (detailed in CHMP).	EPC	Documentation of staff induction. Documentation of communication with NMK. Documentation of the Chance Finds Procedure and any chance finds encountered during construction. Regular auditing of construction practices.
CH-03	Cultural Heritage		Construction	Consultation with NMK to identify appropriate archive for collected samples and potential support for obtaining and publishing results of analytical research of obsidian samples.	TKBV	Documentation of communication with NMK.
CH-04	Cultural Heritage	Ground disturbance/change in land surface within Project footprint on potential archaeological settlement sites	Construction	Pre-construction archaeological investigation within CFA footprint, to be agreed and completed in conjunction with TKBV and NMK.	EPC	Reporting of investigation results and incorporation into the CHMP.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
CH-05	Cultural Heritage	Ground disturbance/change in land surface on sacred trees potentially located within make-up water pipeline RoW	Construction	Pre-construction community liaison and mapping exercise to record the locations of sacred trees along make-up water pipeline RoW. Once mapped, avoidance will be undertaken by micro-alignment. If avoidance is not possible further consultation with the community / site guardian will be undertaken regarding the possible translocation of sites and associated cultural practices. Further detail to be included in the CHMP.	EPC	Documentation of survey results and incorporation into staff training and CHMP.
CH-06	Cultural Heritage	Change in environmental condition as a result of construction dust, which could impact sacred tree health at CH-046.	Construction	Pre-construction consultation with affected community (Lomokomar) to identify reasonable measures that could be implemented. (e.g. undertake a dust monitoring programme during construction to record level of dust deposition at receptor, which will inform the need for potential erection of netting between wellpad and receptor to inhibit dust deposition).	TKBV	Documentation of consultation.
CH-07	Cultural Heritage	Change in environmental conditions as a result of visual changes to setting of sacred trees from construction activities	Construction	Pre-construction consultation by TKBV with affected community (Lomokomar) to identify reasonable measures that could be implemented	TKBV	Documentation of consultation.
CH-08	Cultural Heritage		Construction	Develop and implement a communication plan involving relevant traditional leaders and local administrative leaders to inform local	EPC	Production of TKBV approved communication plan

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				communities of the Project construction schedule and encourage avoidance or minimal exposure.		Documentation of communication of construction schedule/ duration to traditional leaders and local administrative leaders prior to commencement of construction along with any subsequent material changes
CH-09	Cultural Heritage	Ground disturbance/change in land surface on graves and burials	Construction	Micro-alignment of interconnecting network within RoW to avoid receptor (CH-059). Chance Finds Procedure will detail steps for identifying unrecorded graves within the development footprint prior to construction and the process to be followed. Pre-construction community liaison and mapping exercise to record the locations of graves and burials along make-up water pipeline RoW. Once mapped, micro-alignment or exhumation will be completed if required. Further detail to be included in the CHMP.	EPC	Documented review and revision of interconnecting network RoW route. Documentation of use of the TKBV approved Chance Finds Procedure. Regular auditing of construction practices. Documentation of mapping results, consultation and outcomes of mitigation.
CH-10	Cultural Heritage		Construction	Exhumation and relocation of burial in consultation with site guardians and affected communities (CH-105) prior to construction.	TKBV	Documentation of consultation and exhumation.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
CH-11	Cultural Heritage	Ground disturbance/change in land surface on Turkana culture and nomadic pastoralism	Construction	Community consultation and liaison, in accordance with the SEP, to listen to and address community concerns and develop a mechanism to support the sustainability of traditional practices.	TKBV	Documentation of consultation.
CH-12	Cultural Heritage	Ground disturbance/change in land surface on environmental subsistence	Construction	Community consultation and liaison by TKBV, in accordance with the SEP, to map and provide continued access to natural resources. Support the sustainability of traditional subsistence practices, specifically the transfer of traditional knowledge and skills.	TKBV	Documentation of steps taken to promote the transfer of traditional knowledge and skills.
CH-13	Cultural Heritage	Change in environmental conditions as a result of visual changes to setting from the OHTL on sacred trees	Operation	Develop and implement communication plans to engage traditional leaders and local administrative leaders to protect the continued and sustainable use of sacred trees.	TKBV	Production of communication plan. Documentation of communication with traditional leaders.

Table 9.7-11: Emergency, Accidental and Non-Routine Events

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
ERA-01	Natural Hazard	Natural seismicity (earthquakes) on flowlines or containment structures leading to release to the environment.	Construction and Operation	Prepare and implement: ■ Emergency Preparedness Response Plan. ■ OEMP	EPC (construction) & TKBV (drilling and operations)	Publication and operation in accordance with Response and Management plans
ERA-02	Natural Hazard		Construction and Operation	Spill response kits should be available at wellpads and the CFA and used as soon as possible following an event.	EPC (construction) & TKBV (drilling and operations)	Regular audits of spill kit availability and condition.
ERA-03	Industrial Hazard	Failure or rupture of a storage tank leading to release of production fluid to environment.	Operation	Prepare and implement: ■ Emergency Preparedness Response Plan. ■ OEMP	TKBV	Publication and operation in accordance with Response and Management plans
ERA-04	Industrial Hazard		Operation	Spill response kits should be available at wellpads and the CFA and used as soon as possible following an event.	TKBV	Regular audits of spill kit availability and condition.
ERA-05	Industrial Hazard	Perforation or rupture of a flowline or spillage due to poor working practices leading to release to the environment.	Operation	Prepare and implement ■ Emergency Preparedness Response Plan. ■ Water Management Plan ■ Environmental Monitoring Plan.	TKBV	Publication and operation in accordance with Response and Management plans
ERA-06	Industrial Hazard		Operation	Spill response kits should be available at wellpads and the CFA and used as soon as possible following an event.	TKBV	Regular audits of spill kit availability and condition.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
ERA-07	Industrial Hazard	Road traffic accidents on access roads	Operation	Prepare and implement ■ Emergency Preparedness Response Plan ■ OEMP ■ TMP Education programme for drivers and passengers.	TKBV	Publication and operation in accordance with Response and Management plans Documentation of delivery of education programme.
ERA-08	Industrial Hazard	Road traffic accidents on public roads	Operation	Prepare and implement ■ Emergency Preparedness Response Plan. ■ OEMP ■ TMP Education programme for drivers and passengers. Community awareness programme for traffic awareness.	TKBV	Publication and operation in accordance with Response and Management plans Documentation of delivery of education programme. Documentation of delivery of awareness programme.
ERA-09	Industrial Hazard	Induced seismicity due to well testing/ oil production.	Operation	Prepare and implement: ■ Emergency Preparedness Response Plan. ■ Water Management Plan ■ Environmental Monitoring Plan.	TKBV	Publication and operation in accordance with Response and Management plans
ERA-10	Industrial Hazard		Operation	Spill response kits should be available at wellpads and the CFA and used as soon as possible following an event.	TKBV	Regular audits of spill kit availability and condition.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
ERA-11	Industrial Hazard	Well casing/cement integrity failure and down hole collisions during drilling and production.	Operation	Prepare and implement: ■ Emergency Preparedness Response Plan. ■ Water Management Plan ■ Environmental Monitoring Plan	TKBV	Publication and operation in accordance with Response and Management plans
ERA-12	Industrial Hazard		Operation	Spill response kits should be available at wellpads and the CFA and used as soon as possible following an event.	TKBV	Regular audits of spill kit availability and condition.

Table 9.7-12: Cumulative

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
CU-01	Cumulative (LLCOP) – Noise and Air Quality	Concurrent work on LLCOP in the same location as the Project , resulting in cumulative construction noise and air quality (dust) impacts.	Construction	Engagement with the LLCOP project proponent to plan construction programmes so any concurrent work in the same location are minimised as far as practicable. Where concurrent work is required, the project proponents should: ■ Engage to plan construction programmes so any work within 250 m of each project is minimised as far as practicable. ■ Work together to identify additional measures and	EPC	Documentation of engagement with LLCOP project proponent. Documentation of steps taken to minimise concurrent work or any measures/controls implemented.

ID	Topic/Aspect	Impact	Project Phase	Mitigation	Responsibility	Means of Verification
				controls to limit the significance and duration of activities.		
CU-02	Cumulative (LLCOP) – Social	Influx of people and workers as a result of both LLCOP and the Project resulting in cumulative increased risk of HIV/AIDS and other STIs.	Construction and Operation	Engagement with the LLCOP proponent to work together to align proposed mitigation measures defined for community health and safety relating to the potential increased risk of HIV/AIDS and STIs and identify if any additional measures and controls are required to limit significance.	TKBV	Documentation of engagement with LLCOP project proponent. Documentation of steps taken to align mitigation measures or identification of any additional measures
CU-03	Cumulative (OHTL) – Biodiversity	Risk of direct mortality to bird species from OHTL construction	Construction	Engagement with the OHTL contractor to encourage consideration on routing and bird-friendly OHTL design measures.	TKBV	Documentation of engagement with OHTL contractor.
CU-04	Cumulative (Airstrip Upgrade) – Noise	Airstrip upgrade works resulting in cumulative noise impacts.	Construction	Engagement with the owners of the airstrip to consider relocation or livelihood restoration of receptors within 210 m of the Kapese airstrip during any upgrade works.	EPC	Documentation of engagement with owners of airstrip.
CU-05	Cumulative (Borrow Pits) – Biodiversity	Development of borrow pits resulting in cumulative impacts upon biodiversity receptors.	Construction	The Project BCoW will engage with the borrow pit contractor/developer to discourage their development in sensitive biodiversity areas and to ensure that site-specific Project reports are developed for the borrow pits and submitted to NEMA.	EPC	Documentation engagement with borrow pit contractor/developer. Audits of site-specific reports.

9.8 Project Decommissioning Framework

9.8.1 Introduction

The Project has a design life of 25 years. At this stage it is not possible to anticipate the situation at that time. This ESIA presumes that within this period both the receiving environment as well as available technology will be significantly different to present day. As a result, it is not possible to set out a detailed decommissioning plan. The most effective approach to this issue is to set out the broad principles that, at this time, are anticipated to be applicable or relevant to Project closure and decommissioning.

9.8.2 Decommissioning Philosophy

In line with good international industry practice, the following Decommissioning Philosophy will be adopted:

- Five years prior to the planned End of Project, a Decommissioning Plan will be developed for agreement with the appropriate authorities.
- Underground equipment will be emptied of oil product, left in a clean state and left in situ unless good practice at the time dictates otherwise; and
- Above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use.

The Decommissioning Plan will be submitted to NEMA and other relevant government authorities for review and approval prior to implementation.

10.0 CONCLUSIONS

This ESIA has systematically reviewed and evaluated the potential impacts on existing environmental and social receptors within the Project's AoI, over the lifetime of the Project. The assessment was undertaken in accordance with Kenyan legislative, regulatory and policy requirements, including the Environmental (Impact Assessment and Audit) Regulations (2003), and, where relevant, references international standards as part of GIIP. It specifically references the IFC PSs on Environmental and Social Sustainability and WBG IFC General EHS Guidelines. It has also been prepared to align with international conventions to which Kenya is a signatory. The ESIA has been prepared with due consideration for the multiple stakeholders within the administrative framework of Kenya, at community, County and National level.

The ESIA assesses potential impacts of the Project based on the Project description and covers all activities and infrastructure associated with the construction, operation and decommissioning of the Project. The ESIA describes the baseline conditions and has evaluated potential impacts on the following:

- Air quality;
- Noise and vibration;
- Water quantity;
- Water quality;
- Soils, terrain, geology and seismicity;
- Landscape and visual;
- Biodiversity, ecology and protected areas;
- Ecosystem services;
- Social and socio-economics; and
- Cultural heritage.

The ESIA has identified that adverse impacts brought about by the Project are largely manifest during the construction phase and are associated with land acquisition, influx, water abstraction, vegetation clearance and groundworks, drilling, construction of buried flowlines and water pipeline. Impacts during normal operation, are associated with influx, emissions from facilities, water abstraction and increased access along the RoW.

Impacts to a number of important receptors were considered to be moderate and major prior to successful implementation of mitigation during the construction and operation of the Project, however, with the adoption of additional mitigation measures identified in the ESIA, these were all reduced to either **Minor** or **Negligible**. This is with the exception of some residual **Moderate** impacts identified including those associated with:

- Construction impacts on elephants, leopards, striped hyaena, Turkana toad and a rare species of ground beetle;
- Construction and operational impacts on vultures;
- Construction and operational impacts to a sacred tree near Twiga; and
- Impacts related to graves that need to be relocated.

For impacts to the socio-economic environment associated with the Project, many impacts are expected to be positive, with **Moderate** or **Major** positive impacts relating to transparent tax payments, infrastructure, employment and business opportunities. The Project intends to target construction and operation employment opportunities at communities within the Project's AoI and provide the necessary pre-employment training to ensure local uptake of jobs. In addition, livelihood restoration and enhancement measures will be developed in consultation with local leadership. The Project also has the potential to contribute positively to community health through health awareness and disease prevention programs associated with its workforce.

A number of other major developments have been identified within the Project AoI that have the potential to generate cumulative impacts with the Project. Impacts associated with the LLCOP project present the greatest potential for cumulative impacts to occur. Cumulative impacts are largely expected to occur during the construction phase of the Projects relating to the concurrent construction schedules and during the operational phase relating to community health and safety. TKBV will engage with the LLCOP project proponent to work together to identify additional measures and controls to limit the significance and duration of any impacts.

TKBV are committed to engage with other associated and third-party projects to encourage implementation of specific mitigation measures including OHTL routing and bird-friendly design, consideration of receptors close to the proposed Kapese airstrip upgrade works and to discourage the development of borrow pits in areas of sensitive biodiversity and to ensure that site-specific Project reports are developed and submitted to NEMA.

In accordance with Kenyan legislation, an outline ESMP has been developed for the Project. An ESMP compiles a set of management, mitigation and monitoring measures to be taken pre-construction, during construction (groundworks, construction and installation), operation (including maintenance) and decommissioning to manage key potential environmental and social impacts identified in this ESIA. An ESMS will be developed for the life of the Project, under which each of the ESMPs will be implemented and operationalised.

This ESIA has developed a number of framework management plans as part of the ESMP, which will be further evolved into formal management plans when the EPC Contractors are appointed and prior to commencement of the Project. The management plans will be 'living documents' that will need to be updated as required throughout operations and as part of the ESMS. There will be a continual effort to enhance and further refine an understanding of the environmental and social concerns associated with the Project throughout construction and operation.

As with the ESMPs, the SEP (developed as part of this ESIA) for the Project will continue to evolve and will be the framework for stakeholder engagement and communication throughout the construction, operation and eventual decommissioning of the Project. The Project will continue to implement and improve the grievance mechanism for all stakeholders and the EPC contractor will similarly develop a grievance mechanism which will be applicable for all contractor and sub-contractor employees engaged by the Project.

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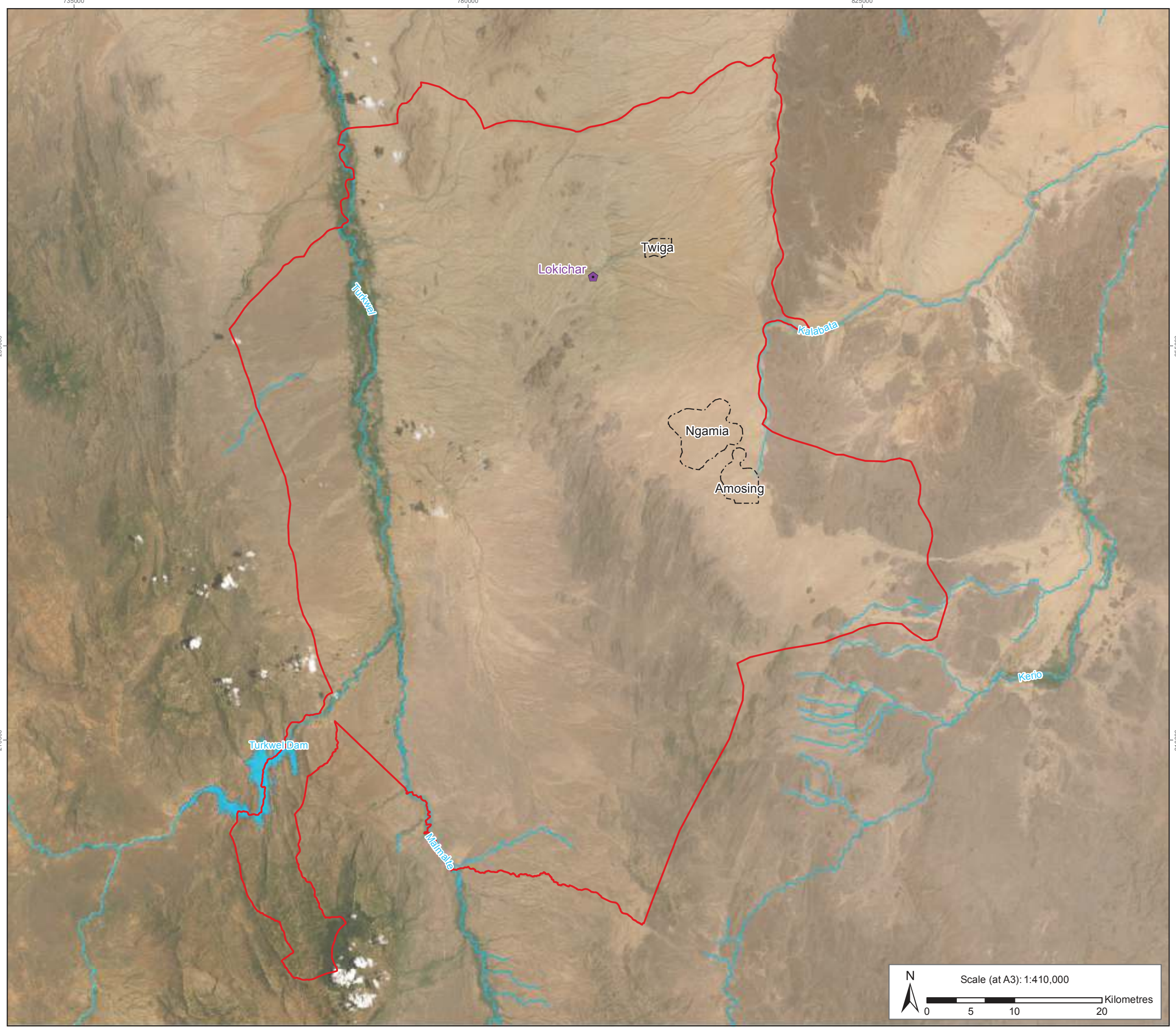
DRAWINGS

Drawing 6.1-1: Potential Area of Influence

Foundation Stage Development



Key

- Settlement
- Area of Influence (AoI)
- Oilfield Boundary
- Waterbody
- Watercourse

Data sources:
Tullow, Worley Parsons
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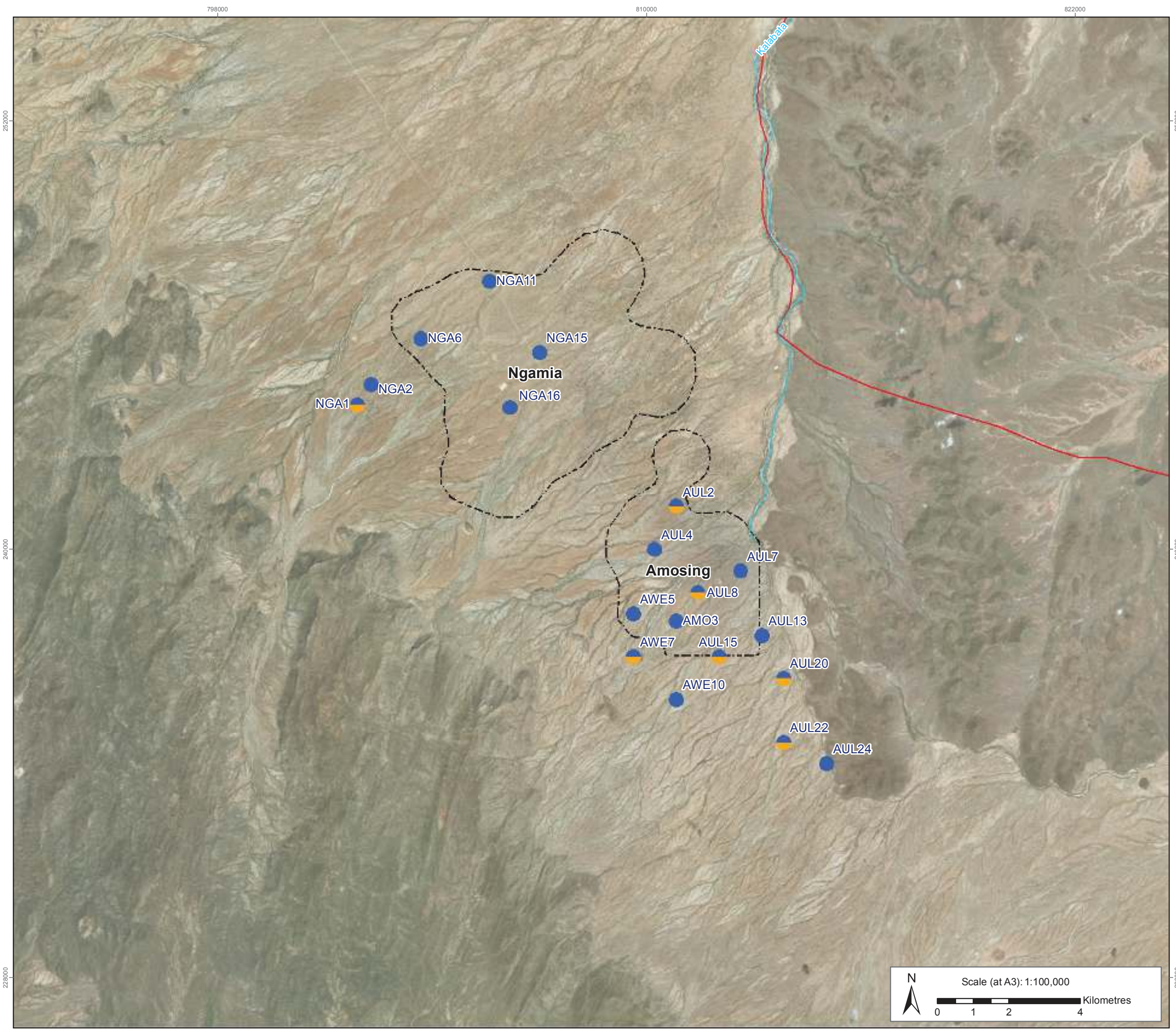

Drawing 6.3-1: Secondary Soil Data Analysis

Foundation Stage Development

Key

- Area of Influence (AoI)
- Oilfield Boundary
- Watercourse

Worley Parsons Test Pit and Sample Locations (2014)

- Particle Size Distribution Results Available
- Chemical Analysis Results Available

Data sources:
Base data sourced from Tullow, Worley Parsons
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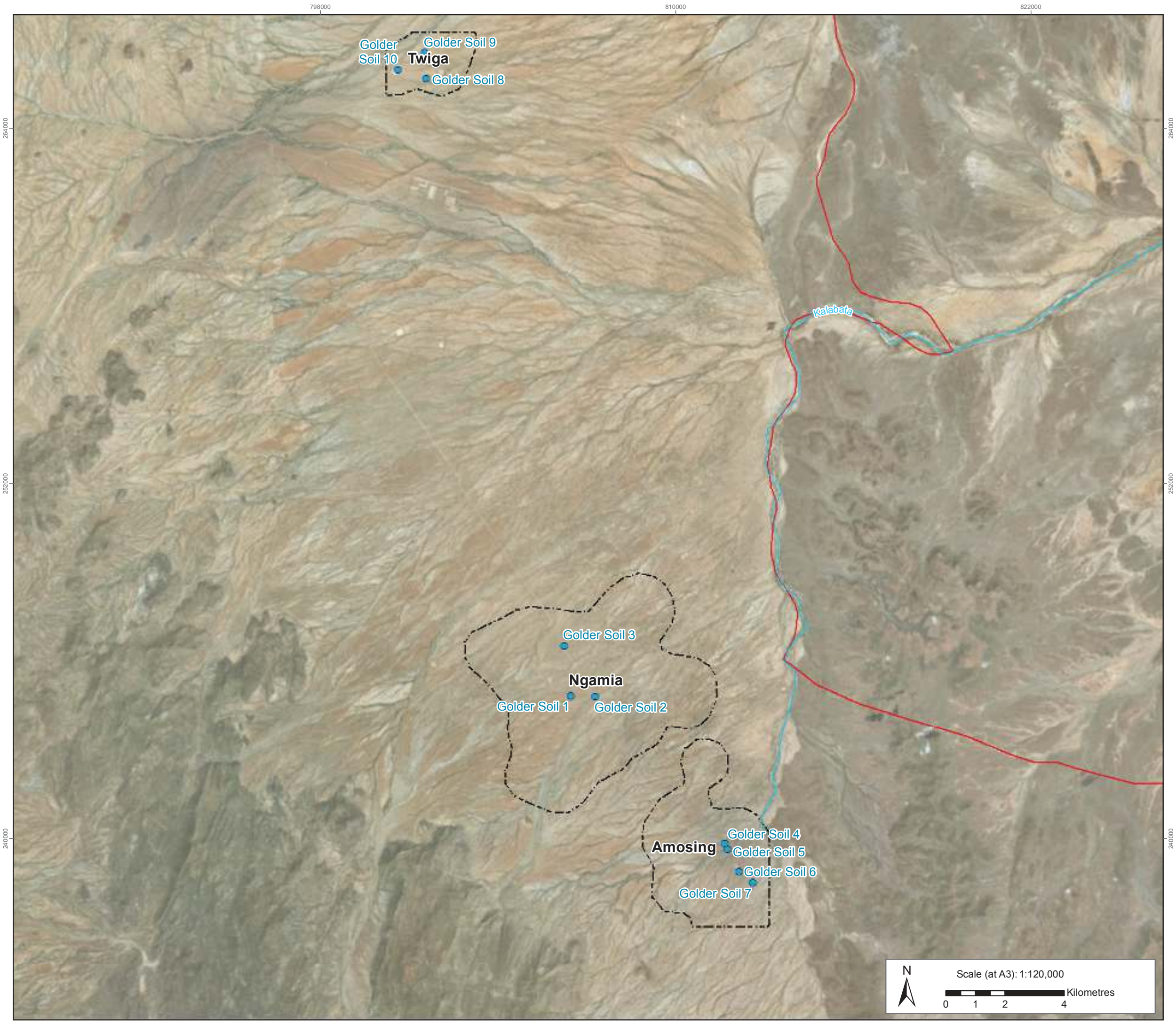

Drawing 6.3-2: Secondary Soil Data Analysis

Foundation Stage Development

Key

- Proposed Soil Sampling Location
- Area of Influence (AoI)
- Oilfield Boundary
- Watercourse

Data sources:
Base data sourced from Tullow, Worley Parsons
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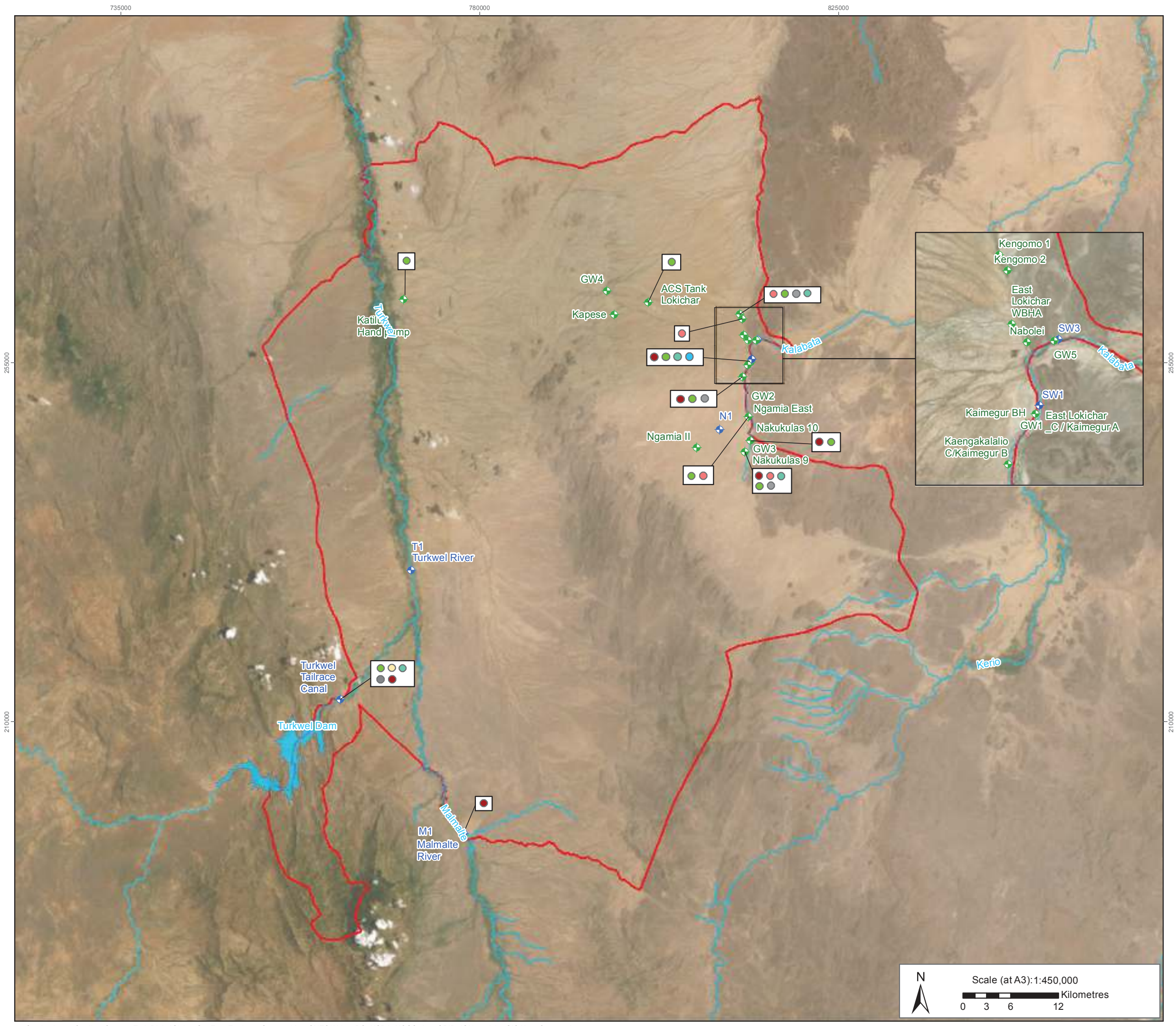

Drawing 6.7-1: Locations of Project Water Quality Standard Concentration Exceedances, Metals and Trace Elements

Foundation Stage Development

Key

- Groundwater Monitoring Location
- Surface Water Monitoring Location
- Area of Influence (AoI)
- Waterbody
- Watercourse

Concentration Exceedances of Project Water Quality Standards

- Aluminium
- Boron (as B or as Boric Acid)
- Cadmium
- Copper
- Iron (Total)
- Selenium
- Zinc

Data sources:
Infrastructure data sourced from Tullow and Worley Parsons. Surface water data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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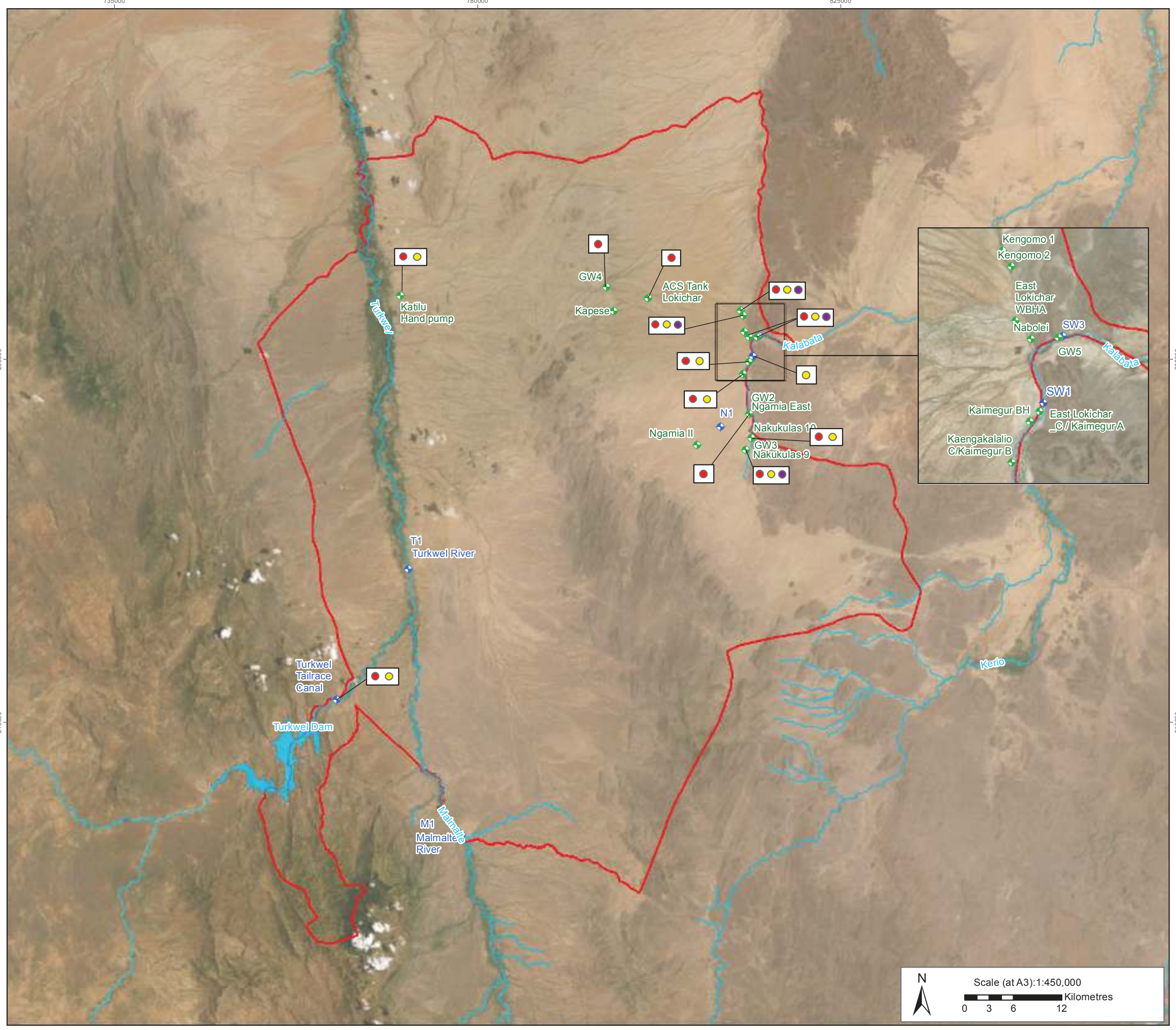

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Drawing 6.7-2: Locations of Project Water Quality Standard Concentration Exceedances, Major Ions

Foundation Stage Development

Key

- Groundwater Monitoring Location
- Surface Water Monitoring Location
- Area of Influence (AoI)
- Waterbody
- Watercourse

Concentration Exceedances of Project Water Quality Standards

- Chloride
- Fluoride
- Sodium

Data sources:
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Coordinate System: WGS 1984 UTM Zone 36N

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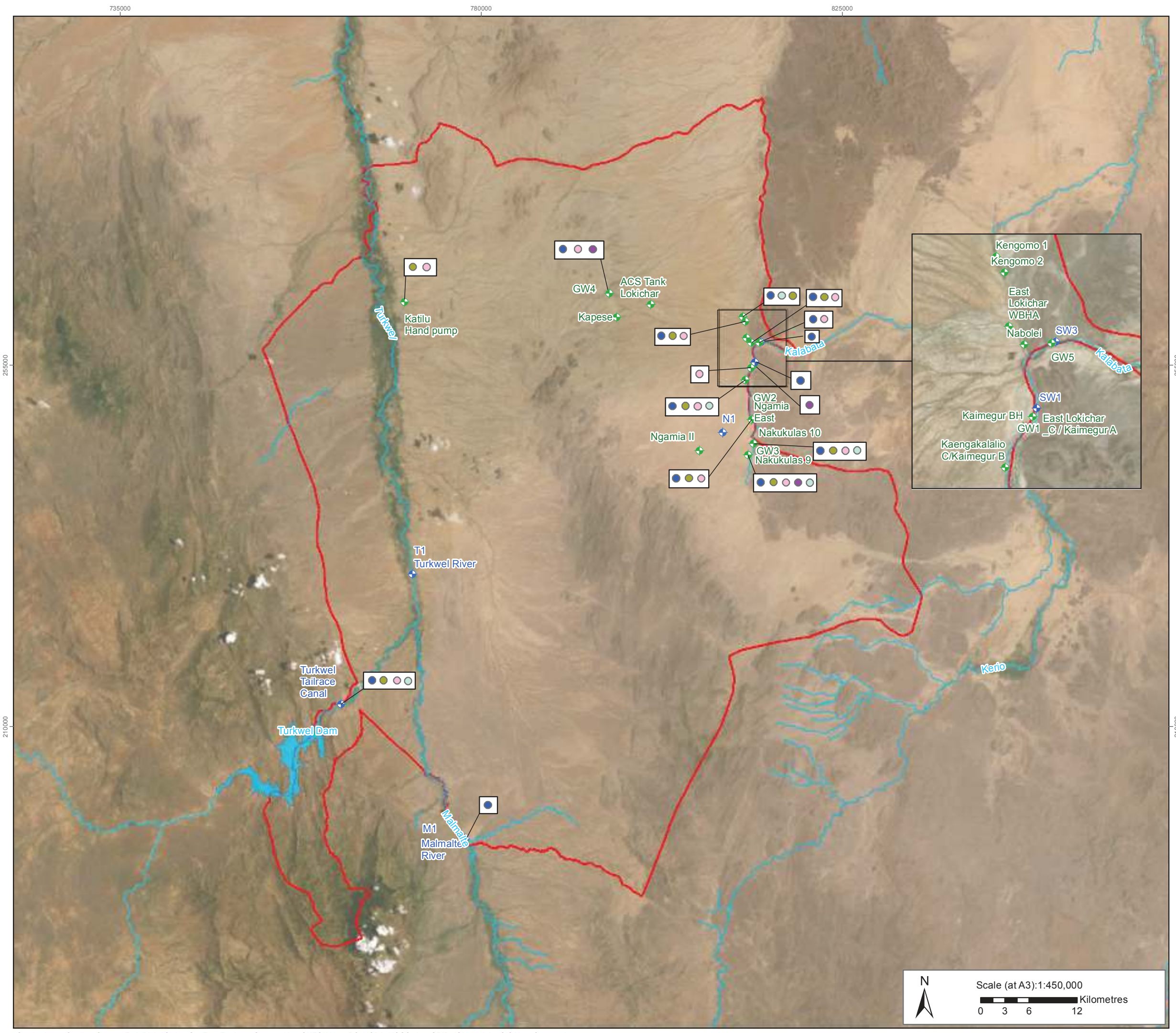

Drawing 6.7-3: Locations of Project Water Quality Standard Concentration Exceedances, Nutrients and Organics

Foundation Stage Development

Key

- Groundwater Monitoring Location
- Surface Water Monitoring Location
- Area of Influence (AoI)
- Waterbody
- Watercourse

Concentration Exceedances of Project Water Quality Standards

- Ammonia (as NH3 or as N)
- Benzene
- Nitrate as NO3
- Nitrite
- Ortho Phosphate as PO4

Data sources:
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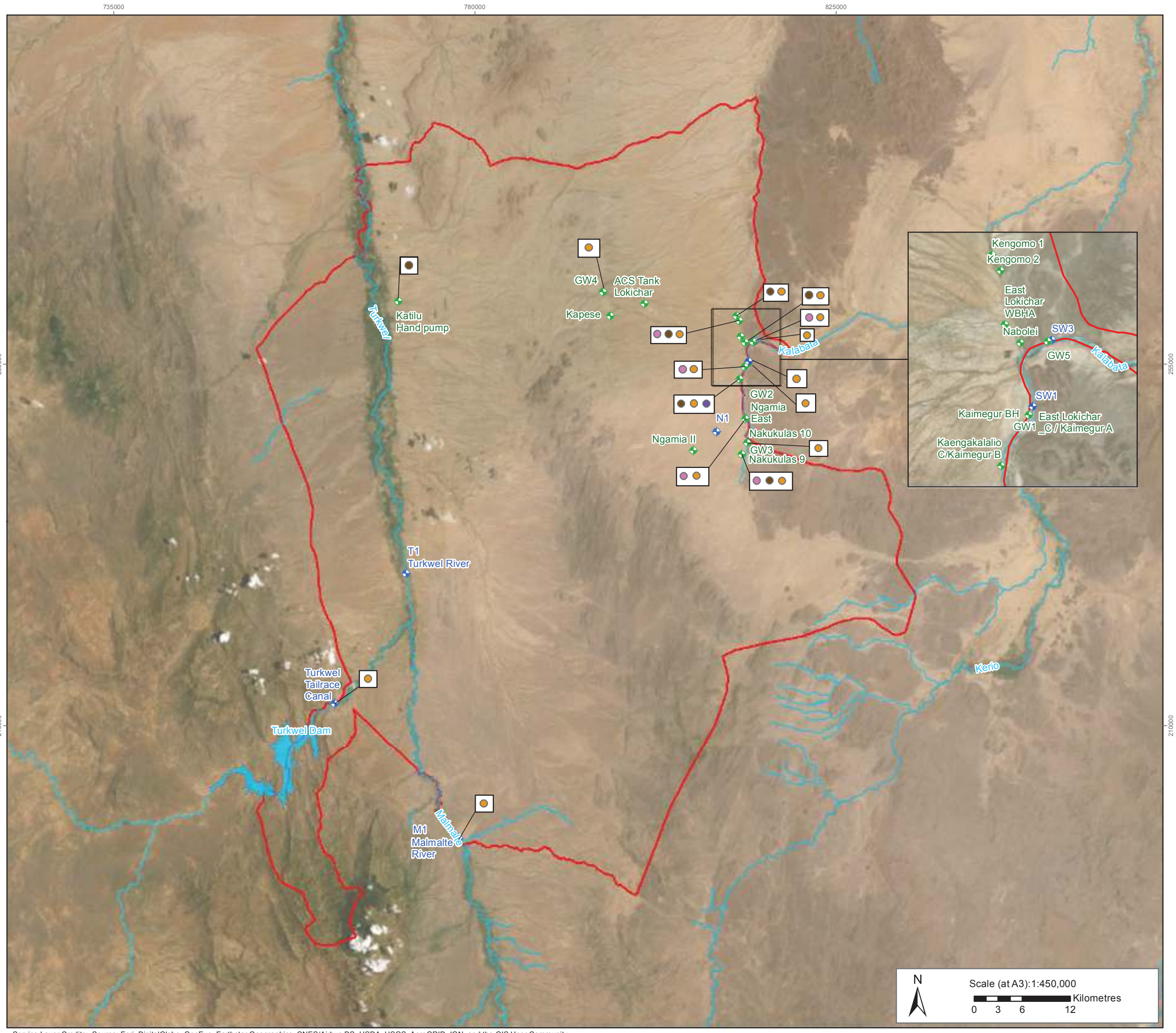
Drawing 6.7-4: Locations of Project Water Quality Standard Concentration Exceedances, Other Parameters

Foundation Stage Development



Key

- Groundwater Monitoring Location
- Surface Water Monitoring Location
- Area of Influence (AoI)
- Waterbody
- Watercourse

Concentration Exceedances of Project Water Quality Standards

- pH
- Total Dissolved Solids
- Total Hardness Dissolved (as CaCO3)
- Total Suspended Solids

Data sources:
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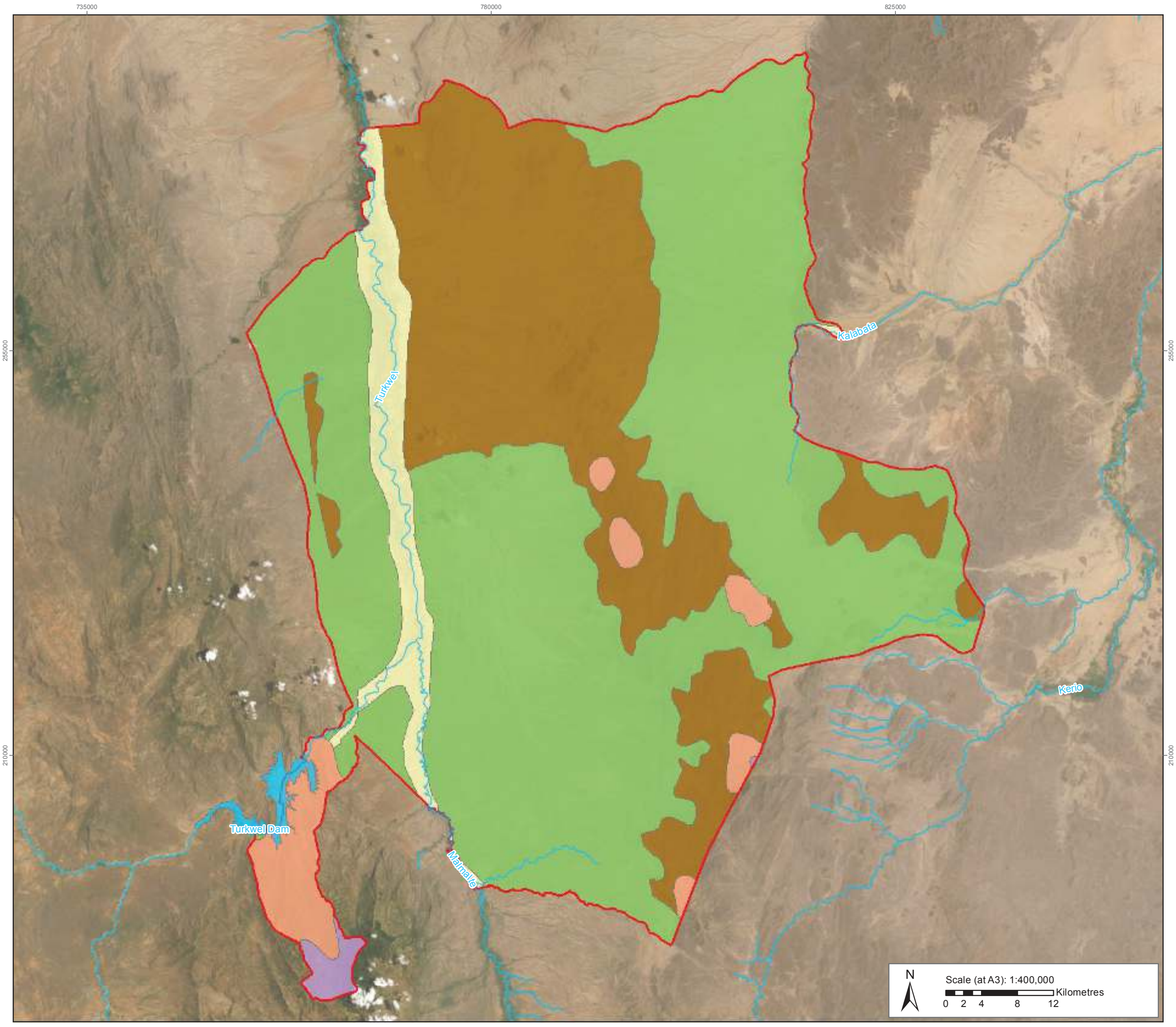
Drawing 6.9-1: Vegetation and Climate Change in Eastern Africa

Foundation Stage Development



Key

- Area of Influence (AoI)
- Waterbody
- Watercourse

Vegetation

- Acacia-Commiphora Stunted Bushland
- Afromontane Undifferentiated Forest
- Evergreen and Semi-Evergreen Bushland and Thicket
- Riverine Wooded Vegetation
- Somalia-Masai Acacia-Commiphora Deciduous Bushland and Thicket

Data sources:
Base data available from Tullow and Worley Parsons.
Surface water data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).
(ODbL) by the OpenStreetMap Foundation (OSMF).
Vegetation data available from VECEA 2015

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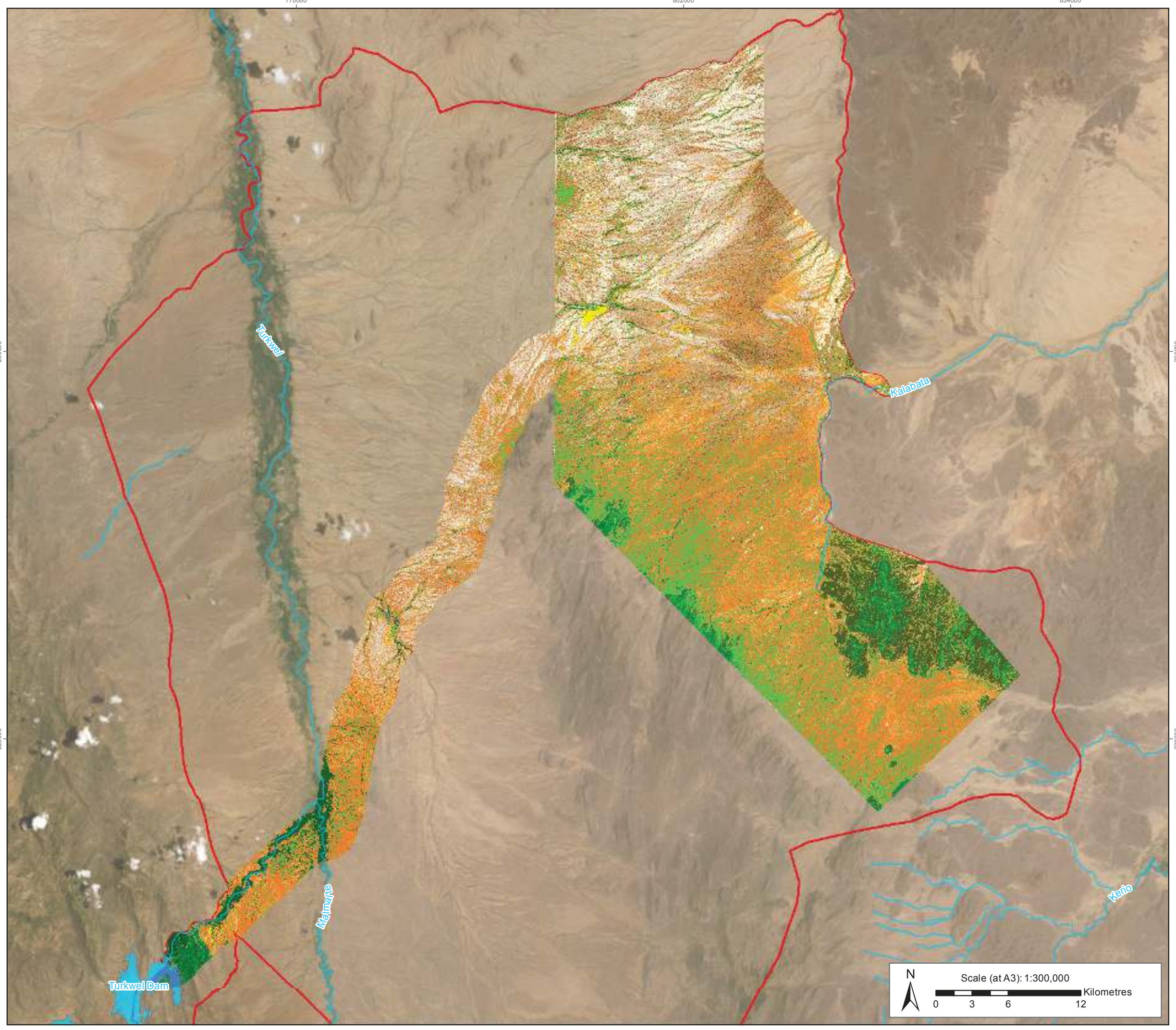

Drawing 6.9-2: Landcover Classification

Foundation Stage Development

Key

- Area of Influence (AoI)
- Waterbody
- Watercourse

Landcover Classification

- Acacia Dominated Forest (Tall Trees) Along Major Riparian Zone
- All Cultivated Land, Including Both Currently Active and Old, Long Term Fallow / Abandoned Field
- Acacia and Other Spp Dominated Forest (Tall Trees) Along Major Riparian Zone
- Dense Bush and/or Taller Shrub (Most Dense Bush Dominated Class), on Mountain or Rocky Hill
- Dense Bush and/or Taller Shrub (But Less Dense Than Dense Bush Class #1, on Mountain or Rocky Hill
- Dense Bush and/or Taller Shrub (But Less Dense Than Dense Bush Class #2, on Mountain or Rocky Hill
- Dense Bush and/or Taller Shrubs (But Less Dense Than Dense Bush Class #3: Least Dense, But More Dense Than Open Bush Classes), on Mountains or Rocky Hills
- Dense Low Shrub and/or Grass Cover, With Only A Few Bushe, on Mountain or Rocky Hill
- Dense Tree and Tall Bush Combination Class, on Mountain or Rocky Hill
- Grass Dominated Areas, With Only A Few Trees, Bush or Shrub, on Mountain or Rocky Hill
- Open and/or Scattered Bush and Shrub Cover, on Mountain or Rocky Hill.
- Open and/or Scattered Bush and/or Shrub, on Mountain or Rocky Hill
- Sparse to Open Grass Cover Area, Typically Containing Scattered Bush and Shrub, on Mountain or Rocky Hill
- Sparse Low Shrub and/or Grass Cover, With only A Few Bushes on Mountains or Rocky Hill
- Sparse Non-Riparian Woodland Cover on Plain
- Dense Non-Riparian Woodland Cover on Plain
- Open Non-Riparian Woodland Cover on Plain
- Open / Semi-Dense Non-Riparian Woodland Cover on Plain
- Low Shrubland on Plains, Dense Cover
- Medium Height Shrubland on Plain, Dense Cover
- Low or Tall Shrubland On Plains, Sparse Cover
- Tall Shrubland on Plains, Dense Cover
- Riparian Woodland (not Closed Canopy, Taller Forest) Along Major Riparian Zone
- Non-Vegetated Bare Sand
- All Settlement and Built-up Areas In the Extended Western Pipe Transect, this Includes Small "kraal" Concentrations as Well as Established Settlements and Built-up Area
- Water in Lake and Major River System
- Shallow Water in Pan System

Data sources:
Base data sourced from Tullow and Worley Parsons. Surface water data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF). Landcover data available from GeoTerraImage (GTI) Pty Ltd.

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Project Ref:	Prepared By:	Reviewed by:	Approved by:
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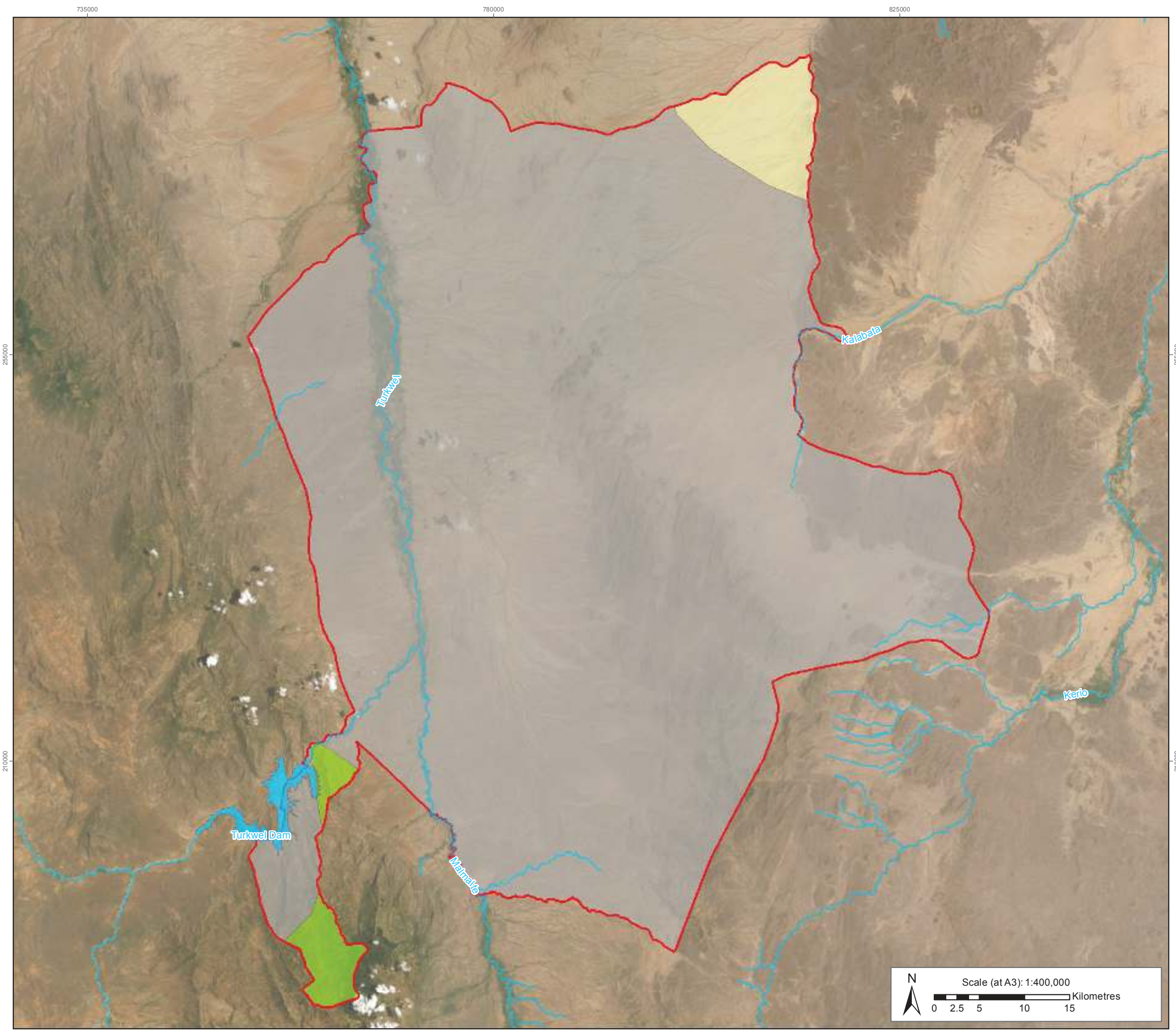
Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_109_Biodiversity\02_PRODUCTION\MXD\1433956_620_109_OG_659_AOI_Landcover_D002.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Drawing 6.9-3: WWF Ecoregions

Foundation Stage Development

Key

- Area of Influence (AoI)
- Waterbody
- Watercourse

WWF Ecoregion

- East African Montane Forests
- Masai Xeric Grasslands And Shrublands
- Northern Acacia-Commiphora Bushlands And Thickets

Data sources:
Infrastructure data sourced from client. Road data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF). Ecoregions available from WWF

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1433956	KP 18-11-2019	PK 18-11-2019	KP 18-11-2019

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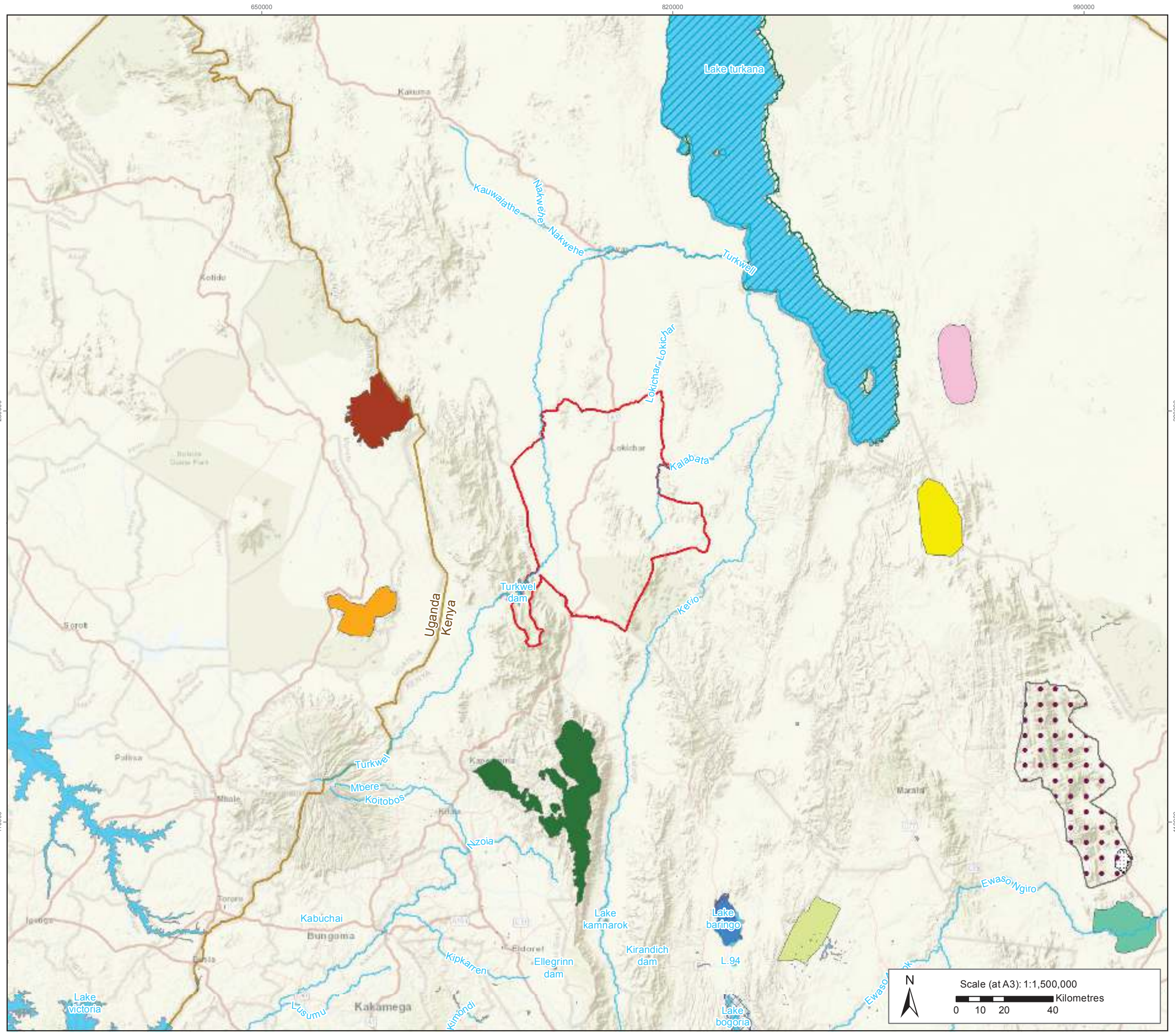
Drawing 6.9-4: Global Key Biodiversity Areas

Foundation Stage Development



Key

- Area of Influence (AoI)
- Watercourse

Global Key Biodiversity Area (KBA)

- Cherangani Hill
- Laikipia National Reserve
- Lake Baringo
- Lake Bogoria National Reserve
- Lake Turkana
- Matthews Range
- Mount Kadam
- Mount Kulal Forest
- Mount Moroto Forest Reserve
- Mount Nyiru Forest Reserve
- Ol Donyo Sabache
- Samburu and Buffalo Springs National Reserves

Data sources:
Base data available from Tullow and Worley Parsons. Surface water data islicensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).Key Biodiversity Areas available from IBAT 2018

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1433956	KP 18-11-2019	PK 18-11-2019	AM 18-11-2019

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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_109_Biodiversity\02_PRODUCTION\MXD\1433956_620_109_OG_661_KBAs_D004.mxd

Drawing 6.9-5: Ramsar Sites

Foundation Stage Development

Key

- RAMSAR Site
- Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Data sources:
Based data available from Tullow and Worley Parsons. Surface water data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1433956	KP 18-11-2019	PK 18-11-2019	AM 18-11-2019

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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

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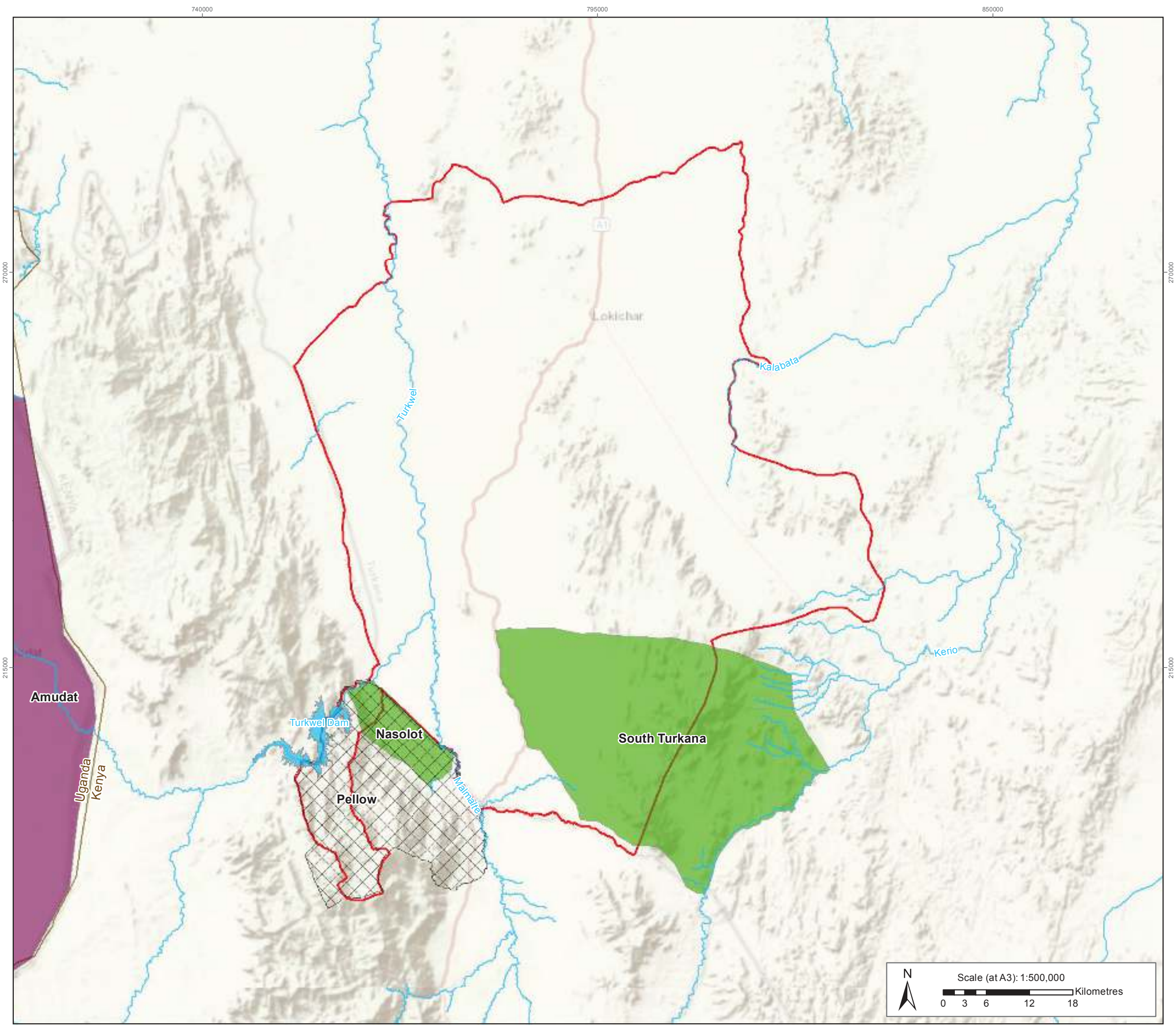

Drawing 6.9-6: Protected Areas

Foundation Stage Development

Key

- Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Protected Areas

- Community Wildlife Management Area
- National Reserve
- Community Conservancy

Data sources:
Based data available from Tullow and Worley Parsons.
Surface water data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).
Protected areas available from IBAT 2018 and Northern Rangelands Trust 2019

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1433956	KP 18-11-2019	PK 18-11-2019	AM 18-11-2019

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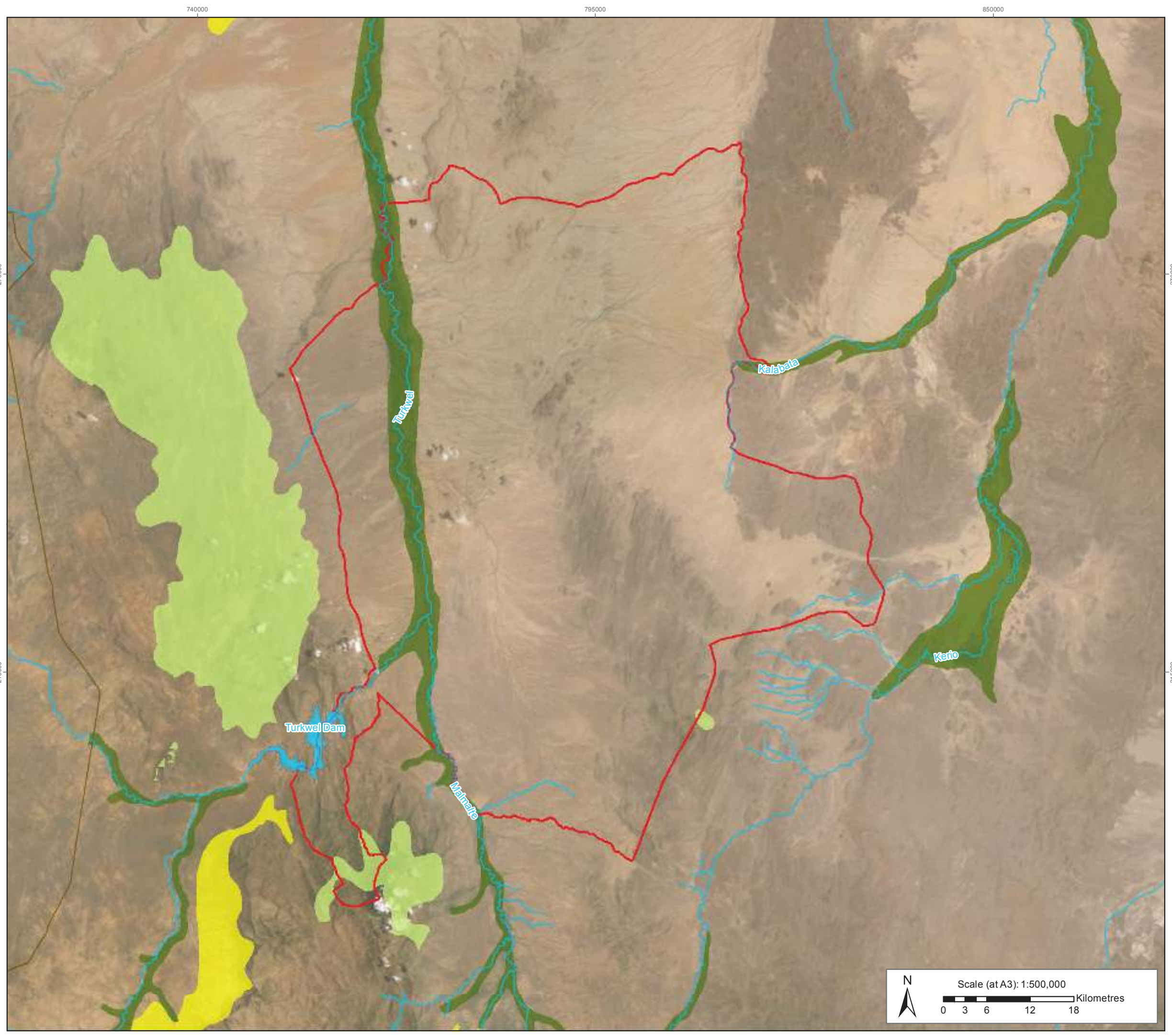
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_109_Biodiversity\02_PRODUCTION\MXD\1433956_620_109_OG_663_WDPA_D006.mxd



Drawing 6.9-7: Important Habitats

Foundation Stage Development

Key

- Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Important Habitats

- Acacia Tortilis Wooded Grassland
- Afromontane Undifferentiated Forest
- Riverine Wooded Vegetation

Data sources:
Based data available from Tullow and Worley Parsons.
Surface Water data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).
Vegetation data available from VECEA 2015

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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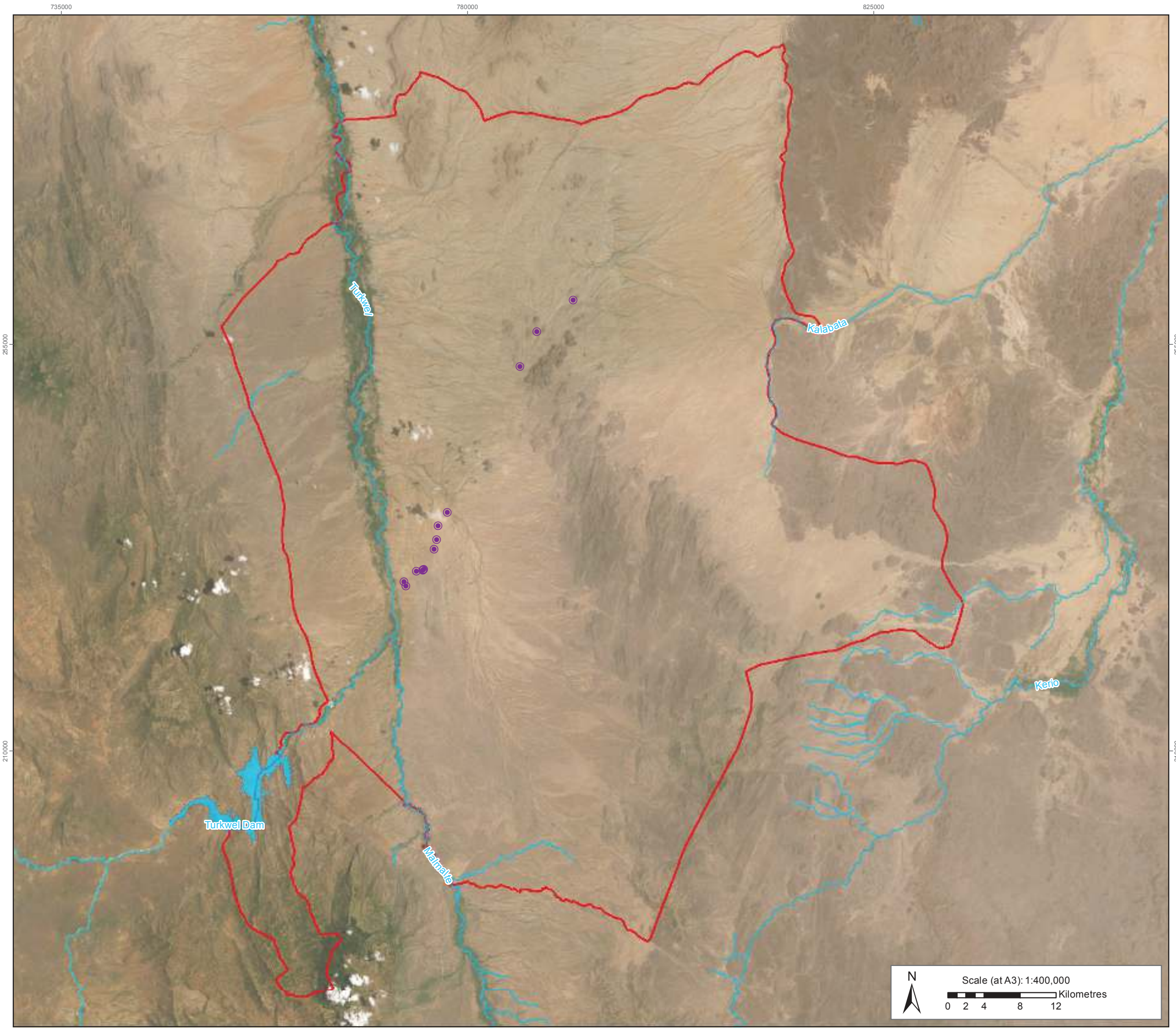
Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_109_Biodiversity\02_PRODUCTION\MXD\1433956_620_109_OG_664_Habitats_D007.mxd



Drawing 6.9-8: Locations of Euphorbia turkanesis colonies

Foundation Stage Development

Key

- Euphorbia Turkanensis
- Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Data sources:
Based data available from Tullow and Worley Parsons.
Surface water data islicensed under the Open Data Commons Open Database License (ODbL) by the Open StreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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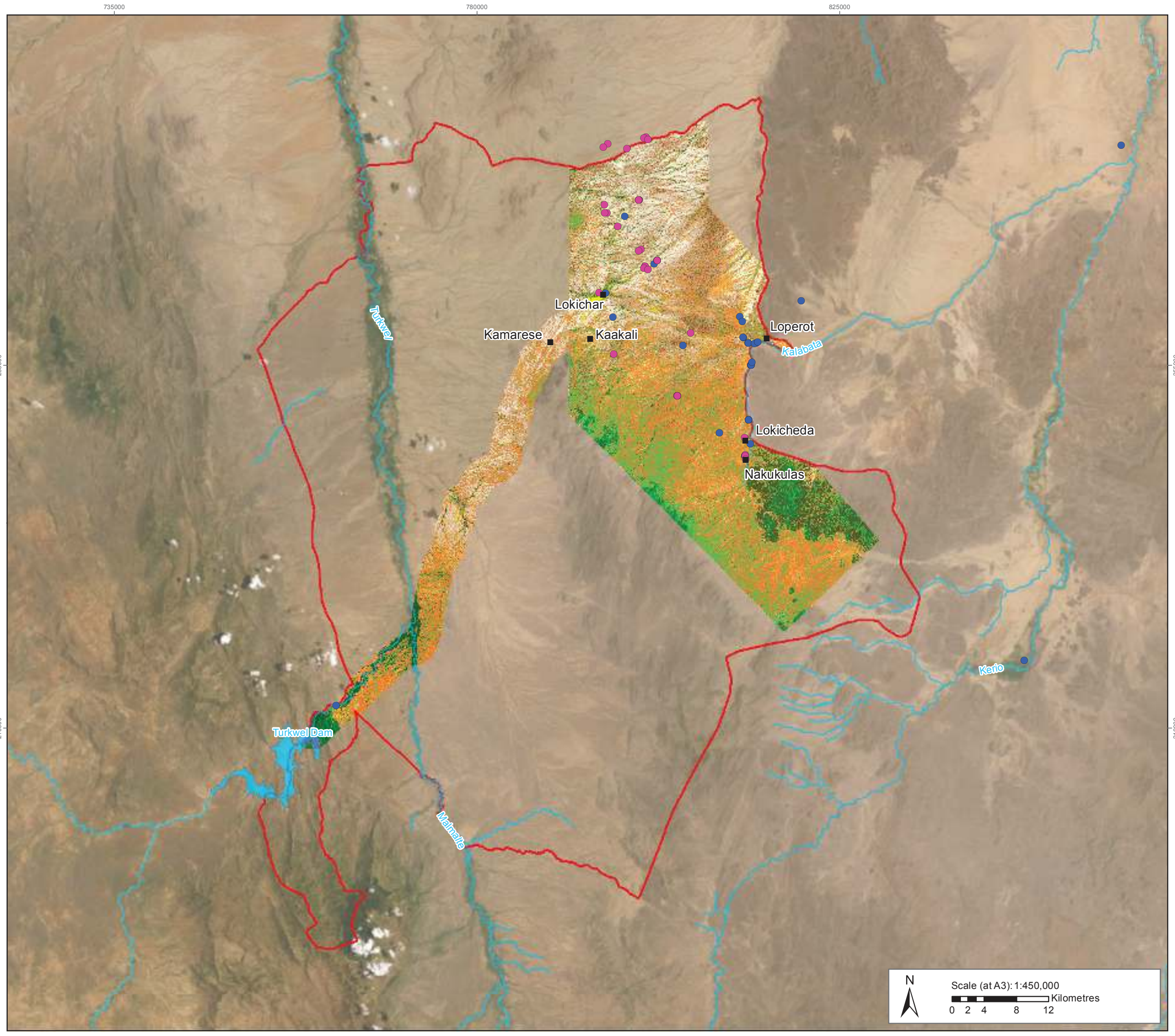
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_109_Biodiversity\02_PRODUCTION\MXD\1433956_620_109_OG_665_Turkanesis_D008.mxd



Drawing 6.10-1: Landcover Classification

Foundation Stage Development

Key

- Settlement
- Cultural Tree
- Hand-Dug Well
- Area of Influence (AoI)
- Waterbody
- Watercourse

Landcover Classification

- *Acacia* Dominated Forest (Tall Trees) Along Major Riparian Zone
- All Cultivated Land, Including Both Currently Active and Old, Long Term Fallow / Abandoned Field
- *Acacia* and Other Spp Dominated Forest (Tall Trees) Along Major Riparian Zone
- Dense Bush and/or Taller Shrub (Most Dense Bush Dominated Class), on Mountain or Rocky Hill
- Dense Bush and/or Taller Shrub (But Less Dense Than Dense Bush Class #1, on Mountain or Rocky Hill
- Dense Bush and/or Taller Shrub (But Less Dense Than Dense Bush Class #2, on Mountain or Rocky Hill
- Dense Bush and/or Taller Shrubs (But Less Dense Than Dense Bush Class #3: Least Dense, But More Dense Than Open Bush Classes), on Mountains or Rocky Hills
- Dense Low Shrub and/or Grass Cover, With Only A Few Bushe, on Mountain or Rocky Hill
- Dense Tree and Tall Bush Combination Class, on Mountain or Rocky Hill
- Grass Dominated Areas, With Only A Few Trees, Bush or Shrub, on Mountain or Rocky Hill
- Open and/or Scattered Bush and Shrub Cover, on Mountain or Rocky Hill.
- Open and/or Scattered Bush and/or Shrub, on Mountain or Rocky Hill
- Sparse to Open Grass Cover Area, Typically Containing Scattered Bush and Shrub, on Mountain or Rocky Hill
- Sparse Low Shrub and/or Grass Cover, With only A Few Bushes on Mountains or Rocky Hill
- Sparse Non-Riparian Woodland Cover on Plain
- Dense Non-Riparian Woodland Cover on Plain
- Open Non-Riparian Woodland Cover on Plain
- Open / Semi-Dense Non-Riparian Woodland Cover on Plain
- Low Shrubland on Plains, Dense Cover
- Medium Height Shrubland on Plain, Dense Cover
- Low or Tall Shrubland On Plains, Sparse Cover
- Tall Shrubland on Plains, Dense Cover
- Riparian Woodland (not Closed Canopy, Taller Forest) Along Major Riparian Zone
- Non-Vegetated Bare Sand
- All Settlement and Built-up Areas In the Extended Western Pipe Transect, this Includes Small "kraal" Concentrations as Well as Established Settlements and Built-up Area
- Water in Lake and Major River System
- Shallow Water in Pan System

Data sources:
Base data sourced from Tullow. Surface data is licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).Landcover data available from GeoTerraImage (GTI) Pty Ltd.

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1433956	KP 18-11-2019	PK 18-11-2019	AM 18-11-2019

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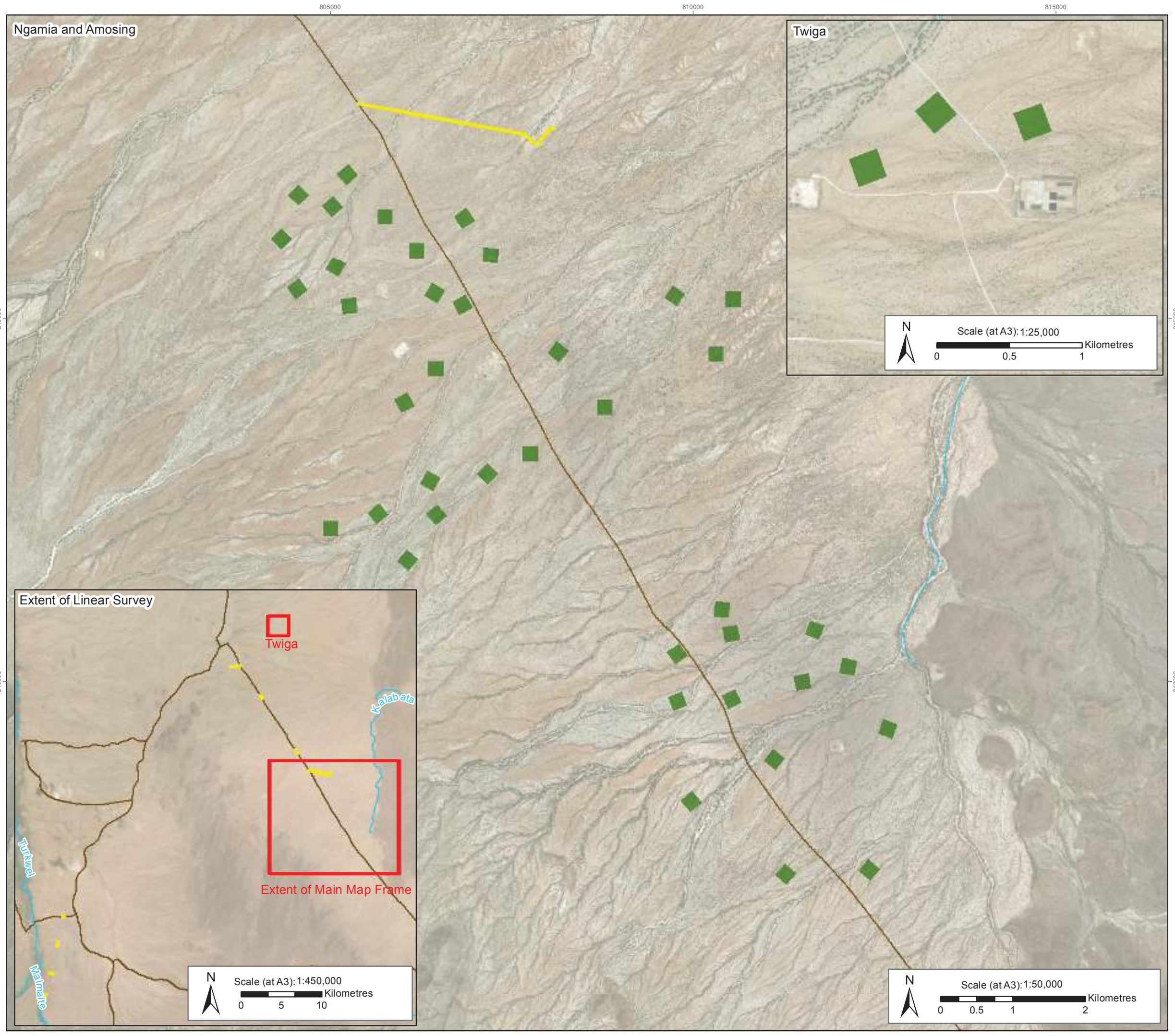
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_110_Ecosystem_Services\02_PRODUCTION\MXD\1433956_620_110_OG_685_Biodiversity_D001.mxd



Drawing 6.13-1 - Cultural Heritage - Primary Data Gathering Survey Locations

Foundation Stage Development

Key

- Extent of Linear Survey
- Surveyed Area
- Existing Road
- Watercourse

Note: Excludes survey coverage of Turkwel Survey.
Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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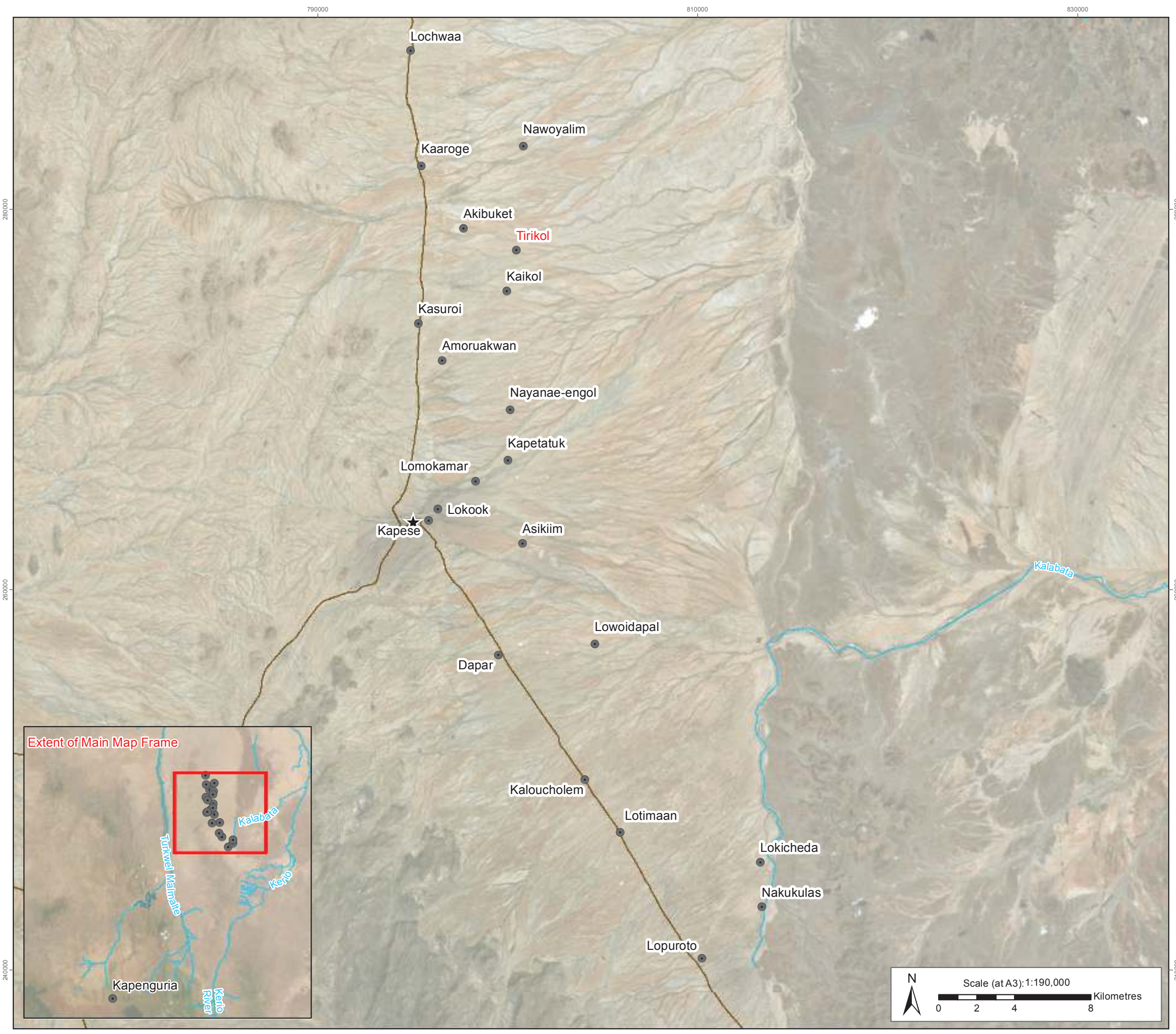

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Drawing 6.13-2 - Cultural Heritage - Locations for KIIs

Foundation Stage Development

Key

- Settlement
- Lokichar
- Existing Road
- Watercourse

*KII not completed at Tirikol as no elders present

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

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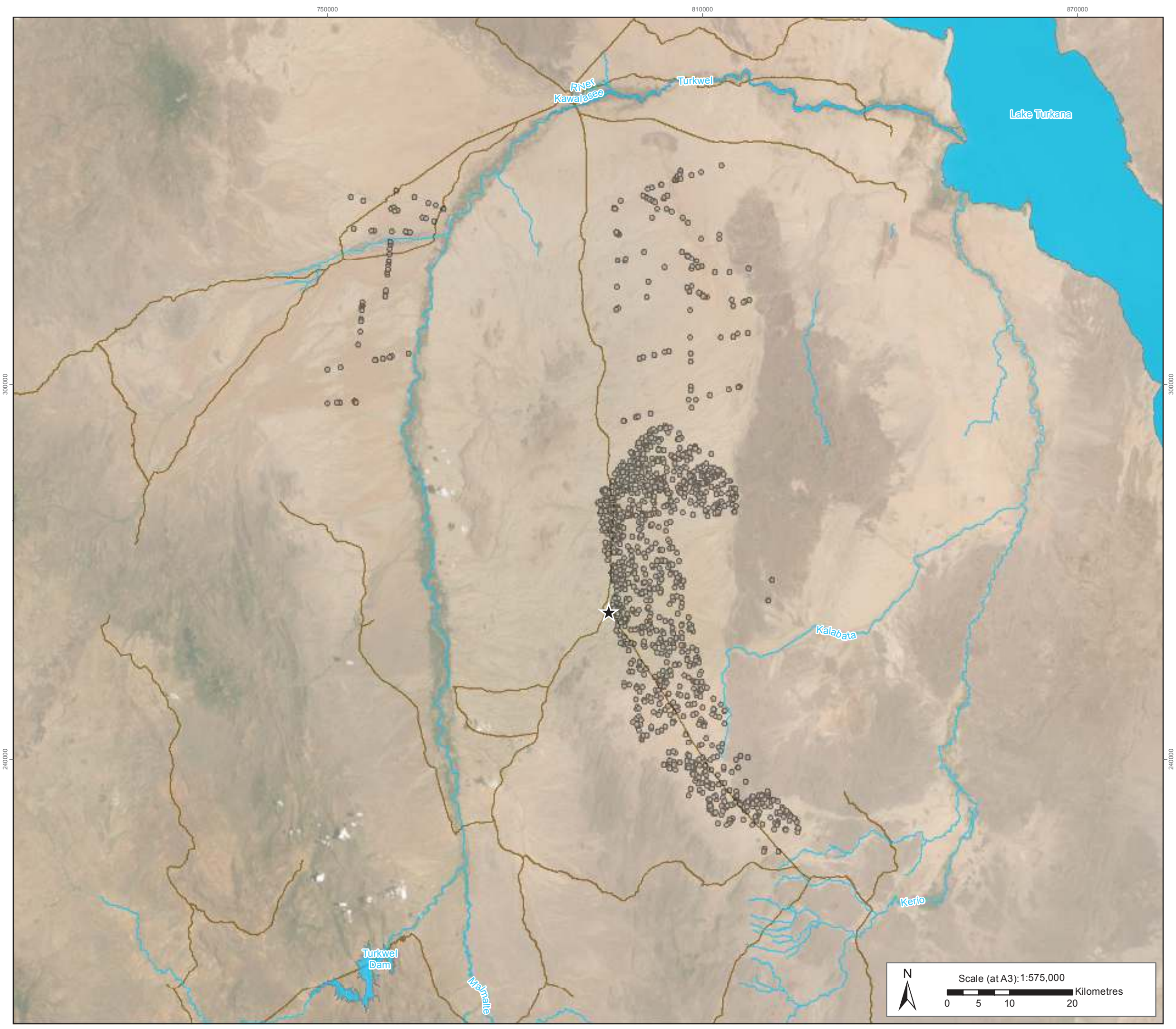

Drawing 6.13-3 - Cultural Heritage - All Known Assets from Secondary Data

Foundation Stage Development

Key

- Cultural Heritage Asset
- Lokichar
- Existing Road
- Waterbody
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
Cultural Heritage data from NMK
Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

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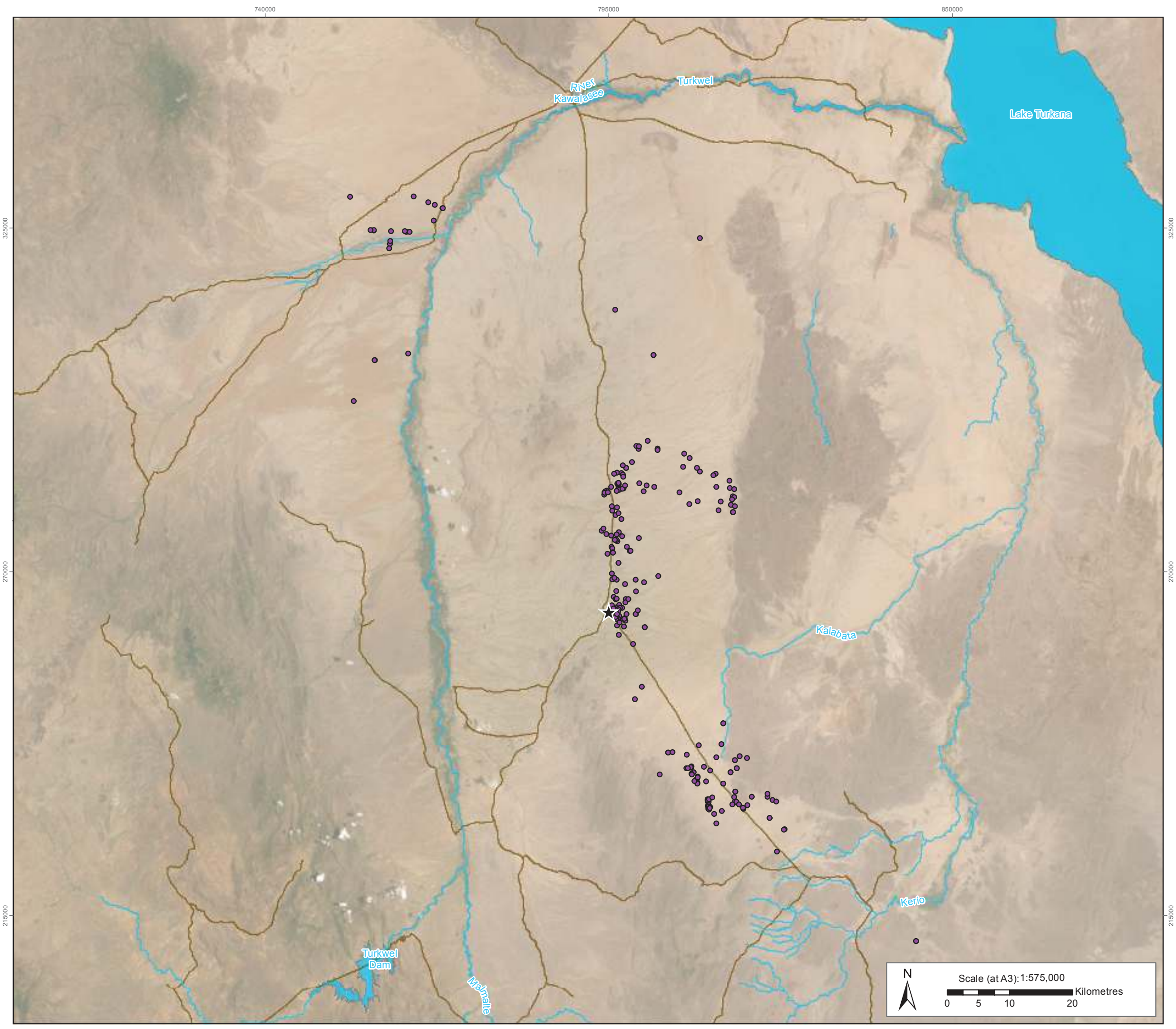
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Upstream_ESIA\99_PROJECTS\1433956\1433956_620_113_CH\02_PRODUCTION\MXD\1433956_620_113_OG_605_Secondary_Data_All_Assets.mxd

Drawing 6.13-4 - Cultural Heritage - Secondary Data - Known Burials



Foundation Stage Development

Key

- Burial
- Lokichar
- Existing Road
- Waterbody
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
Cultural Heritage data from NMK
Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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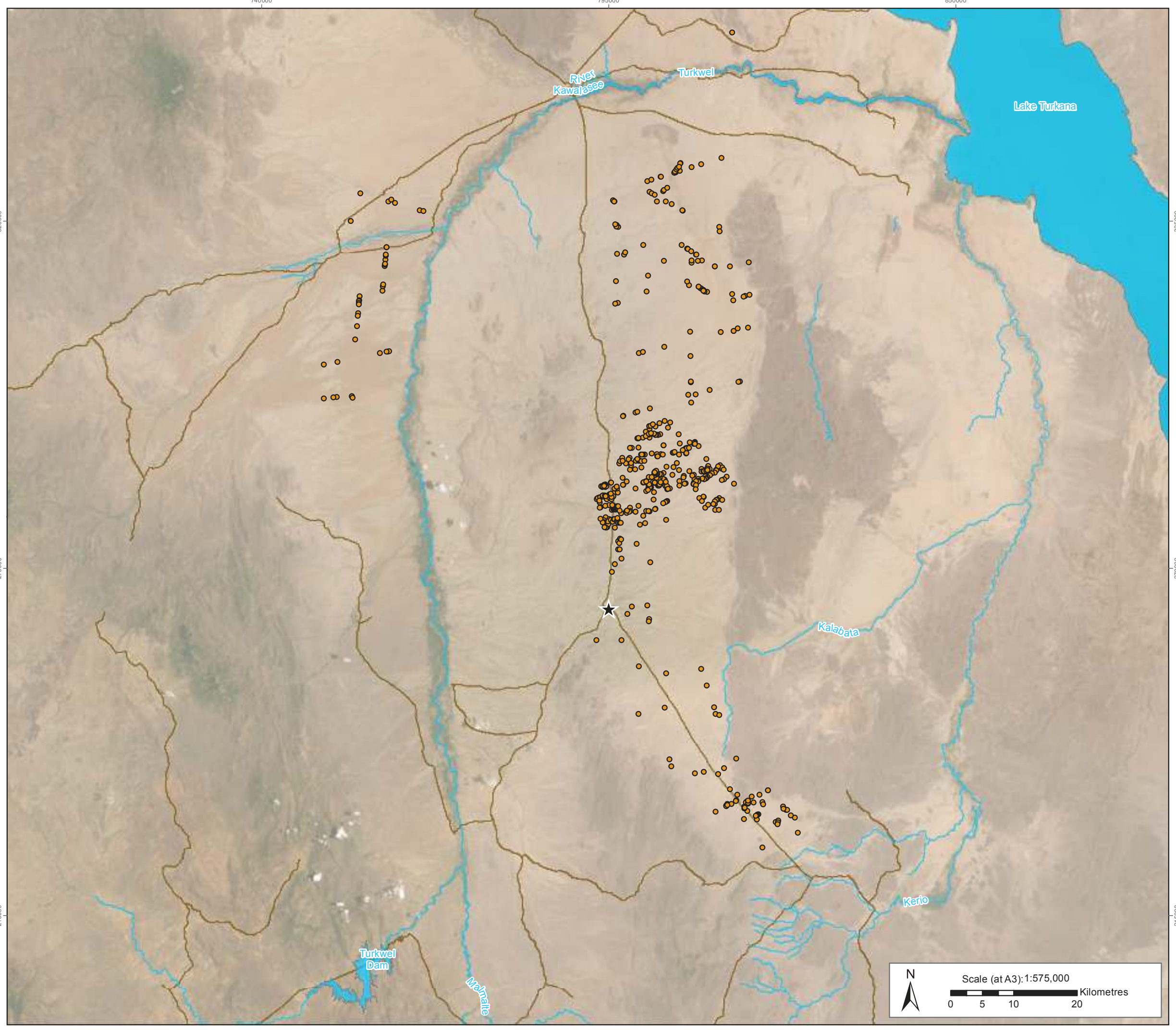

Drawing 6.13-5 - Cultural Heritage - Secondary Data - Lithic Remains

Foundation Stage Development

Key

- Lithic Remains
- Lokichar
- Existing Road
- Waterbody
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
Cultural Heritage data from NMK
Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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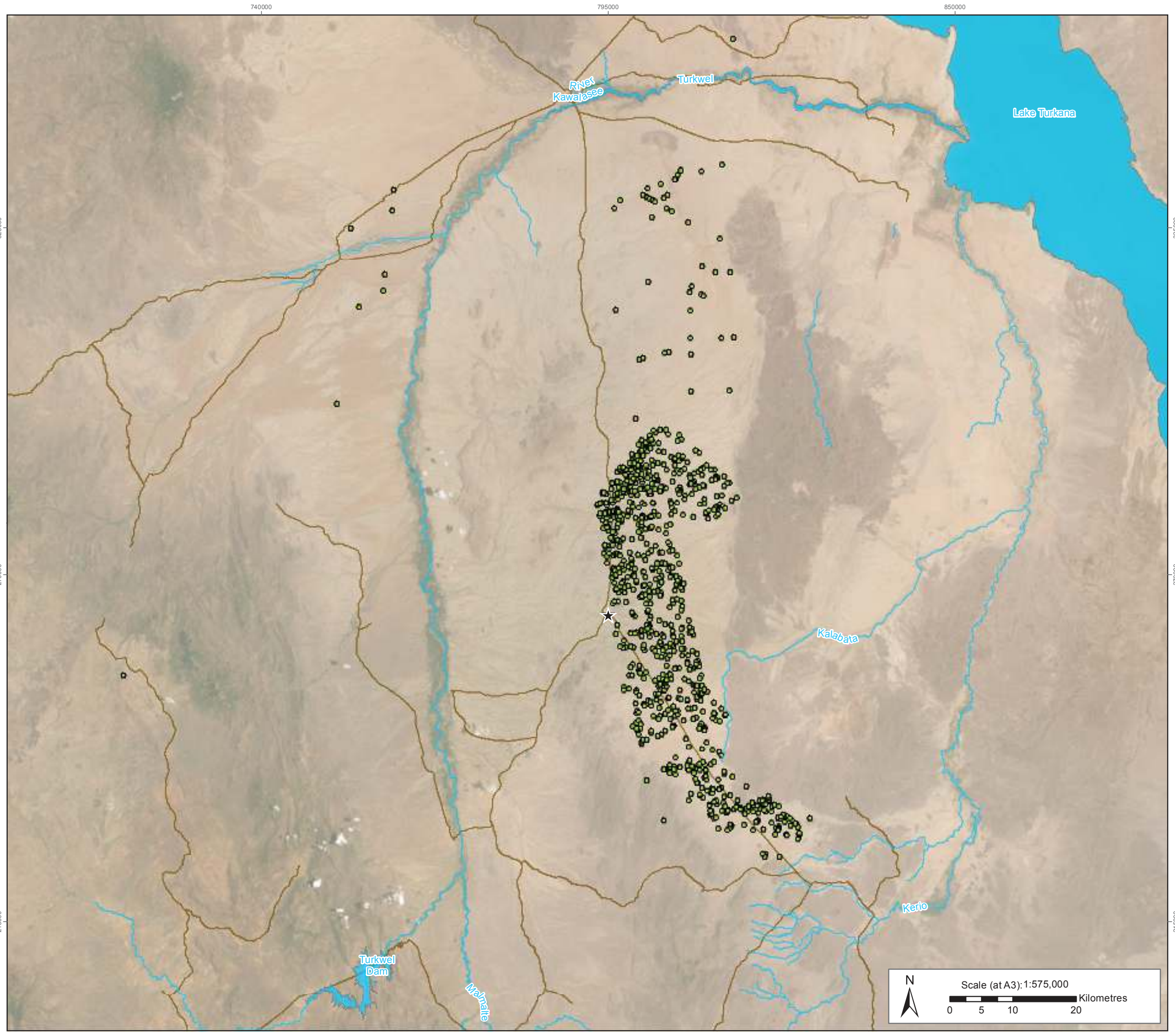

Drawing 6.13-6 - Cultural Heritage - Secondary Data - Pottery

Foundation Stage Development

Key

- Pottery
- Lokichar
- Existing Road
- Waterbody
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
Cultural Heritage data from NMK
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Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

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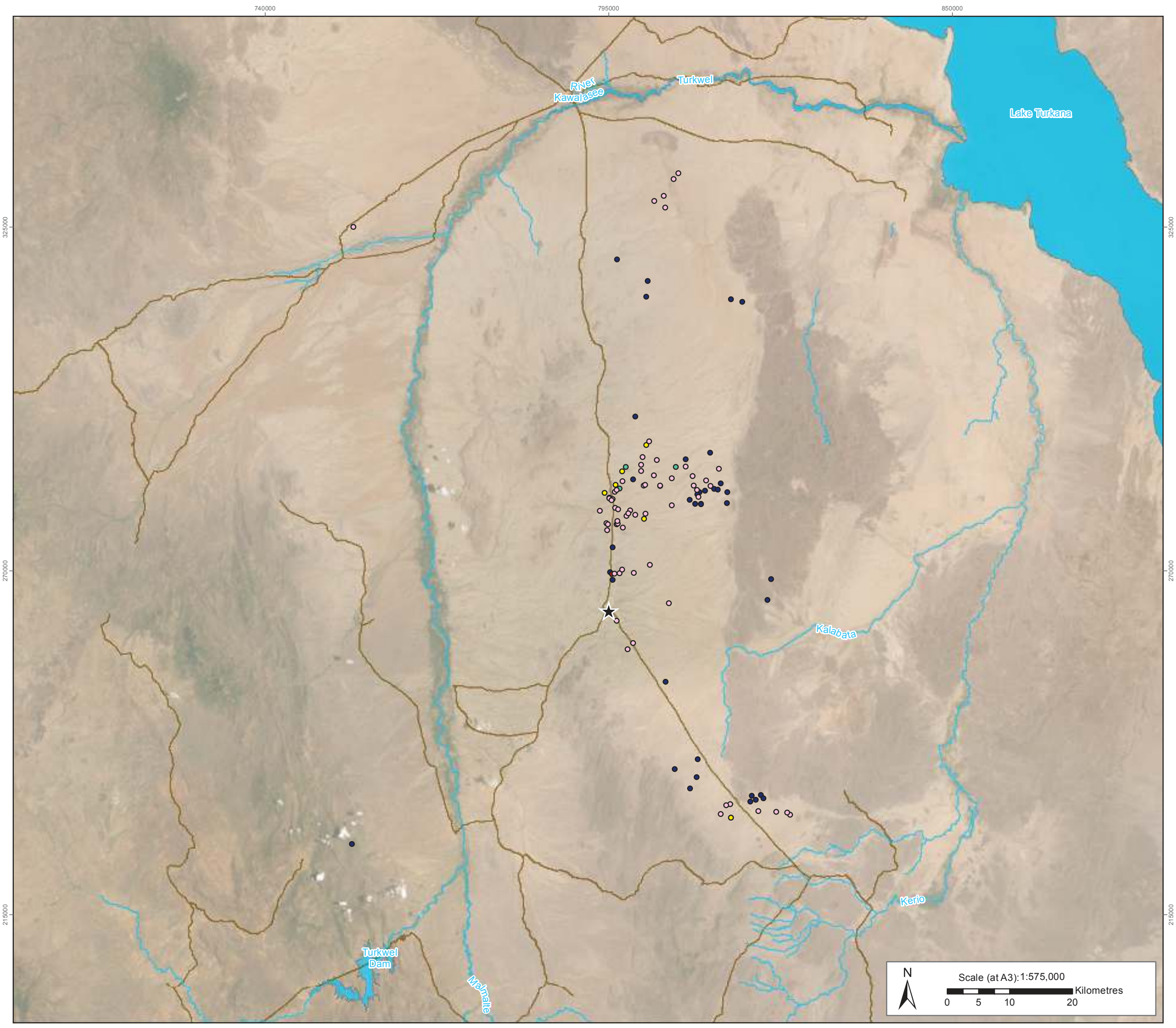

Drawing 6.13-7 - Cultural Heritage - Secondary Data - Other Assets

Foundation Stage Development

Key

- Faunal
- Grindstone
- Jewellery
- Monument
- Palaeontological
- Lokichar
- Existing Road
- Waterbody
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow Cultural Heritage data from NMK
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Coordinate System: WGS 1984 UTM Zone 36N

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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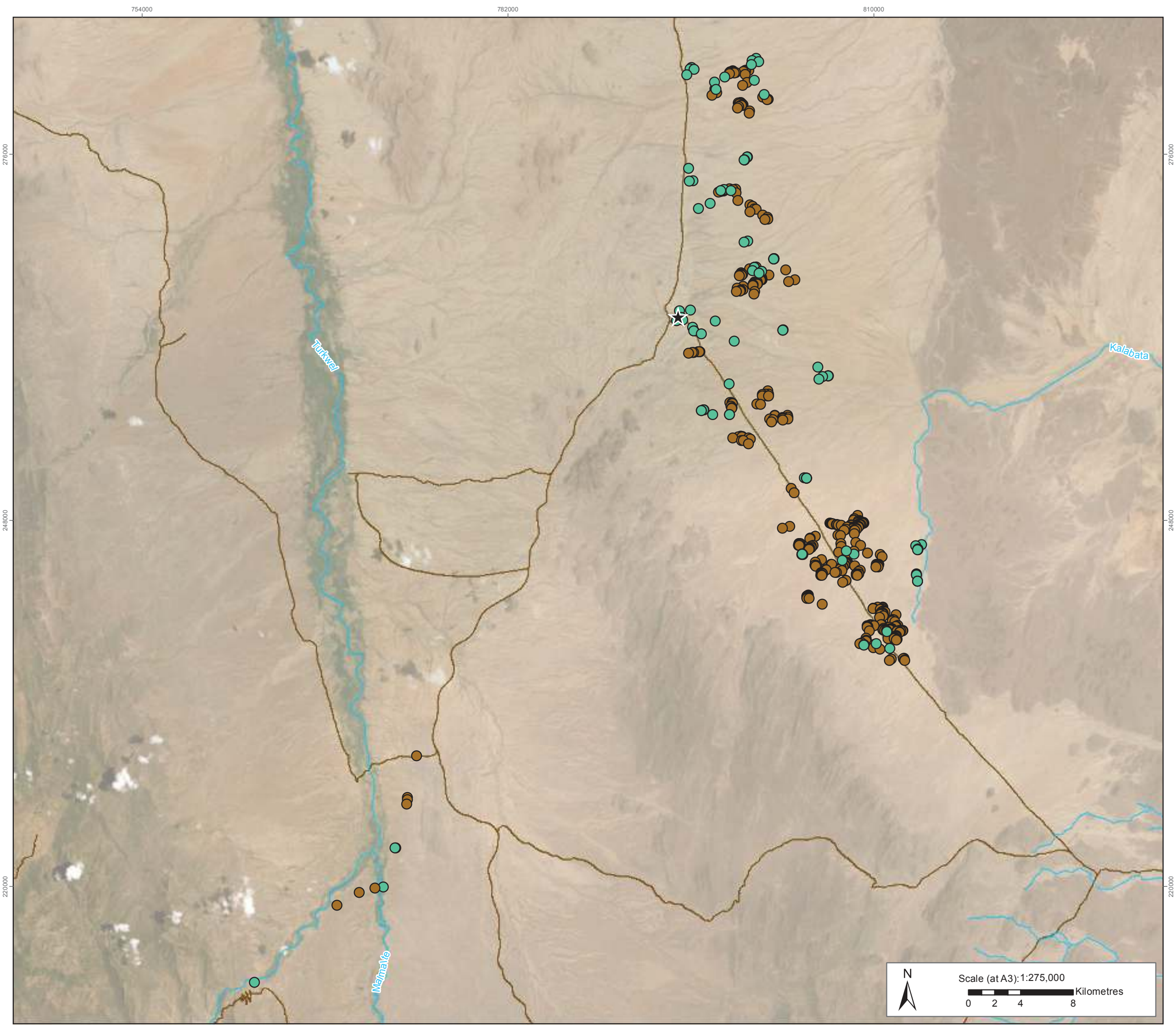

Drawing 6.13-8 - Cultural Heritage - All Known Assets from Primary Data Gathering

Foundation Stage Development

Key

- Archaeology
- Living Cultural Heritage (CH)
- Lokichar
- Existing Road
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

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1433956	CR 16-09-2019	CR 16-09-2019	AM 16-09-2019

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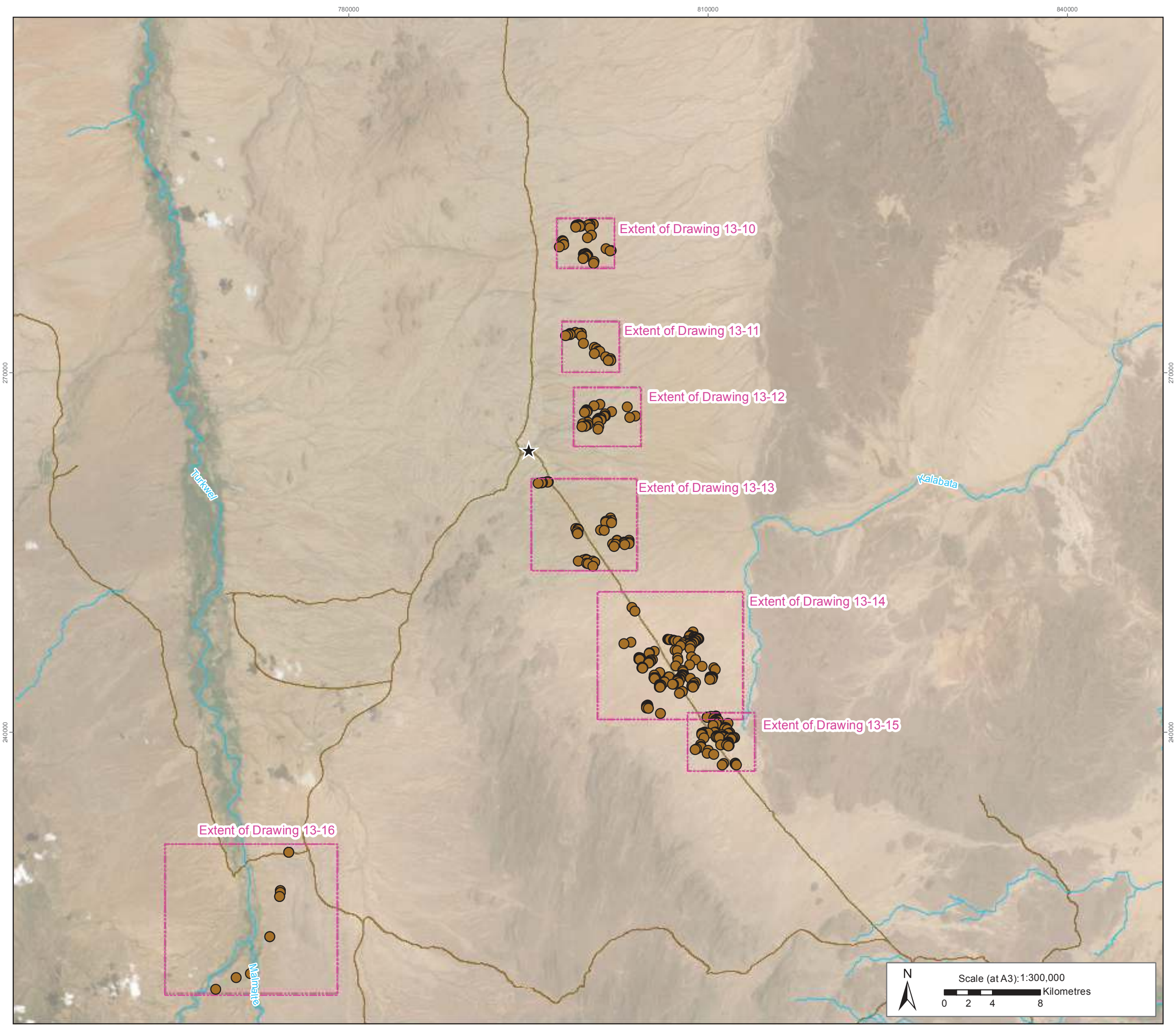
Drawing 6.13-9 - Cultural Heritage - Primary Data - Archaeology (Key Map)

Foundation Stage Development



Key

- Archaeology Asset
- Lokichar
- Existing Road
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
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Coordinate System: WGS 1984 UTM Zone 36N

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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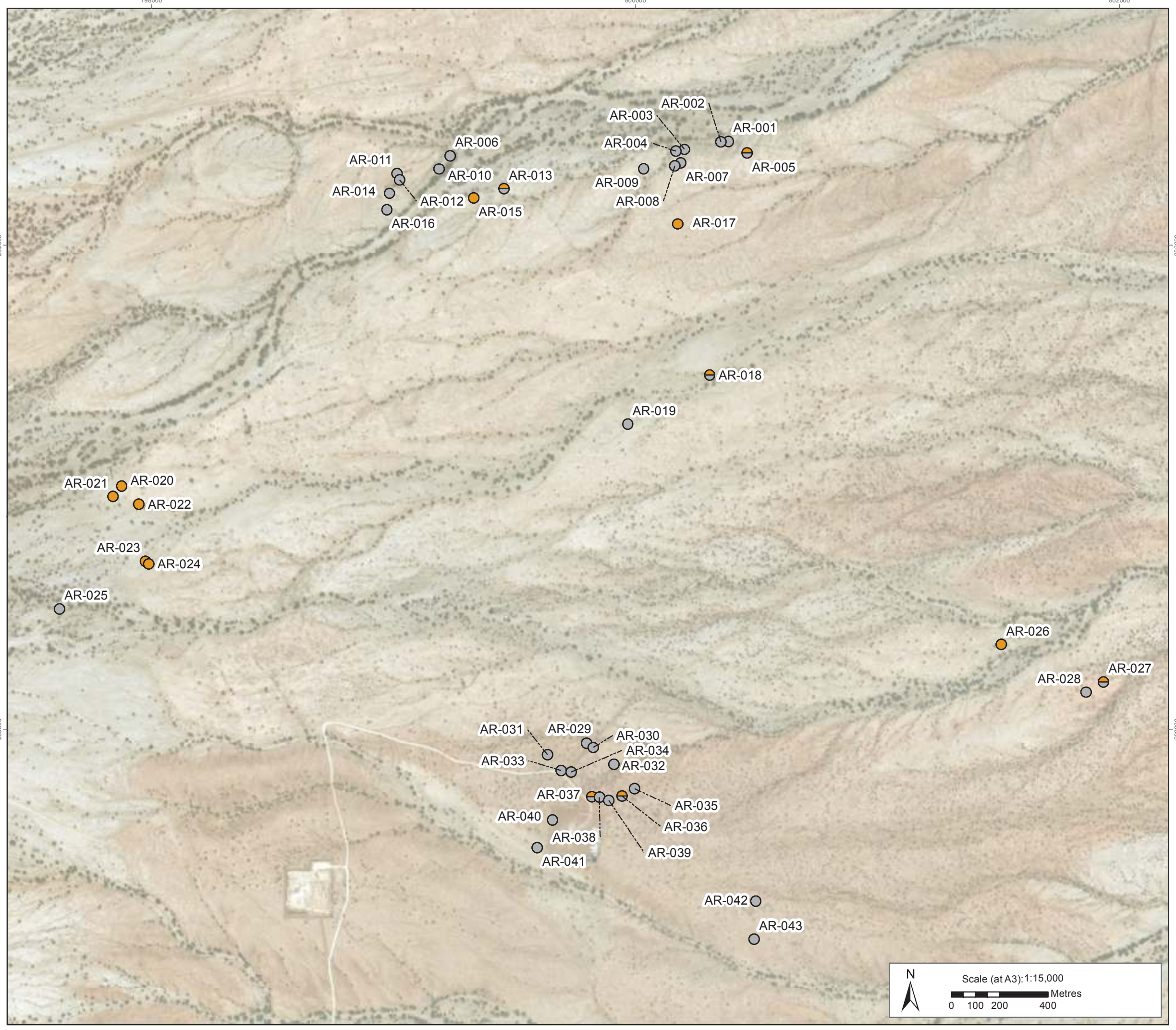

Drawing 6.13-10 - Cultural Heritage - Primary Data - Archaeology (Etom)

Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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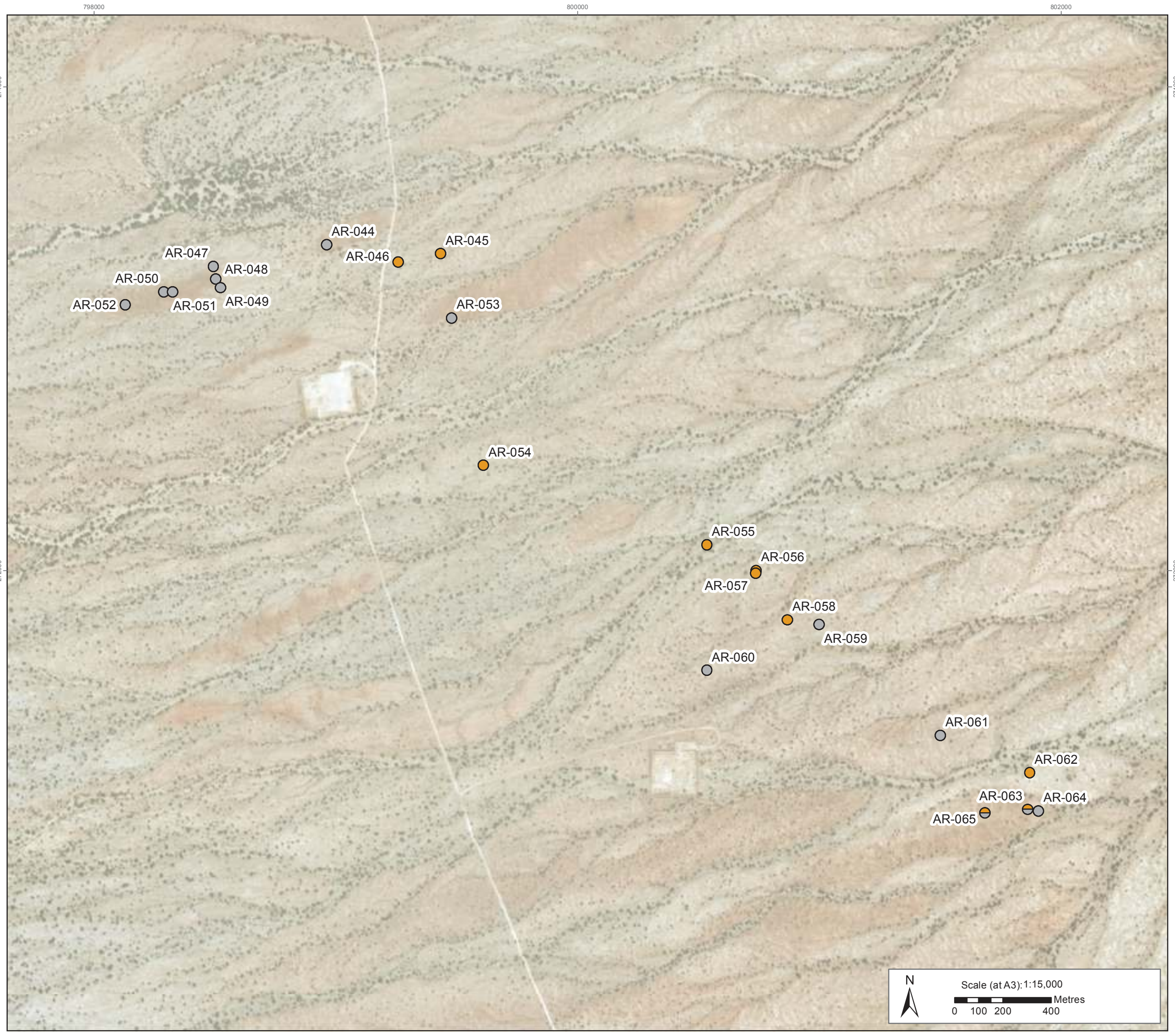

Drawing 6.13-11 - Cultural Heritage - Primary Data - Archaeology (Agete)

Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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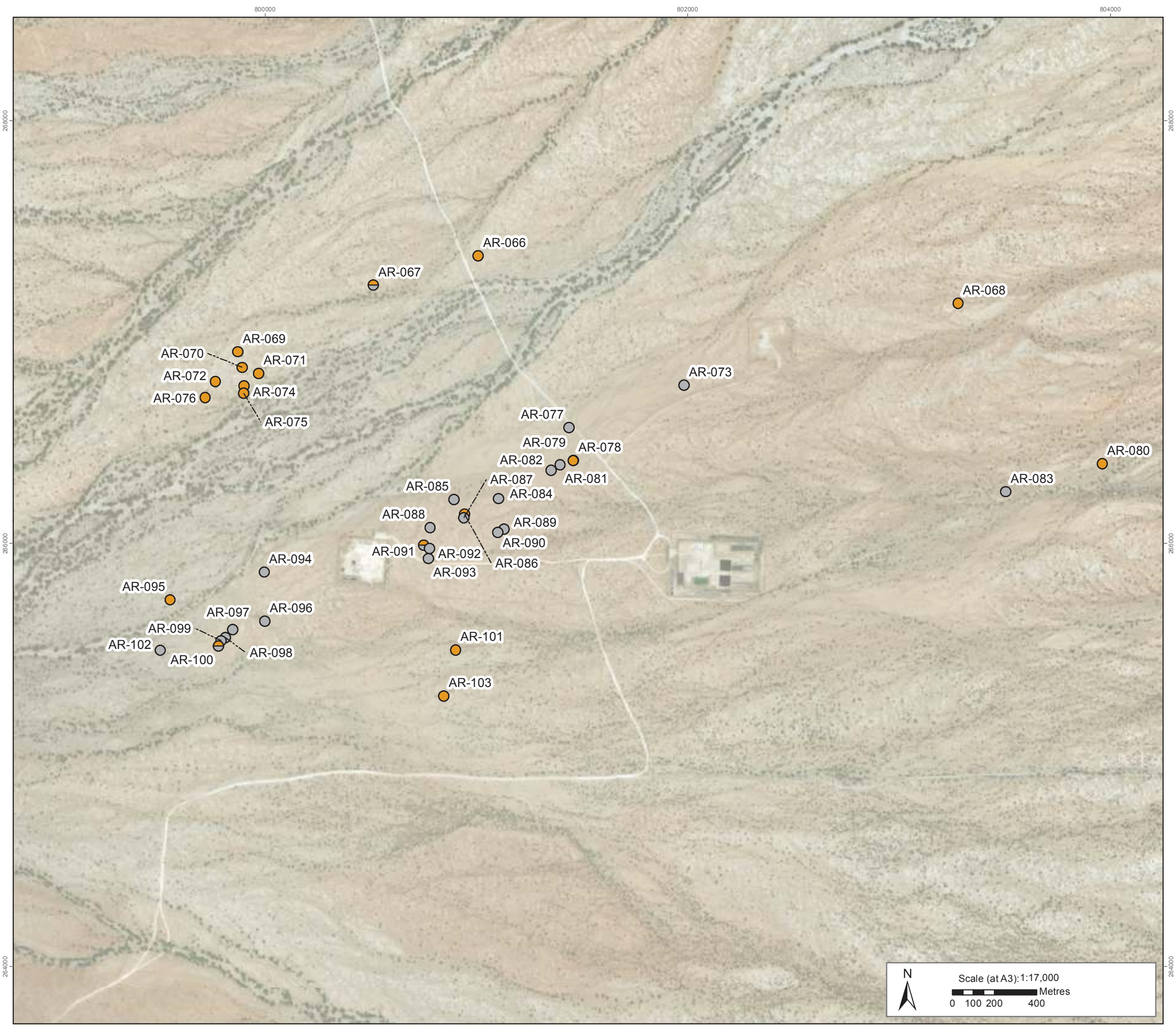

Drawing 6.13-12 - Cultural Heritage - Primary Data - Archaeology (Twiga)

Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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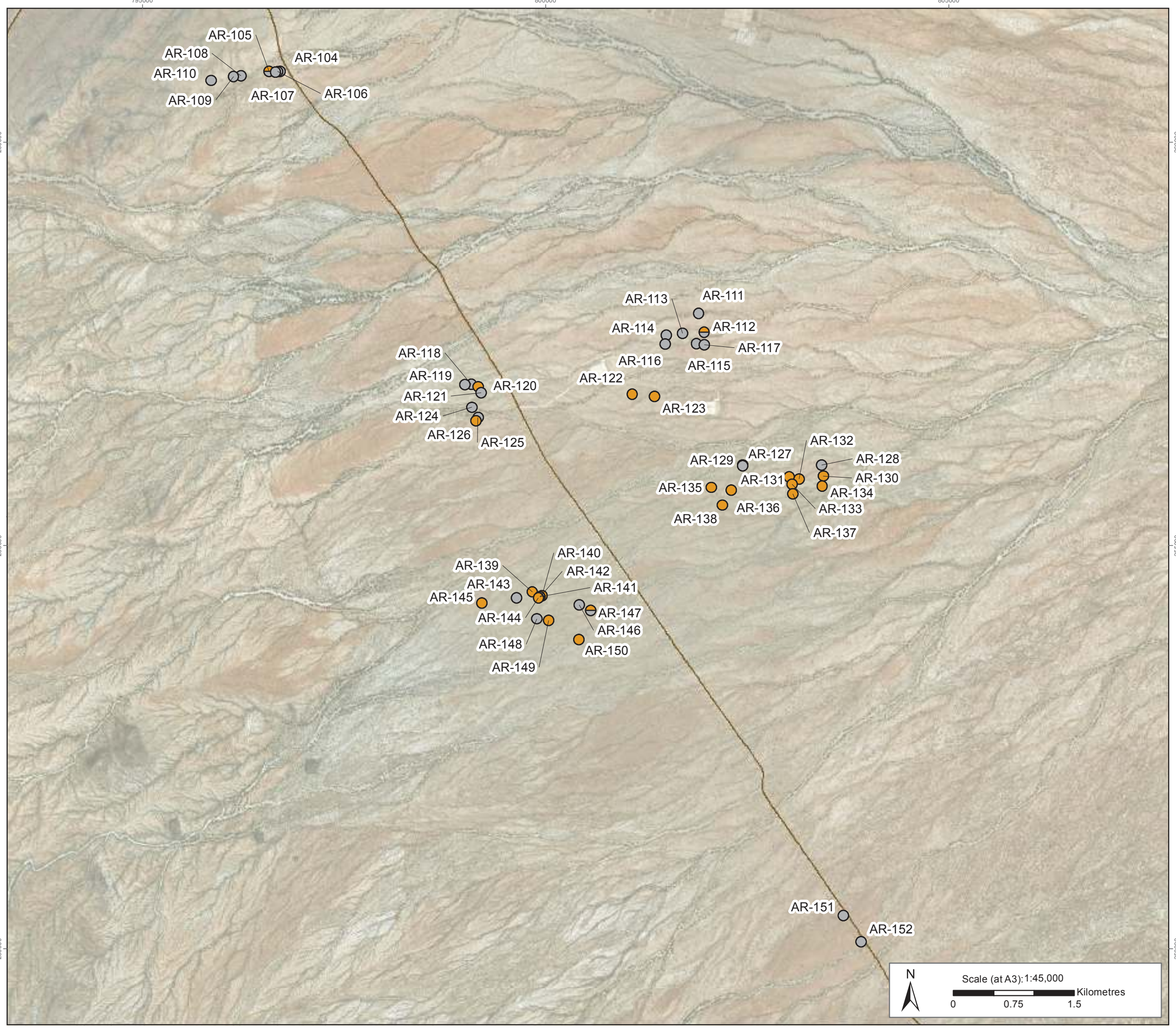

Drawing 6.13-13 - Cultural Heritage - Primary Data - Archaeology (Ekales)

Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery
- Existing Road

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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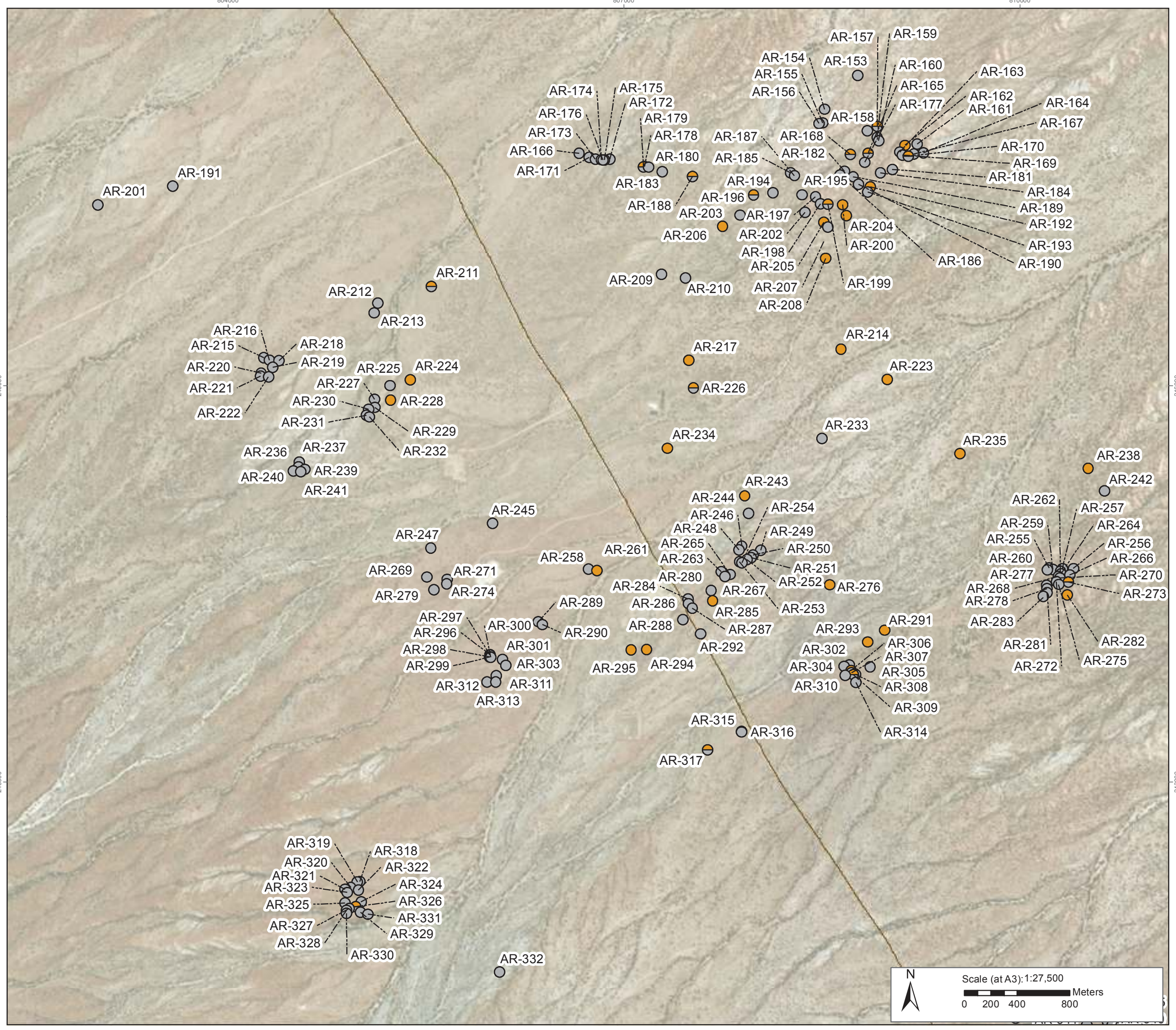

Drawing 6.13-14 - Cultural Heritage - Primary Data - Archaeology (Ngamia)

Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery
- Existing Road

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

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Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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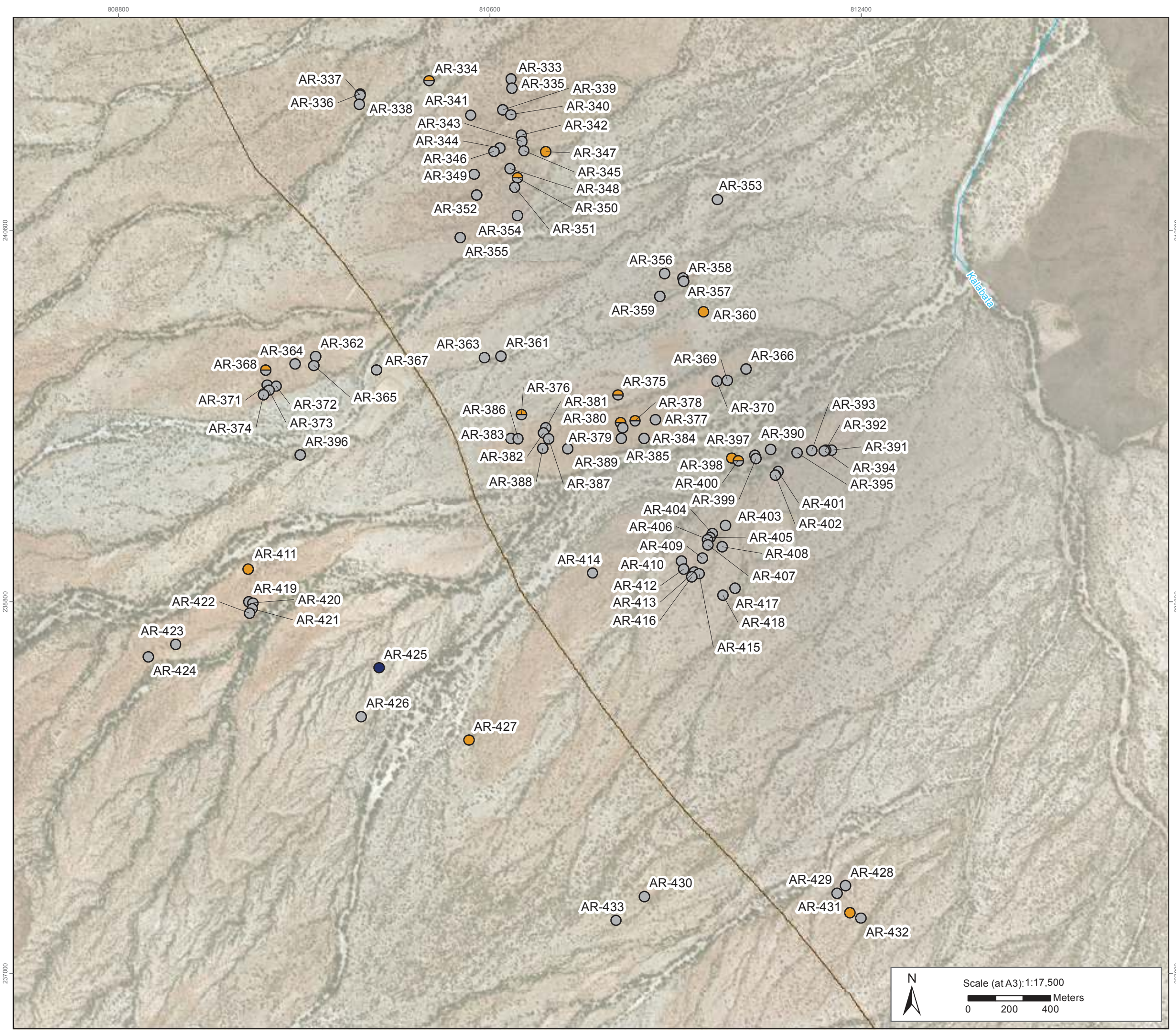

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Drawing 6.13-15 - Cultural Heritage - Primary Data - Archaeology (Amosing)

Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery
- Existing Road
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

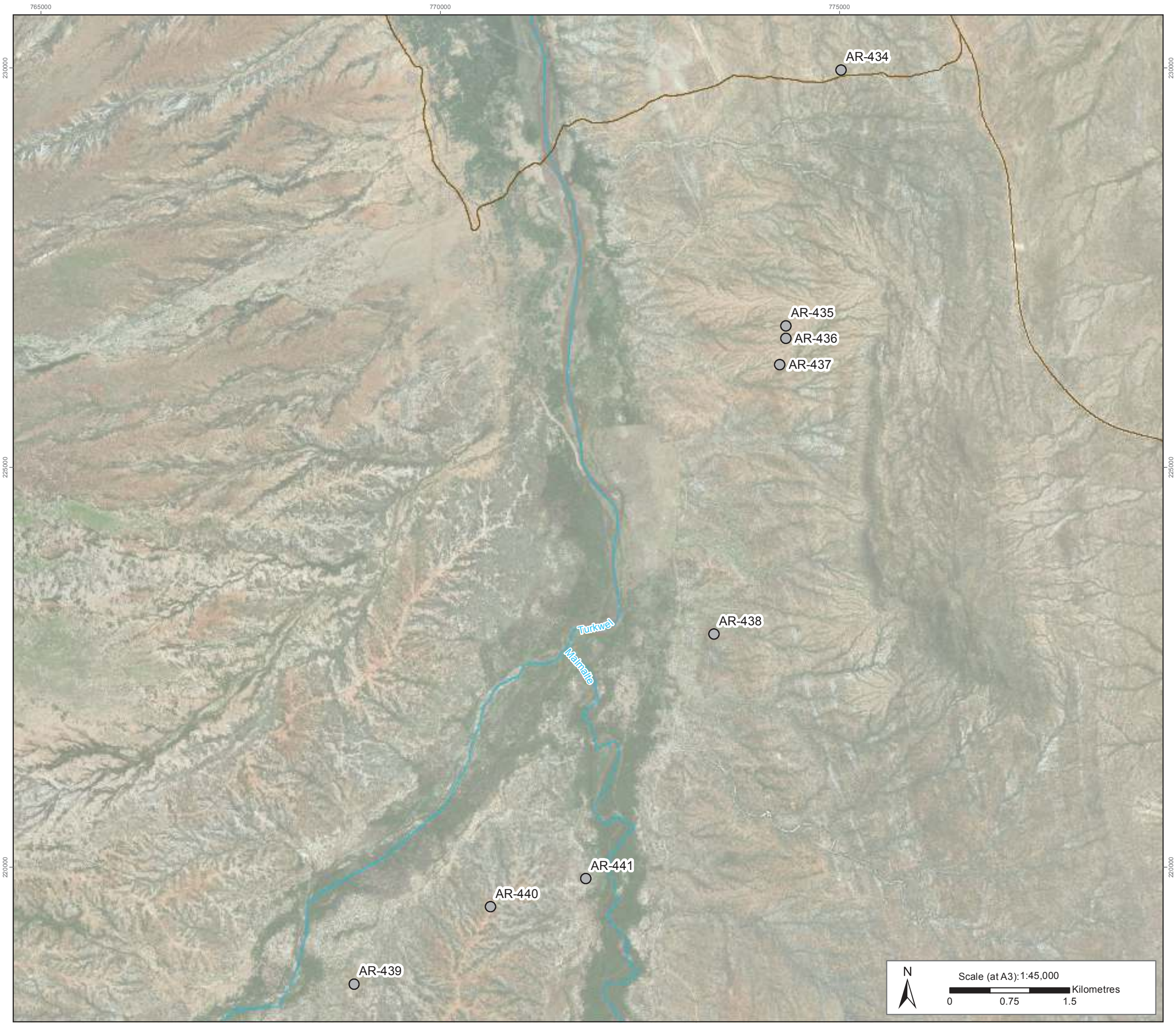
Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Drawing 6.13-16 - Cultural Heritage - Primary Data - Archaeology (Malmalte)



Foundation Stage Development

Key

Archaeological Asset

- Pottery
- Lithic
- Palaeontological
- Jewellery
- Existing Road
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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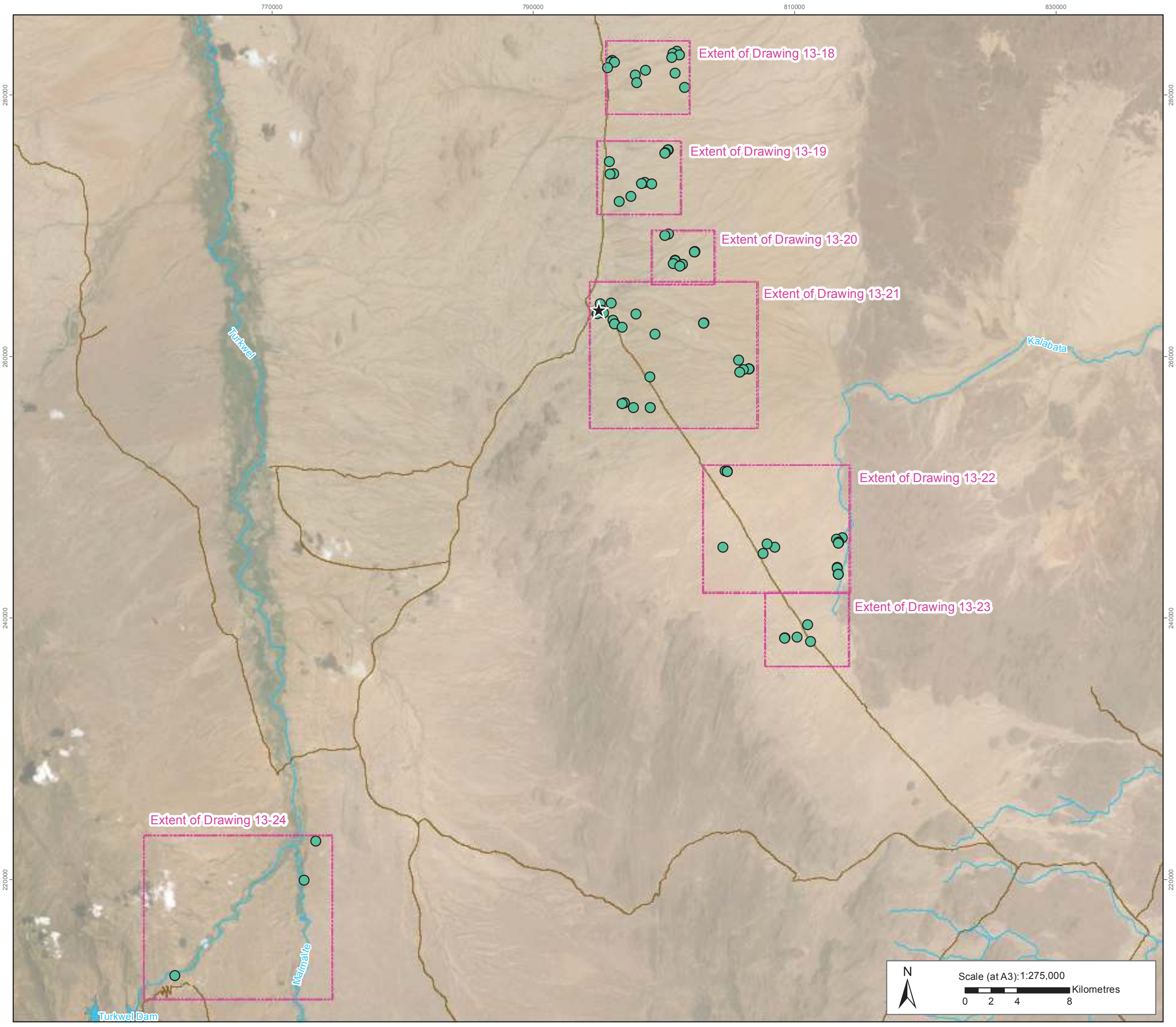

Drawing 6.13-17 - Cultural Heritage - Primary Data - Living Cultural Heritage (Key Map)

Foundation Stage Development

Key

- Living Cultural Heritage (CH)
- Lokichar
- Existing Road

Watercourse

- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow Surface water data licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref: 1433956	Prepared By: CR 18-11-2019	Reviewed By: PW 18-11-2019	Approved by: AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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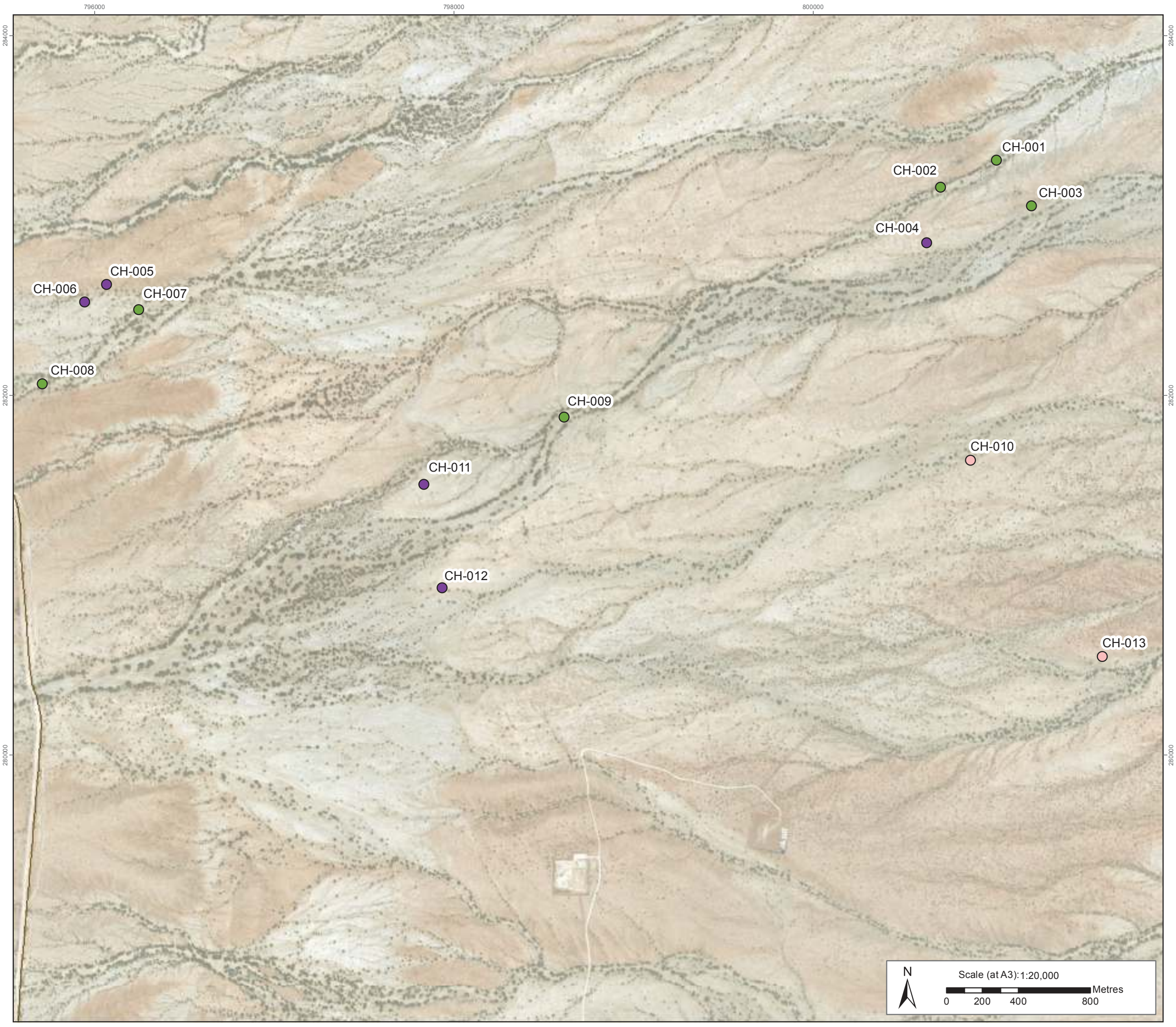

Drawing 6.13-18 - Cultural Heritage - Primary Data - Living Cultural Heritage (Etom)

Foundation Stage Development

Key

- Grave/Burial
- Meeting Tree
- Fire Pit
- Religious Building
- Living Cultural Heritage Other
- Existing Road

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2018

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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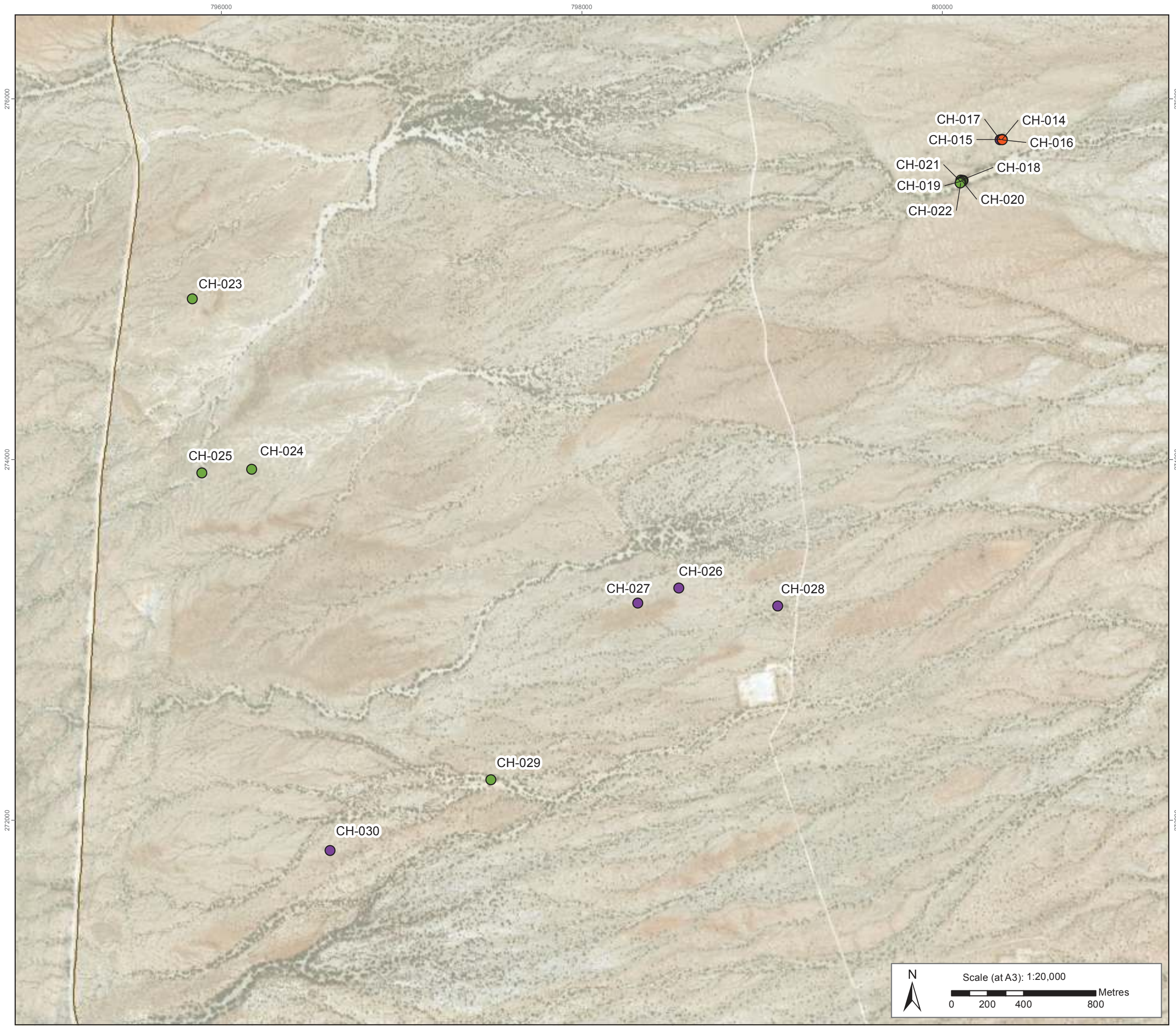

Drawing 6.13-19 - Cultural Heritage - Primary Data - Living Cultural Heritage (Agete)

Foundation Stage Development

Key

- Grave/Burial
- Meeting Tree
- Fire Pit
- Religious Building
- Living Cultural Heritage Other
- Existing Road

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

TULLOW OIL plc

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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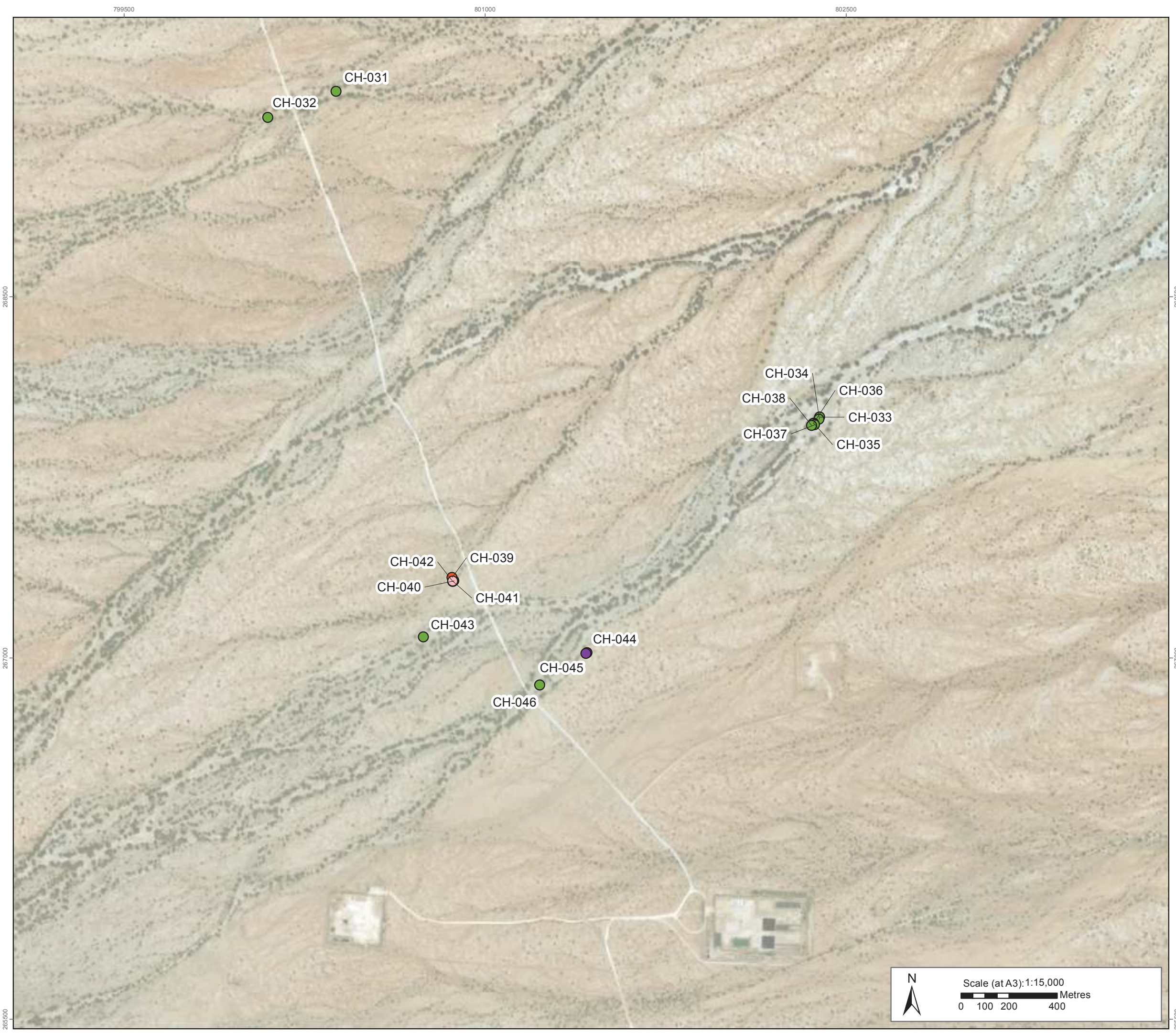
Drawing 6.13-20 - Cultural Heritage - Primary Data - Living Cultural Heritage (Twiga)

Foundation Stage Development



Key

- Grave/Burial
- Meeting Tree
- Fire Pit
- Religious Building
- Living Cultural Heritage Other

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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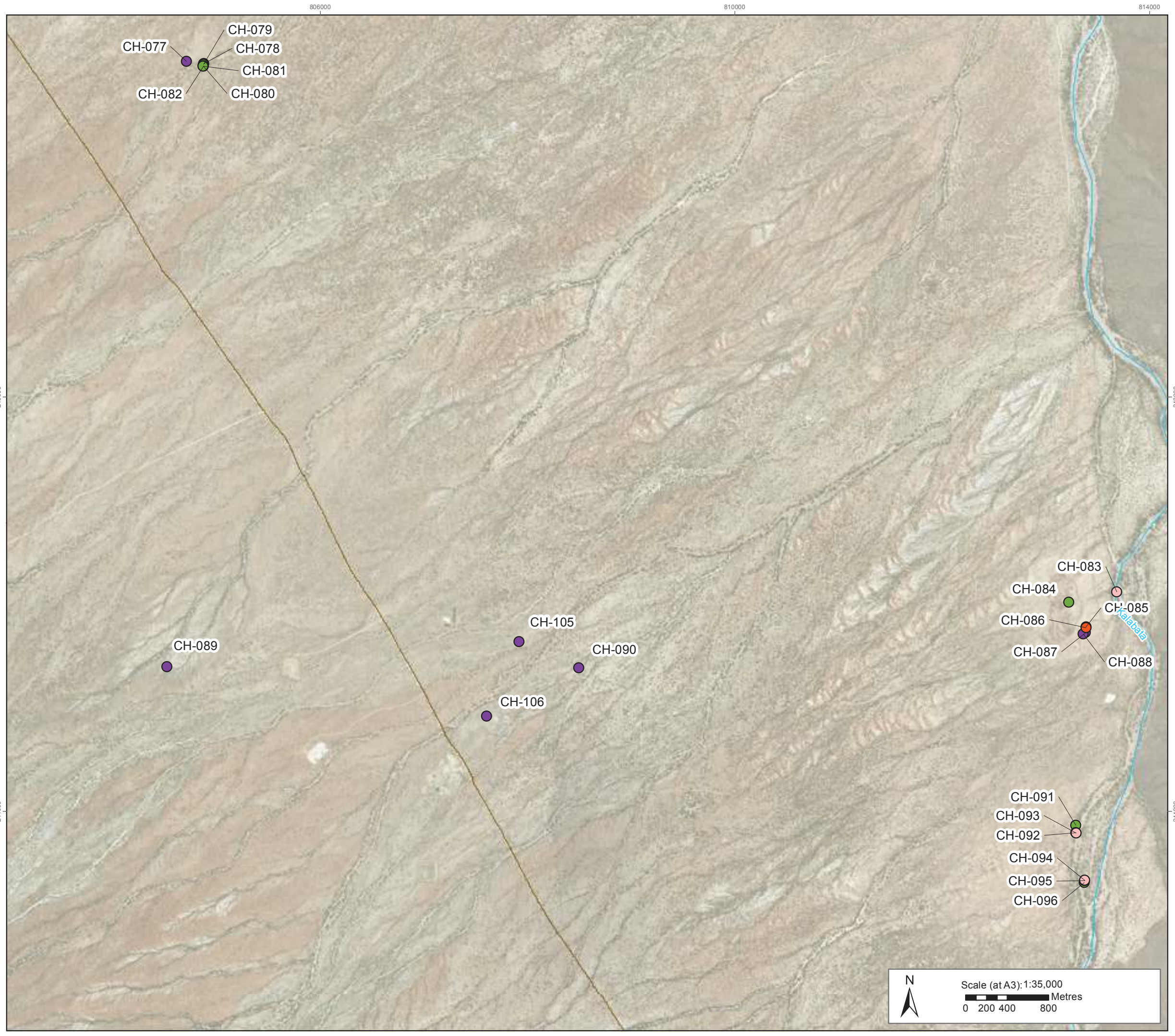

Drawing 6.13-22 - Cultural Heritage - Primary Data - Living Cultural Heritage (Ngamia)

Foundation Stage Development

Key

- Grave/Burial
- Meeting Tree
- Fire Pit
- Religious Building
- Living Cultural Heritage Other
- Existing Road
- Watercourse

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
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Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
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GOLDER
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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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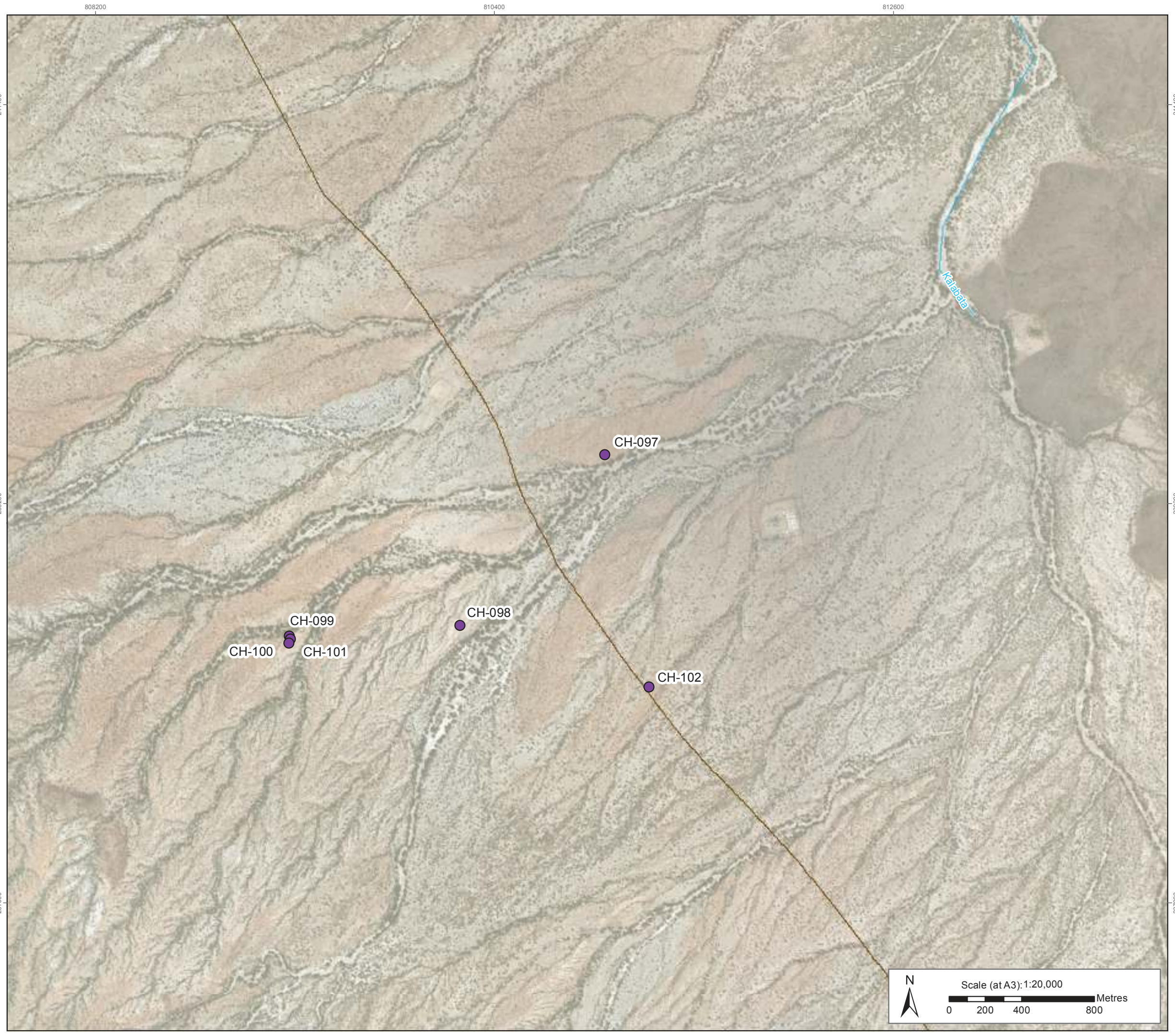

Drawing 6.13-23 - Cultural Heritage - Primary Data - Living Cultural Heritage (Amosing)

Foundation Stage Development

Key

- Grave/Burial
- Existing Road

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow
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Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

TULLOW OIL plc

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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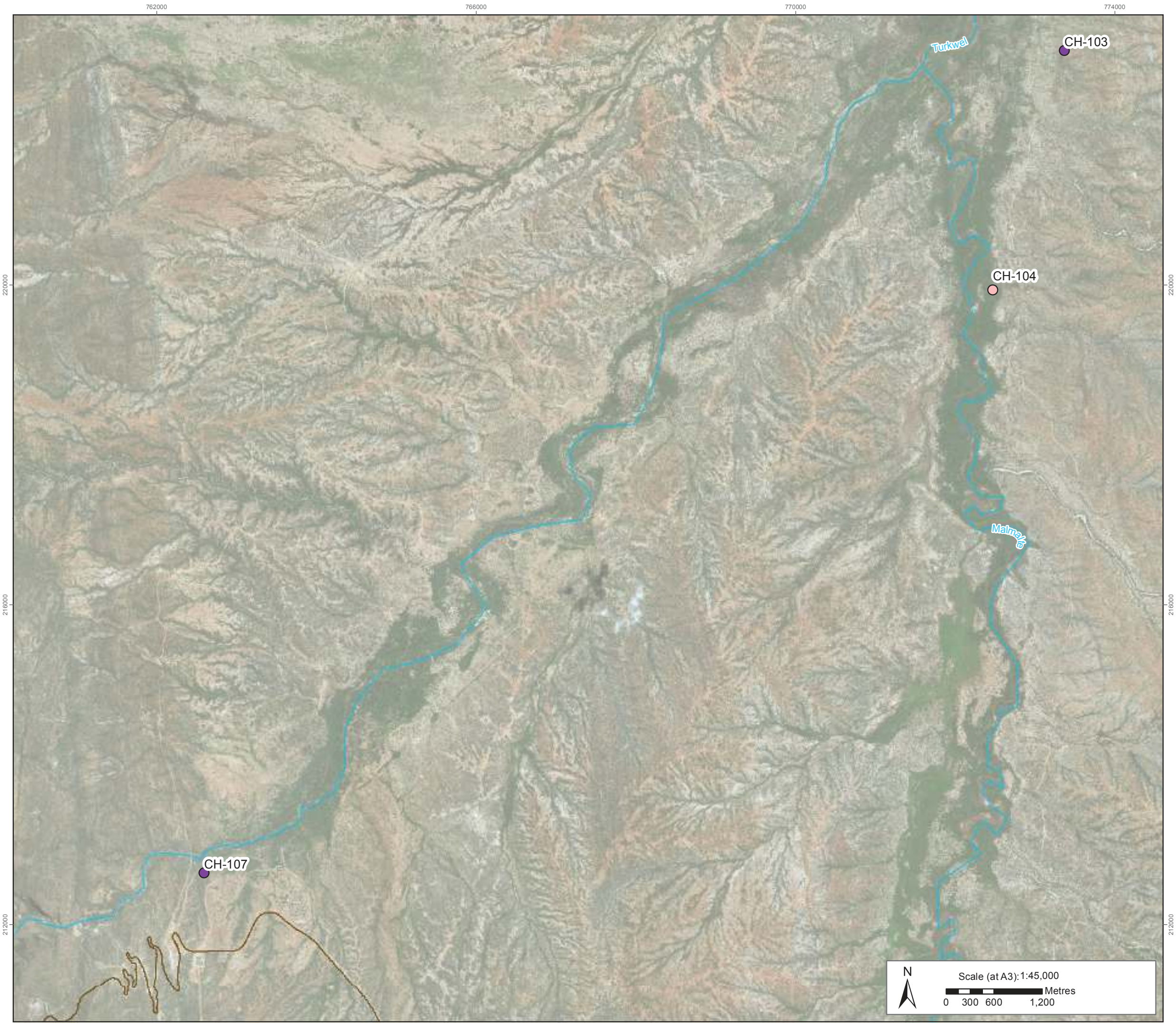

Drawing 6.13-24 - Cultural Heritage - Primary Data - Living Cultural Heritage (Malmalte)

Foundation Stage Development

Key

- Grave/Burial
- Living Cultural Heritage Other
- Existing Road

Data sources:
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Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared By:	Reviewed By:	Approved by:
1433956	CR 18-11-2019	PW 18-11-2019	AM 18-11-2019

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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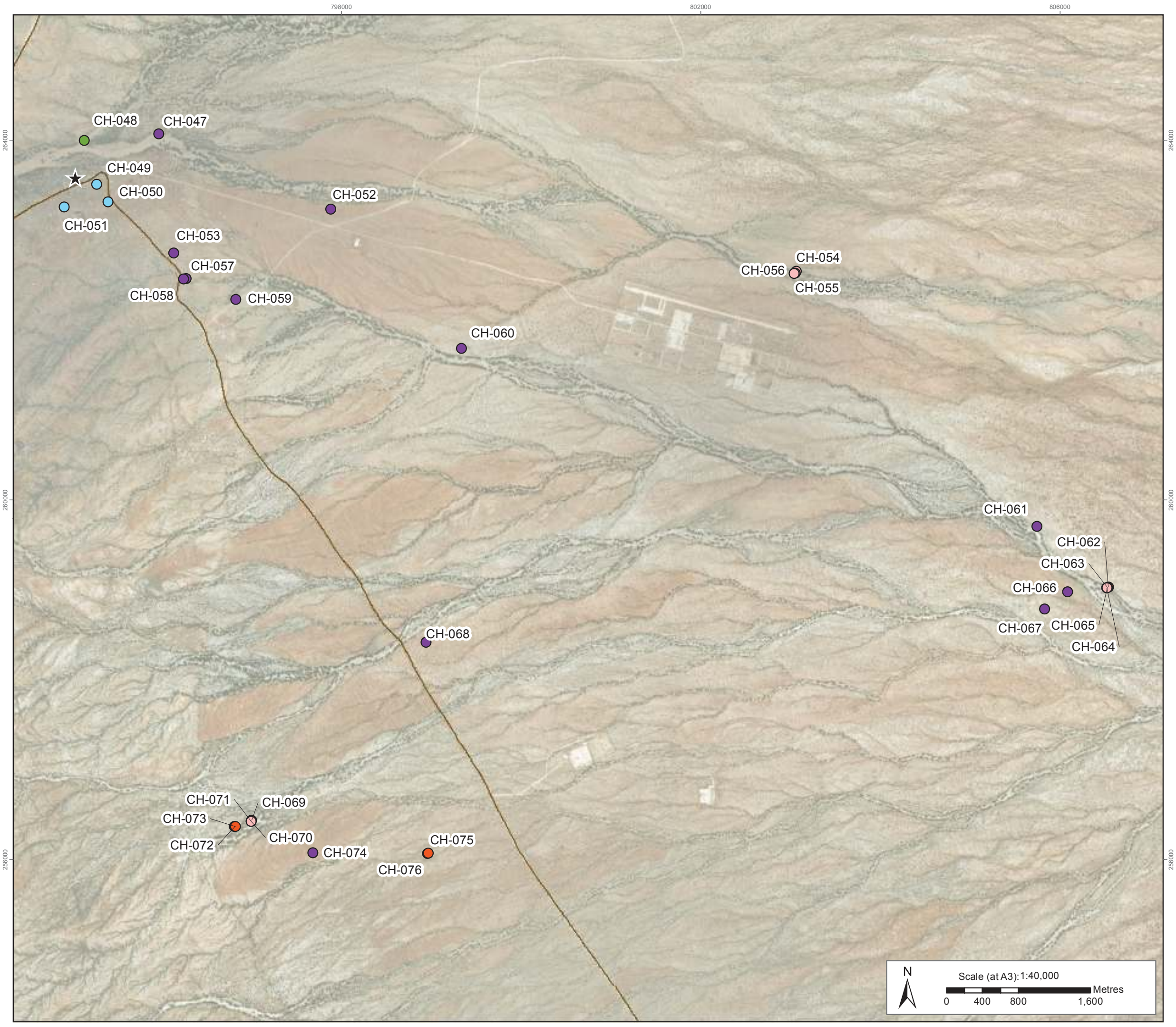

Drawing 6.13-21 - Cultural Heritage - Primary Data - Living Cultural Heritage (Ekales)

Foundation Stage Development

Key

- Grave/Burial
- Meeting Tree
- Fire Pit
- Religious Building
- Living Cultural Heritage Other
- ★ Lokichar
- Existing Road

Data sources:
Proposed Infrastructure data available from Worley Parsons. Base data available from Tullow

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref: 1433956	Prepared By: CR 18-11-2019	Reviewed By: PW 18-11-2019	Approved by: AM 18-11-2019

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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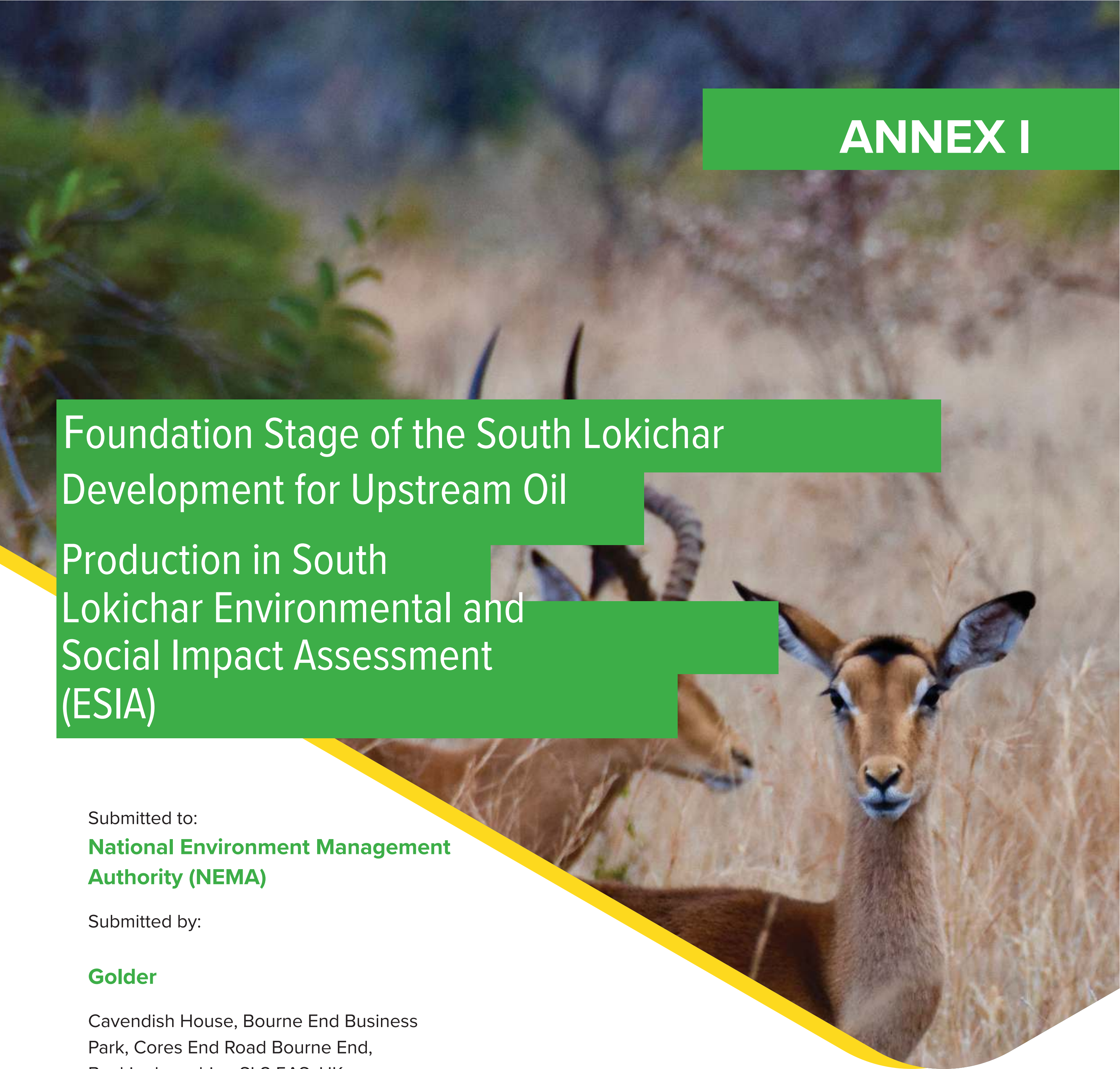

ANNEX I

Foundation Stage of the South Lokichar Development for Upstream Oil Production in South Lokichar Environmental and Social Impact Assessment (ESIA)

Submitted to:

National Environment Management Authority (NEMA)

Submitted by:

Golder

Cavendish House, Bourne End Business Park, Cores End Road Bourne End, Buckinghamshire, SL8 5AS, UK

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Ecologic Consultants Ltd

P.P. Box 55533, City Square, Nairobi, Kenya

June 2020

1433956.637.A2

ANNEX I

Signature Page

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Philip Abuor

NEMA EIA Lead Expert

(Registration No. 9709)

Ecologic Consultants Ltd

DRAFT

Andrew Morsley

Project Director

Golder Associates (UK) Ltd

15 June 2020

ANNEX I

A	Scoping Report and Terms of Reference
B	Project Standards
C	Baseline Supporting Information
D	Impact Assessment Supporting Information

ANNEX I

Scoping Report and Terms of Reference

A

Scoping Report

A1

June 2020

1433956.637.A2

December 2015

TULLOW KENYA B.V.

South Lokichar Development, ESIA Project Report

Submitted to:
Tullow Kenya B.V.
7th Floor
West End Towers
Waiyaki Way
P.O Box 63298-00619
Nairobi
Kenya

REPORT

Report Number 14514160360.516/A.2

Distribution:

Tullow Kenya B.V. - 1 copy
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EMC Consultants
ENVIRONMENTAL KNOWLEDGE IN PRACTISE

Golder Associates

Abbreviations

AEWA	The African-Eurasian Water-bird Agreement
AFEX	Africa Expeditions
AOI	Area of Influence
BLM	Bureau of Land Management
BSI	British Standards Institute
CEC	Cation Exchange Capacity
CHAA	Critical Habitat Assessment Area
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species
CFA	Central Facilities Area
CPF	Central Processing Facility
E&A	Exploration and Appraisal
EBA	Endemic Bird Areas
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIAAR	The EMCA (Impact Assessment and Audit) Regulations
EMCA	Environmental Management and Coordination Act
ERC	Energy Regulatory Commission
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEED	Front-End Engineering Design
FFD	Full Field Development
FPIC	Free, Prior and Informed Consent
GBIF	Global Biodiversity Information Facility
GIIP	Good International Industry Practice
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GoK	Government of Kenya
HCV	High Conservation Value
IBAT	Integrated Biodiversity Assessment Tool
IBA	Important Bird Areas
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
ILRI	International Livestock Research Institute
IPIECA	International Petroleum Industry Environmental Conservation Association
ISB	Integrated Support Base
IWMF	Integrated Waste Management Facility
KBA	Key Biodiversity Areas
KNBS	Kenya National Bureau of Statistics
KPHC	Kenya Population and Housing Census

BPD	Barrels per Day
Mbopd	Thousand barrels of oil per day
Mbwpd	Thousand barrels of water per day
MCA	Member of County Assembly
MEWNR	The Ministry of Environment, Water and Natural Resources
MMscfd	Million Standard Cubic Feet per Day
MRF	Materials Recovery Facility
MW	Megawatts
NDMA	National Drought Management Authority
NEC	National Environmental Council
NEMA	National Environment Management Authority
NGOs	Non-Government Organisations
NMK	National Museums of Kenya
NRT	Northern Rangelands Trust
NTS	Non-Technical Summary
OM	Organic Matter
PAP	Project Affected Peoples
PCC	Public Complaints Committee
PCP	Progressing cavity pumping
PS	Performance Standards
RCIAs	Rapid Cumulative Impact Assessments
SBM	Synthetic Based Mud
SSEA	Safety Sustainability and External Affairs
SEPs	Stakeholder Engagement Plans
SERC	Standard and Enforcement Review Committee
SID	Society for International Development
SPM	Single Point Mooring
SSEA	Safety Sustainability and External Affairs
TKBV	Tullow Kenya B.V.
TOES	Tullow Oil Environmental Standards
TOR	Terms of Reference
VOCs	Volatile organic compounds
WBM	Water Based Mud
WHO	World Health Organisation
WRI	World Resources Institute
ZTV	Zone of Theoretical Visibility

Table of Contents

TABLES

PLATES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Overview of the Proposed Development

Tullow Kenya B.V. (TKBV), a subsidiary of Tullow Oil plc (Tullow), is evaluating the Development of a series of oil discoveries in the South Lokichar Basin, northeast Kenya. Tullow is planning to develop its discoveries to enable production and further exploration to proceed in parallel. The South Lokichar Development Project includes oil discoveries within Blocks 10BB and 13T and represents the Full Field Development (FFD) of up to 5 fields: Amosing, Ngamia, Ekales, Twiga, Agete fields. The intention is to construct an Export Pipeline to the Kenyan coastline, with a Marine Export Terminal.

In accordance with the *Environmental (Impact Assessment & Audit) Regulations 2003 (as amended)* TKBV will need approval from the National Environment Management Authority (NEMA) before the project can proceed. In order to obtain this approval, an Environmental Impact Assessment (EIA) is required. The strategy TKBV have adopted is to prepare an Environmental and Social Impact Assessment (ESIA) for the Upstream activities of the Project, with separate ESIAs prepared for the Export Pipeline and Marine Export Terminal. A Cumulative Impact Assessment (CIA) will also be prepared to identify and assess cumulative impacts that arise from the impacts associated with the Export Pipeline and Marine Export Terminal, plus other third-party projects likely to be implemented in the future within the same geographical region.

The location of the South Lokichar Development Project is illustrated in Plate 1-1.

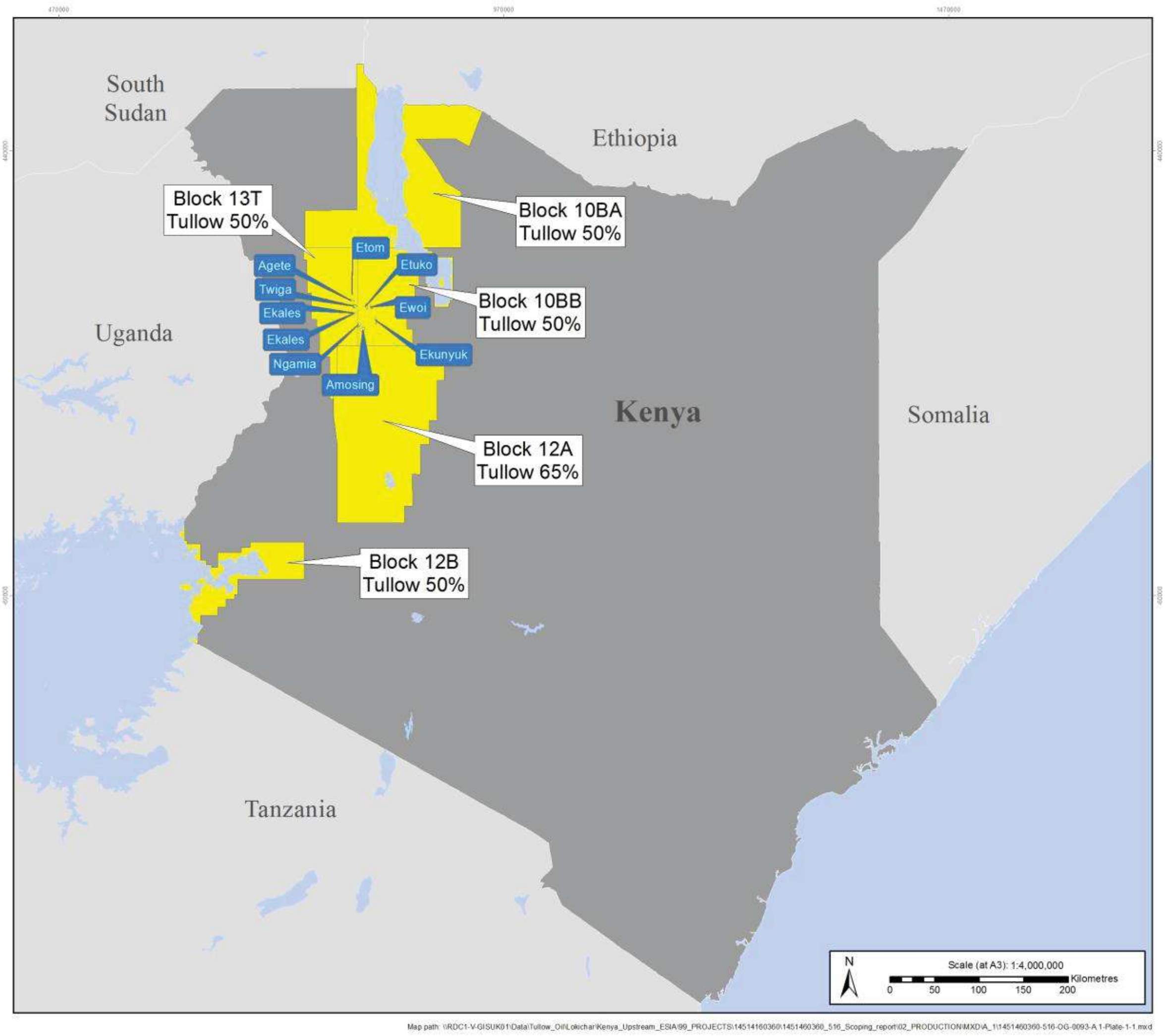

Plate 1-1 Location of the South Lokichar Development Project

1.1.1 Upstream Project

The Upstream activities include the following key components:

- Well pads in different fields within the South Lokichar Basin;
- Interconnecting flowlines;
- A Central Processing Facility (CPF); and
- Support facilities and infrastructure.

The likely Area of Influence (AOI) for Upstream activities is shown in Figure 1. At this stage it includes all infrastructure and activities under consideration. The likely AOI includes options currently being considered for water abstraction, logistics and power supply, for which an optioneering process is currently being undertaken. The preferred option will be based on engineering, financial, environmental and social considerations and will be confirmed before the commencement of the impact analysis. Once preferred options have been confirmed the AOI will be reduced accordingly.

1.1.2 Export Pipeline and Marine Export Terminal

The South Lokichar Development Project will require facilities for the transportation and export of the crude oil. This is expected to comprise a buried, heated crude oil export pipeline to a terminal on the Indian Ocean coast of Kenya. Tullow are currently reviewing a variety of oil export pipeline routes and marine terminal locations. Discussions between the Government of Kenya and other key stakeholders are ongoing to agree on the final route of the pipeline.

Separate ESIAs will be completed for the export pipeline and the marine export terminal in the future. Tullow's future role in the environmental permitting process required for the oil export pipeline and marine terminal is not yet determined and this aspect forms part of the ongoing discussion with various stakeholders.

1.2 Purpose of the Project Report

In accordance with the *Environmental (Impact Assessment & Audit) Regulations 2003 (as amended),* Part III Section 11 (1) an EIA study shall be conducted in accordance with the Terms of Reference developed during a scoping exercise and approved by NEMA. The purpose of the Project Report and accompanying Terms of Reference (TOR) is to present the results of the EIA scoping phase and seek NEMA's approval of the TOR that will be used to complete the rest of the ESIA process.

This Project Report and TOR covers the Upstream activities of the Project only.

1.3 Developer and the Project Team

In 2007 Turkana Drilling Consortium (Kenya) signed a Production Sharing Contract (PSC) for a 100% working interest in newly designated Block 10BB. In 2008 Platform Resources Inc. signed a PSC for a 100% interest in newly designated Block 13T. In 2009 Africa Oil Kenya B.V. (a wholly owned subsidiary of Africa Oil Corporation) acquired Turkana Drilling Consortium (Kenya).

In 2010 Africa Oil Corporation acquired Platform Resources Inc. giving Africa Oil Kenya B.V a 100% interest in both Blocks 10BB and 13T. In 2011 Africa Oil Kenya B.V and Tullow Kenya B.V agreed a farm-in deal whereby Tullow acquired a 50% interest and Operatorship in both Blocks 13T and 10BB. At the time of writing, Africa Oil Kenya B.V and Tullow Kenya B.V have a 50% working interest in both blocks.

The first onshore well in the South Lokichar Basin, Ngamia-1, in Block 10BB, commenced drilling in January 2012 and discovered over 200 m of net oil pay opening up this entire rift basin as a potential major oil province. This has been followed by several further discoveries in the South Lokichar Basin during the exploration phase.

As TKBV's activities move away from the exploration phase and into development, TKBV's Safety Sustainability and External Affairs (SSEA) function has been established to coordinate the three component-specific development ESIAs. The Kenya SSEA team are based in Nairobi and London.

For the Upstream Project ESIA, TKBV has contracted an international ESIA contractor (Golder Associates (UK) Ltd) that is supported by Kenyan-based ESIA consultants (EMC Consultants Ltd).

This Project Report and TOR are submitted by the following NEMA Lead Expert:

Name: Tito Kodiaga (Licence No. 0160)

Name of Firm: EMC Consultants (License No. 6669)

1.4 Structure of Project Report

The structure of the Project Report is summarised below:

Section 1: Introduction

Section 2: Project Need and Alternatives

Section 3: Project Description

Section 4: Approach to the ESIA

Section 5: Policy, Legal and Institutional Framework

Section 6: Technical Topics

Section 7: Emergency Preparedness and Response to Unplanned Events

Appendix A: Terms of Reference.

Appendix B: Scoping Consultation presentation slides.

2.0 PROJECT NEED AND ALTERNATIVES

2.1 Need for the Project

The South Lokichar Development Project will generate significant capital economic flows that will support financial and socio-economic policies of the Government of Kenya (GoK). Kenya is aiming to become an East African hub for the export of oil to international markets, where crude oil from Uganda and potentially other countries, is channelled through a Marine Export Terminal on the Indian Ocean coast of Kenya.

The Project requires the direct (and indirect) employment of national citizens and businesses, many of whom will receive training and skill development opportunities which will increase the technical and vocational capacity of Kenyans within the rapidly emerging oil and gas sector. The use of national citizens to the maximum extent possible during the ESIA, completion of technical studies and during construction and operation of the South Lokichar Development Project, is also in alignment with national government policy.

2.2 Main Alternatives

The Upstream Area was defined using data from seismic surveys, and exploration and appraisal drilling activities. The proposed plan to develop resources is based on results of such exploratory activities. Due to the nature of extraction of such resources, there is no geographical alternative to the Upstream Area of the proposed development.

However, Tullow are considering a number of options for various key elements of the Project, within the upstream project footprint. This optioneering process takes into account environmental, social, financial and operational considerations and will lead to a Project Description which will be included in the Front-End Engineering Design (FEED) and will be assessed by the ESIA.

The options under consideration for the following key elements of the Project are described in Chapter 3.0, and include the following:

- Locations for the CPF;
- Sources of water supply;
- Waste management treatment and disposal options;
- Locations for workforce accommodation areas;
- Locations of infield roads;
- Locations of an airfield; and
- Potential changes to road and rail connections.

3.0 PROJECT DESCRIPTION

This Project Description focuses on the development of wells, a gathering system, a CPF and associated infrastructure. The Upstream Project Area of the South Lokichar Development Project spans five oil fields and each field has multiple compartmentalised reservoirs.

The project description draws upon information generated by various infrastructure and logistics studies commissioned by Tullow to study options associated with the provision of power, location of key facilities and the use of existing road and rail routes for the transport of goods and materials to project locations. These studies include the following:

- South Lokichar Basin Stage1 Development Overall Study Report, A01, 2 February 2015 (Xodus Group Ltd.); and
- Environment Project Report Study for the Proposed Kapese Integrated Support Base, October 2014 (Kurrent Technologies Ltd.).

3.1 Environmental and Social Setting

The Upstream Area lies in a remote, unindustrialised, location, circa 1,000 km from any commercial sea port. No existing infrastructure exists except for some local murram roads and infrastructure associated with the exploration and appraisal drilling campaign completed by TKBV.

The proposed development sites in South Lokichar are located in the Rift Valley to the south and west of Lake Turkana. The whole of the Lokichar area is volcanic and is seismically active.

The Upstream Area of the Project is located in a semi-arid environment with an extensive network of wide shallow ephemeral streams. There are two rainy seasons in the Upstream Project Area, between March and June and between October and December, but rainfall can be sporadic. There are extensive seasonal floodplains in places around the shores of Lake Turkana, particularly at the deltas of the mouths of the rivers that flow into the southern region of the lake. Seasonal wetlands are also located along the Kerio, Turkwel and Lokichar rivers, tributaries of which are located within the Upstream Area, and the Kalamata River which may pass through the Upstream Area pending the completion of the optioneering studies.

The Rift Valley zone is known for its archaeological and anthropological importance with respect to early hominid fossils and artefacts and Lake Turkana itself and adjoining national parks have been declared World Heritage sites. Lake Turkana is also an important ecosystem supporting large populations of Nile crocodile, hippopotamus and fish, and unique flora and fauna assemblages.

Lake Turkana, which is located within the Study Area and extends past the Upstream Area, does form an international border (with Ethiopia). Consequently, there is a possibility that the AOI of the Project could extend to form trans-boundary effects. The ESIA will determine whether or not any effects of the Project are likely to extend to habitats and communities across the border. Until such effects can be demonstrated, the ESIA will not consider trans-boundary effects, and therefore this scoping study only considers the study area and baseline data gathering within Kenya.

No environmental protected areas have been identified within the Upstream Area. South Turkana National Reserve is located 7 km to south of the Upstream Area southern boundary.

In the Lake Turkana area, there are no large-scale agricultural initiatives planned, primarily due to limited water being available. Tourism activities in the South Omo and Lake Turkana areas provide an alternative source of income for some local communities, although tourism infrastructure is not extensively developed and it remains difficult to travel to the area due to poor-quality roads and a lack of supporting tourism infrastructure.

The population in the local area is characterised by tribal pastoralists and consequently the available, appropriately skilled, human resource pool is small and does not currently match the skill requirements for either the construction or operational stage of the Project. Literacy and educational levels across Turkana are low.

Turkana supports a number of tribal groups, amongst whom there has historically been antagonism, which has periodically escalated into episodes of localised conflict, presenting a potential security issue for the Project.

Conflict in Turkana can often be based on tribal affiliation, and is driven by a complex combination of the increasing availability of small arms, competition over pastoral grazing lands and livestock, tribal claim to land based upon their grazing value, and the socio-cultural importance of keeping large quantities of livestock for socio-economic status.

3.2 Design Parameters

The key design parameters for the Project include the following:

- Project infrastructure has a design life of 25 years for continous oil production during this period;
- Existing infrastructure from the exploration and appraisal stage has been re-used to the maximum extent possible to reduce the requirement for additional areas of land to be cleared and fenced;
- New infrastructure is designed to use the minimum amount of land required to minimise the footprint of the Project;
- There will be no routine flaring during the operational phase of the project. The presence of associated gas within reservoir fluids will be optimised and used for power generation to the maximum extent possible. However, the CPF will have a flare system designed to dispose of asssociated gas in an emergency or non-routine event. Fugutive emissions will be minimised by the design and the continous venting of associated gas;
- Where applicable, project facilities are designed using a closed drains system that will collect discharge from equipment (e.g. tanks, vessels) during routine operations and maintenance and direct the liquids to a dedicated storage vessel to prevent release to the environment;
- All hazardous material storages feature a secondary bund to prevent the release of pollutants to the environment following failure of primary containment;
- Materials to be used for the Project have been selected to take into consideration specific reservoir fluids and operating conditions whilst trying to use materials with a low environmental toxicity to reduce the volume and type of waste generated;
- Best Available Technology will be used. The Project is designed so that all emissions and discharges meet applicable environmental standards; and
- The project will be designed in line with the commitments to environmental mitigation measures defined in the ESIA.

3.3 Provisional ESIA Schedule

The provisional ESIA schedule is summarised below:

- Baseline data collection started in October 2015 and will continue for a minimum of 12 months;
- A FEED process will be completed to refine the existing design of the Project. This will have a minimum duration of 9 months;
- The ESIA Report will subsequently be submitted to NEMA; and
- NEMA will take no more than 3 months to review the ESIA for approval.

3.4 Operational Infrastructure

3.4.1 Well pads

The number of well pads may range from 30 to 50, and each well pad will be designed for 24 well slots per pad with alternative designs under consideration. Each wellpad will have several manifolds and each production well will have a pump and electric well bore heating. The well pads will be fully rated for well-head shut-in pressure and have an associated gathering system that follows the infield road network.

Each well pad will be accessed via all-weather access roads. Power and communications will be required at each well pad and security at the well pads will be managed through fences and CCTV.

It is expected that each well pad will have a temporary waste storage area. These will be transfer facilities where waste from construction activities as well as operational waste will be stored for either recycling or pre-treatment and then transferred to the Integrated Waste Management Facility (IWMF) near the CPF. These pad areas will be relatively small and the bulk of waste materials will be drill cuttings and spent drilling muds. An evaluation will be undertaken during the ESIA to identify the optimum type of drilling additives used with the aim of minimising the generation of Synthetic Based Mud (SBM) waste that is generated, with Water Based Mud (WBM) used to the maximum extent possible.

3.4.2 Central Processing Facility

The CPF will be made up of the following components:

- Processing Plant: The processing plant will have a design life of 25 plus years with operations planned to commence following commissioning;
- Processing Facility Ancillaries: including accommodation, helipad, offices, site clinic, emergency response facilities, waste handling facilities, fuel and chemical storage and dispensing areas, fuel storage areas, water storage and treatment facilities; and
- Centralised gas turbine power generation with waste heat recovery with additional heating provided by a combination of oil and gas fired heaters.

Based on the preliminary investigations, the current preferred option is a single facility. It will be designed to process circa 80 Thousand Barrels of Oil per Day (Mbopd), 480 Thousand Barrels of Water per Day (Mbwpd) and 28 Million Standard Cubic Feet per Day (MMscfd) gas. Note that the CPF layout is designed to be readily expandable to an additional 50% above these flow rates.

3.4.3 Water

3.4.3.1 Water supply options

The process of identification of a water source or a combination of water sources to support appraisal drilling, construction, field camps, community water schemes and to support all operational project needs is subject to a range of ongoing studies. The water supply options (options 1 to 7) that have been considered for project water supply are presented in Figure 2.

Options 1 (Nile River), 5 (Indian Ocean) and 7 (Lake Victoria) have been discounted during the early phases of the selection process. The four options, which are still under consideration, are described in sections 3.4.3.1.1. to 3.4.3.1.4.

A quantity of potable water for the operations stage will be necessary. The source(s) of piped water for all infield requirements will be identified from Tullow specialist studies and be adopted in the planning.

Surface water would be abstracted at a selected area to minimise disturbance to flora and fauna in the vicinity of the offtake. A pipeline would run from the abstraction point to the CPF. The pipeline would be buried.

3.4.3.1.1 Option 2: Turkwel Dam

The Turkwel Dam is on a tributary of the Turkwel River and has an integrated hydro-electric scheme producing 106 megawatts (MW). Sustainable abstractions directly from the reservoir and from downstream of the dam are being considered.

3.4.3.1.2 Option 3: Lake Turkana

Lake Turkana is an important natural habitat and will be considered sensitively in this context. Should this option be further considered, the ESIA will characterise the sensitivities associated to the lake. Detailed water supply studies are underway to consider sustainable use of the lake as a water supply.

3.4.3.1.3 Option 4: Local groundwater (within 13T and 10BB)

Groundwater abstraction from a network of boreholes within Blocks 13T and 10BB, is under consideration. There is an ongoing programme of drilling and findings to date indicate that the most productive water supply boreholes are likely to be along the valleys of the Turkwel River and Kerio River. A pipeline system could link several sources and distribute water as required. It is likely that several tens of boreholes would be needed to provide the volume of water required for the Project, although partial supply of water from these boreholes is also being considered.

3.4.3.1.4 Option 6: Distant groundwater

Studies to identify a candidate aquifer are ongoing. One option may be to install a network of boreholes in the Suguta Valley, north of Lake Baringo. A network of boreholes would be required to feed into a collection point and then be pumped to the Upstream Area.

3.4.3.2 Water treatment and storage

Water from whichever source(s) is eventually developed to supply the Project will arrive to the water treatment plant within the CPF via a water trunk line. Where required, make-up water for reinjection will be treated within the processing plant and will be stored in two buffer tanks. A separate water treatment plant is planned within the Central Facilities Area (CFA) for the supply of potable water to the CPF and other areas.

A potable water storage tank, located within the CFA, is planned and will be sized to store approximately four to five days requirement of potable water. Two tanks will be provided for service water needs.

A further water storage tank, to be used to store off-spec water for dust suppression, and for operation and maintenance purposes, is also planned for the CFA. Two fire water tanks, sized to provide a minimum of 30 minutes of water at calculated deluge rates, will also be located within the CPF.

3.4.3.3 Water injection network

Pipelines carrying water for re-injection will be connected to the well pads from the processing plant. Pipelines (oil and water injection) will be aligned with the infield road network where practical.

The water injection network is buried, heavily insulated (using the same insulation and heat tracing system as the gathering network i.e. insulated to a maximum U value of 0.5 W/m2.°C) and electrically heat traced.

Superheating is provided at the CPF to ensure correct water arrival temperature and to optimise heat and power consumptions. Heat tracing is supplied but is not normally on (used for upset and start-up conditions).

The requirement for heat tracing and the value of always-on heat tracing should be assessed at a later stage of design.

During normal operation, the arrival temperature at the well pads is controlled via the level of superheat added at the CPF. In an upset condition, additional heat can be provided via the CPF or by use of the electrical trace heating.

Injection water must be at least 80°C for injection at the wellhead. During start-up, water not meeting this temperature specification may be returned to the CPF via the production gathering network.

3.4.4 Integrated Waste Management Facility

A number of waste management options are being considered as part of the design and construction of an Integrated Waste Management Facility (IWMF). Options relating to the reuse of construction waste, wastewater, recycling and composting of organic waste will be considered to minimise the total quantity of waste generated, and treatment and disposal options will also be assessed during the design.

The IWMF will handle all waste generated at the CPF site and wastes from construction and operational activities as they are initiated, through the use of a modular design. The facility will continue being developed during construction until it is complete and fully functional.

Waste management for the Upstream Area will operate using the Waste Hierarchy as a central principle. Waste generated will be handled, segregated, treated and/or disposed of in a dedicated facility. A Materials Recovery Facility (MRF) will be constructed within the IWMF for waste sorting, where reusable and recyclable materials will be removed from the waste stream for transfer to relevant external facilities. Compost from the facility will be transferred to off-site receivers. Effluent treatment facilities will also be designed as part of the facility and the potential for energy from waste will be investigated.

It is anticipated that smaller ancillary waste handling facilities will be located strategically to service the more remote areas within the Upstream Area where waste can be temporarily stored and pre-treated prior to being transported to the IWMF facility, if necessary. These smaller facilities will be constructed as the Project expands. They will include source separation and removal of recyclable materials where feasible, and temporary storage of waste streams, including construction waste, and drill cuttings pre-treatment.

3.4.5 Transportation

3.4.5.1 Roads

Infield roads linking the CPF to all facilities and well site locations will consist of upgraded and new access roads to support access to all operational locations in the Lokichar Basin. Within the field there will be a hierarchy of roads provided. Some of these roads may be shared with the public whilst others will only be intended for use by Tullow.

The main access road C46 and airfield access will consist of a two-lane single, sealed, all weather, carriageway with public access used to facilitate the movement of vehicles from the CPF to/from the well pad access roads and to the national road network.

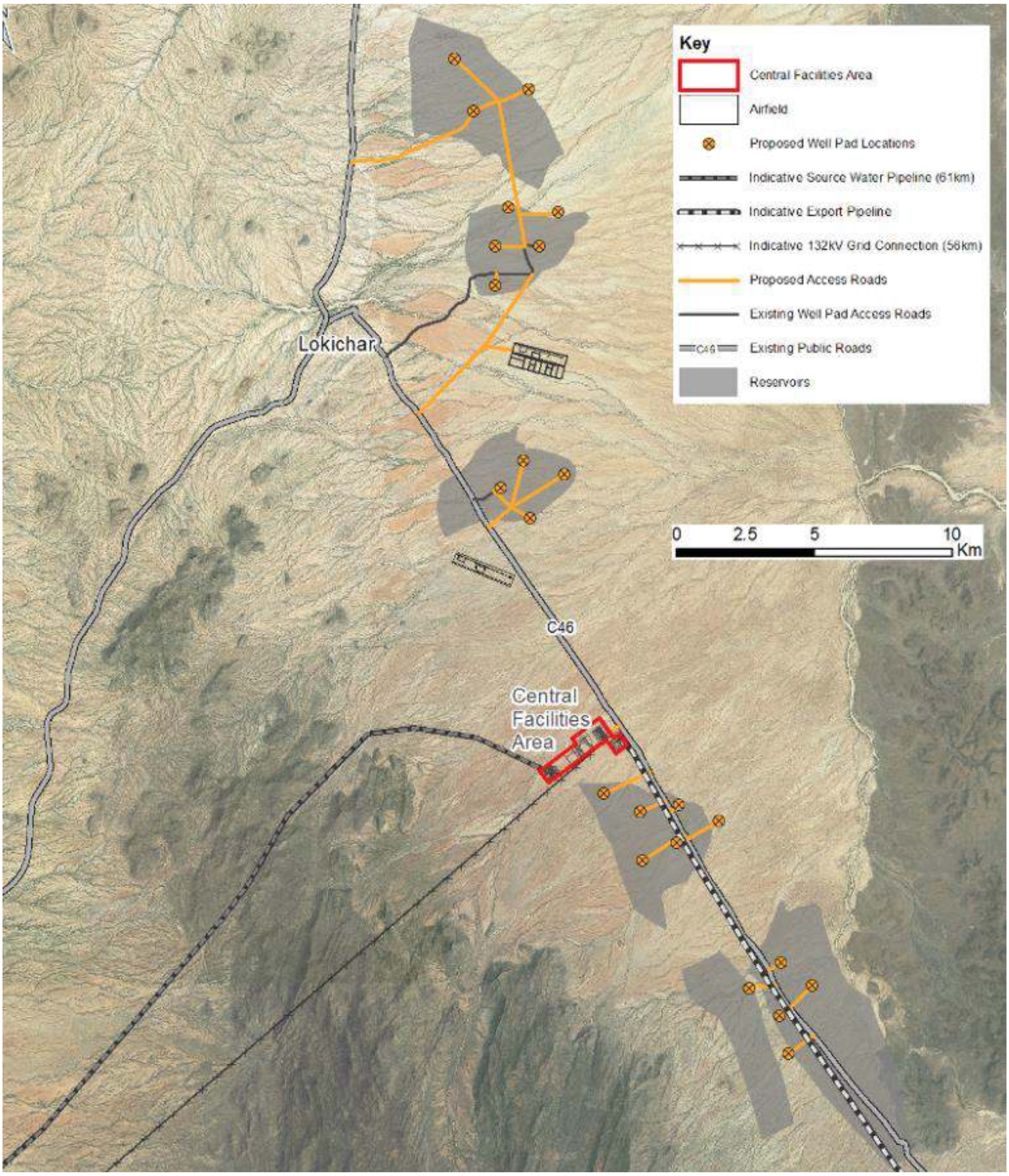

Plate 3-1 Proposed Field Layout (indicative only)

Other components of the infield road network include the following:

- Internal access roads: two lanes, all weather, carriageway not intended for public access. These roads will facilitate the movement of vehicles to/from the well pads to the main access road;
- Well pad access roads: single lane, all weather, gravel riding surface not intended for public access. These roads will facilitate access to/from well pads; and

- Internal CPF roads: these will be single lane. Permanent roads will be bituminous surfaced and temporary/construction road will be gravel surfaced. Internal CPF roads are not intended for public access and will facilitate access within the CPF area.

3.4.5.2 Air transport

A permanent airfield will be required in the vicinity of the CPF.

There are two existing airfields that are within driving distance of the CPF: Kapese and Lokichar. These options were investigated and it was found that due to expansion constraints, the poor standard of the Kapese airfield, the distance from the CPF to both airfields (25 km and 30 km) and the relative insecurity of the area, these existing airfields were unsuitable.

After discounting the Kapese and Lokichar Airfields, preliminary investigations undertaken as part of the Master Plan Study identified three potential sites where a new airfield could be developed.

Airstrip

The new airfield will be designed for a Dash 8 Q400 or similar airframe. This requires a runway length of up to 1.8 km, the final length and width is to be confirmed. It is calculated that the maximum traffic for Tullow's requirements will be several flights per day. This will be during the construction stage, based on the manpower requirements.

In addition to the runway, there will be a need for a small terminal building, workshop and store for airport related vehicles, a bus terminal, a small number of parking bays and aircraft refuelling and maintenance facilities.

Helipad

A helipad will be required to facilitate the extraction of injured or ill staff to external medical facilities in the event of an emergency, transporting VIPs to and from the Site, or field maintenance activities. This facility may be located within the CPF or at the adjacent airfield depending on the location of the airfield.

3.4.5.3 Road and rail connection

Road and rail options are being considered for the importing of construction and operational materials and plant from the port.

A rail connection from the CPF to the current rail network is unlikely to occur. Therefore for rail to be considered as part of an option, a multimodal solution would be required i.e. rail from the port to a railhead/transfer station at Eldoret or Webuye, which would need to be constructed, and a road thereafter. An evaluation of the capacity of the existing rail infrastructure is being conducted. Road transportation would then be used from Eldoret or Webuye to Lokichar via the A1 and the Lokichar bypass to the C46 down to the CPF location.

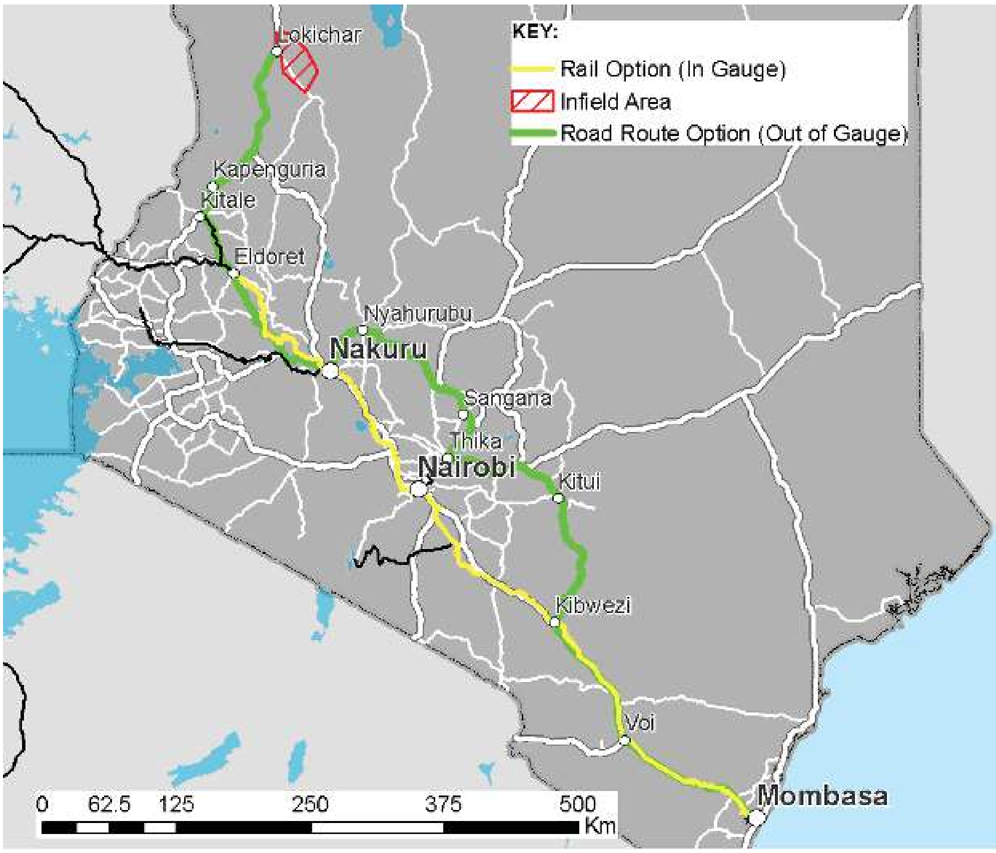

Plate 3-2 Rail/Road Option (indicative only)

3.4.5.4 Power

Tullow will commission a power plant that will be used to provide electricity to the entire operation. Power will be required by all facilities within the CPF. Power will be generated within the process plant area and distributed throughout the Project site (CPF and field) via an above ground network. Diesel generators will provide back-up power, along with other potential sources.

A Best Available Technology (BAT) assessment will be completed to identify the optimum source(s) of electrical energy required for the project. The BAT assessment will consider a range of options associated with the generation of energy and consider renewable energy sources including solar energy, wind energy and also electrical power through a connection to the national grid.

3.4.6 Accommodation

A number of options are being considered for accommodation during operations. Accommodation options will be evaluated to minimise environmental and social effects, including indirect effects of the Project relating to influx.

During operation, permanent accommodation will be required for staff associated with the operation of the process plant and ongoing field maintenance/operations as well as consultants, and contractors working within the Lokichar operation.

Temporary accommodation will be provided during the construction phase for a period of up to 3 years. This will be located close to the main CPF where the majority of the activity will be taking place. Temporary accommodation will be mothballed after the construction phase.

The permanent accommodation facility will have a design life of 25 plus years.

3.4.7 Interface with oil pipeline

An export pipeline is currently planned from the process plant to the coast where export facilities are to be constructed for the Project. An alignment for this pipeline is still being investigated. Provision for a corridor to access the process plant site will be required and provision for inlet facilities and storage interface shall also be accommodated. There is a separate ESIA process for the oil pipeline.

The interface location between the Upstream Area and the pipeline area is at the central process plant. Therefore there will be a length (to be confirmed) of pipeline within the study area for the Upstream Project ESIA.

3.4.8 Infield pipelines

Infield pipelines will connect the well pads to the process plant within the CPF, transporting well fluids from the well pads and water for re-injection back to the well pads. All pipelines (well fluids and water) will be buried and will be aligned with roads where practical.

Flow lines will feed into a manifold at well pad locations. A single infield pipeline will then connect the well pads to the CPF via infield trunklines.

3.4.9 Fuel storage

All fuel requirements for project operations, including refuelling facilities, will be stored and managed from an appropriate location. All fuel required on-site will be stored in a designated bunded area or a fuel drainage area. All refuelling will take place within designated areas.

3.5 Construction

3.5.1 Well pads

Construction of well pads will commence during the construction phase but will continue along with the Project throughout the operational phase.

3.5.2 Central Processing Facility

During construction, the CPF will also include temporary facilities (a construction camp and temporary laydown areas including warehouse and fabrication shops). These areas will be returned to an open area outside the perimeter fence following construction.

3.5.3 Water

Within the Upstream Area water is scarce. Therefore, the construction plan for water usage will identify how construction water can be minimised and water recovery maximised. It is assumed that construction water will be sourced from one of the options currently under evaluation and brought to site via a pipeline prior to treatment on-site.

Depending on route and the quality of the source water, connections along the pipeline route may be a solution to support bowser truck filling points that are nearer to the work fronts.

During construction, water will be required for:

- Soil compaction;
- Equipment, piping and pipeline hydro-testing;
- The construction camp – drinking water and ablutions; and
- Dust suppression – low quality water.

3.5.4 Solid waste and wastewater

The construction stage will generate significant quantities of inert wastes and incidental quantities of hazardous materials. Wastes will be generated from physical construction activities (off-cuts and surplus materials, combined with any arising from demolition, site clearance and preparatory ground works) but also waste from the various construction camps. Basic waste management facilities will be established at each camp with an objective of segregating and reducing waste and promoting recycling where possible. The waste management facilities will have to use simple technologies and be relatively mobile as it is assumed that the camps may have to re-locate on occasions to suit the construction operation and, as such, waste management equipment will have to be readily mobile. Processes will be established to reduce to a minimum the quantity of wastes from construction activities including but not limited to 'designing out' waste where possible and reduction of the need for off-cuts by pre-fabrication.

Inert wastes that cannot be recycled or re-used will be stored and later directed to the waste management facility at the CPF location for temporary storage until disposal capability at that site is available. Alternatively local waste disposal locations will be used where available. Wastes will be transported by dedicated vehicles or if possible, back-hauled by construction deliveries. It is unlikely that significant hazardous waste quantities will be encountered, although processes and protocols will be established to adequately store (temporary) such materials before haulage and final disposal at the IWMF.

A wastewater treatment plant is envisaged for the camp, to be constructed in during the appraisal stage, with the extension of this planned during development drilling, when the larger camp is envisaged.

3.5.5 Transportation

It is envisaged that construction personnel will be able to walk to the CPF construction area and the fabrication/assembly workshops from the temporary construction camp. Shuttle buses are proposed to transport construction personnel to and from the well pad areas. Buses will be used to transport construction personnel to and from the airport and drop off/collection points.

3.5.6 Power

There will not be any electrical power network during the majority of the construction period. Diesel generators will be utilised for the provision of electricity prior to first production, with each contractor being required to provide adequate power for their own use. A range of potential electrical energy sources, which will include use of a connection to the grid and solar energy, will be considered to supplement the use of diesel generators.

3.5.7 Accommodation

A number of options are being considered for accommodation during construction. Accommodation options will be evaluated to minimise environmental and social effects, including indirect effects of the project relating to influx.

Specifically, accommodation capacity during construction will need to account for the revised construction manpower estimate which could be in the range of several thousand people at the Central Infrastructure Area.

3.5.7.1 Integrated Waste Management Facility

It is proposed that the IWMF described in Section 3.4.4 will handle all waste (except produced water) that is generated at the CPF site will also be designed to handle construction waste produced during the construction stage. The first stage of the IWMF will be built during the enabling works phase (first 12 months of the construction phase) so that it is available for the rest of the construction phase.

3.6 Decommissioning

Decommissioning and closure of the Upstream Project will comply with international best practice, IFC Standards, NEMA, Tullow's environmental and social policies and also Kenyan legislative and regulation requirements. As part of the ESIA, a Site Closure and Restoration Plan will be developed.

Tullow will also adopt appropriate measures during the operational life of the Upstream Project to minimise and mitigate any impacts upon decommissioning.

3.7 Associated facilities

Associated facilities may include but not be limited to the following:

- Road upgrades outside of the AOI; and
- Railhead and transfer station.

4.0 APPROACH TO THE ESIA

4.1 The ESIA process

4.1.1 Overview

The ESIA is a process and management technique which allows consideration of the likely environmental and social impacts of a development prior to it proceeding. This provides an opportunity to ensure that the design is optimised in an integrated manner, minimising negative environmental and social impacts and maximising positive impacts.

The ESIA will be undertaken in accordance with the applicable requirements of:

- Kenyan EIA legislation and policy;
- IFC Performance Standards (PS) on Environmental and Social Sustainability (2012);
- Tullow internal policies and standards; and
- Good International Industry Practice (GIIP).

The ESIA process in Kenya is shown schematically in Plate 4-1:

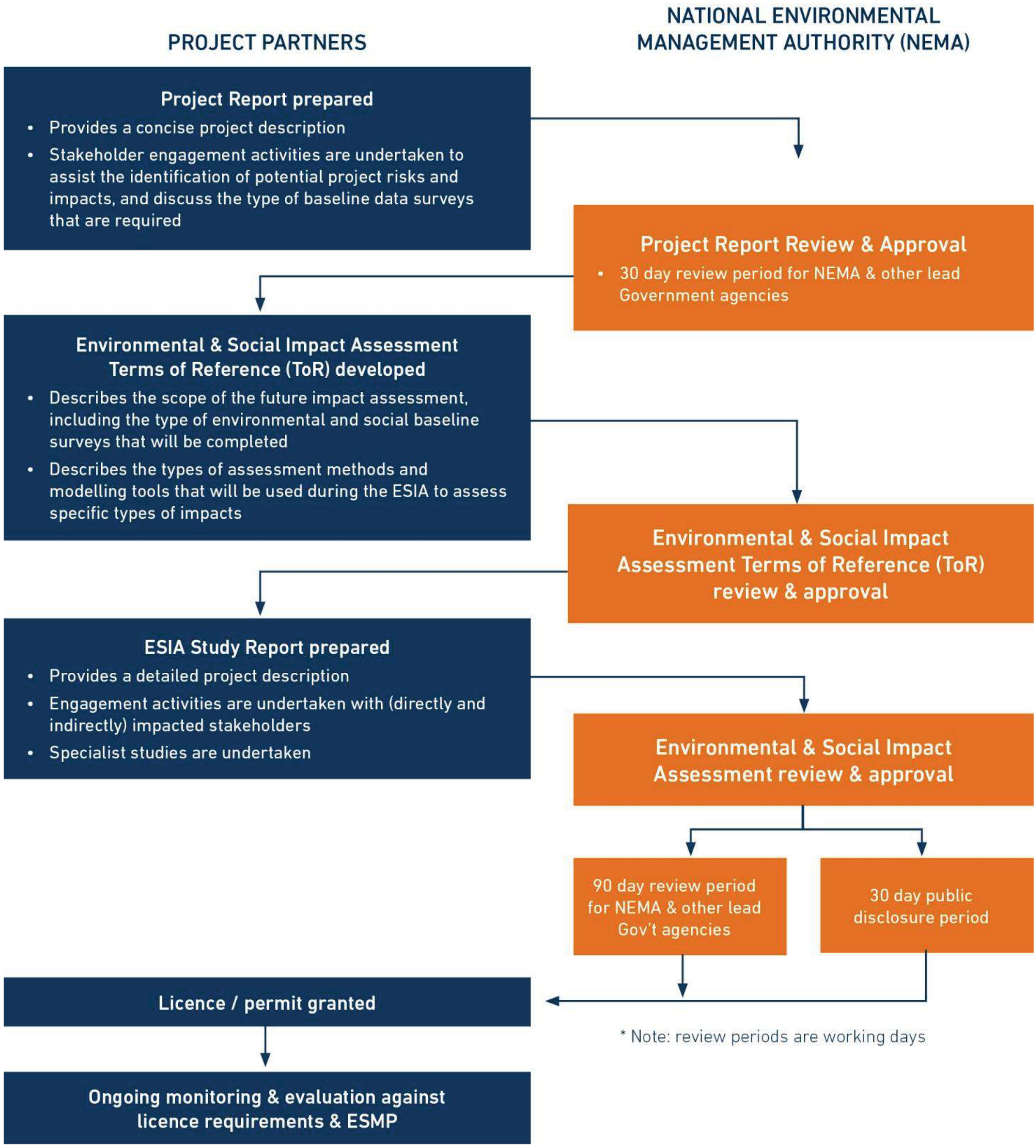

Plate 4-1 Overview of the ESIA Process in Kenya

4.1.2 Scope of the ESIA

The technical scope refers to the range of topics to be addressed in the ESIA. The technical topics proposed to be considered in the ESIA are set out in Chapter 6.0.

The ESIA temporal scope will include consideration of effects arising from the construction, operation and decommissioning of the Project.

The spatial extent of the ESIA is described as the geographical area potentially affected by the Project. The following definitions have been used to determine the Study Area and AOI:

The Study Area is defined as the spatial area within which data will be required to provide the context to inform the assessment of effects within the AOI (see below). The Study Area may be larger than the AOI and may cover local, regional, national and international scales. The Study Area may vary between the topic areas.

Based on the IFC definition, the AOI for the Project is defined as encompassing:

"*The area likely to be affected by: the Project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the Project; impacts from unplanned but predictable developments caused by the Project that may occur later or at a different location; and indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent. Associated facilities, which are facilities that are not funded as part of the Project and that would not have been constructed or expanded if the Project did not exist and without which the Project would not be viable."*[1]

The AOI does not include cumulative impacts, which will be assessed under a separate CIA for the entire project and presented as a separate report.

A summary of the various steps in the ESIA process are set out below.

4.1.3 Scoping stage

The aim of scoping is to identify potential impacts on environmental and social receptors arising from Project activities that will need to be further considered in baseline data collection, the impact assessment and to determine how such an assessment will be undertaken.

The primary output of scoping is the preparation of a Project Report and ToR, setting out potential impacts that will be considered in the ESIA as well as those scoped out (with reasons why). For those impacts scoped in, the method and approach proposed to predict and evaluate their significance will also be presented in the report. The Project Report and ToR will be submitted to NEMA for approval.

4.1.4 Establishment of baseline conditions

Baseline data will be collected to characterise the existing environmental and social receptors and conditions in the Study Area, and trends in such conditions including the situation that would prevail in the absence of the Project. Baseline data determination largely comprises:

- Review of existing published sources; and other available secondary information, including those held by government agencies, Non-governmental Organisations (NGOs), research agencies; and
- Site reconnaissance visit and field surveys and the subsequent analysis and interpretation of data.

4.1.5 Stakeholder engagement

Stakeholder engagement will be incorporated at all stages of the ESIA process. The objective of this engagement is to ensure that legislative requirements are met; sources of information and expertise are identified; stakeholder concerns and expectations are registered and addressed; and affected communities have the opportunity to discuss Project risks and impacts, and proposed mitigation and monitoring measures. A Stakeholder Engagement Framework has been prepared by TKBV for the Development Project and a Stakeholder Engagement Plan (SEP) has been prepared for the Upstream ESIA. The stakeholder engagement process has been discussed with NEMA to comply with Kenyan EIA Regulations; and to provide NEMA with an opportunity to comment on the consultation and disclosure activities that will be conducted during the ESIA process.

[1] IFC Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts, January 2012

Engagement during the Scoping stage informs the Environmental Project Report and Terms of Reference for the full ESIA.

During baseline studies and prior to completion of the draft ESIA, all baseline research, such as key informant interviews and focus groups will be used to disclose project information and provide participants in primary research with an opportunity to raise issues comments and questions.

Upon competition of the draft ESIA, all stakeholders will be invited to participate in consultation meetings linked to the draft ESIA. These meetings, conducted prior to the submission of the final ESIA for approval, will meet and exceed the NEMA requirements for a public hearing, specifically Environmental (Impact Assessment & Audit) Regulations (2003) (as Amended), Reg. (17), which requires at least three public meetings with affected parties and communities. In this regard, the number, location and format of public meetings will be discussed with NEMA prior to the publication of the disclosure schedule.

4.1.5.1 Engagement during Exploration and Appraisal

TKBV has been active in Kenya since 2010 and oil exploration activities have been occurring within the area of operations (North West Kenya) since 2011. During this period, the extent and complexity of stakeholder engagement activities at a national, county and community level has increased substantially, which has been driven by several factors including:

- An increase in exploration activities and associated work (e.g. seismic and drilling operations);
- The geographic footprint of the operations has expanded significantly as new basins/areas have been targeted within the extensive licence areas;
- The on-going management of new contractors with different operating models and experience;
- Changes in Government roles and responsibilities as a result of newly devolved County Government powers; and
- Fluid and shifting community dynamics.

Considering that Kenya is a new hydrocarbon province, engagement activities to date at both national and local levels have focused on building broad based understanding of the oil and gas industry in parallel to operational specific engagement and consultation activities.

During the course of previous engagement and consultation activities, a range of issues have been raised by external stakeholders. Given the current stage of the oil lifecycle (exploration), many of the issues raised focus on more immediate activities and short-term impacts. However, these can often be relevant for future lifecycle phases such as construction and operations. Stakeholders have also raised issues that have longer term and far reaching implications and can require a multi-stakeholder consultation approach.

The following provides a summary of some key issues raised by key stakeholder groups, which will inform focused engagement activities in the ESIA programme.

- From community level stakeholders:
  - Expectations of and access to employment opportunities;
  - Land take and associated land use, including compensation and consideration of traditional use;
  - Access to water; and
  - Benefits and opportunities.
- From National level Government stakeholders:
  - Revenue and transparency;
  - Natural resource use and the effective use of revenues;

- National content/capacity building;
- Security; and
- Project association and relationship to other major infrastructure projects.

- From Non-Government Organisations and Civil Society Groups:
  - Transparency and disclosure of Project documents;
  - Distribution of revenues;
  - Land rights with specific emphasis on livelihoods;
  - National content / capacity-building; and
  - Avoiding a “Niger Delta”-type situation.

4.1.5.2 Early engagement with NEMA

At the inception of the development stage of the Project and the scoping stage for the ESIA in October 2014, Golder met with NEMA. The Golder Project Manager (Andrew Morsley), Socio-economic and Stakeholder Engagement Lead (Paul Lawrence) and Kenyan Project Coordinator (Tito Kodiaga) briefly presented the ESIA team for the Upstream Project, the approach to scoping and the scoping consultation (including a communications plan), and the approach to the ESIA. Since then, Tullow have engaged with NEMA regularly to further discuss the approach and progress of the Upstream ESIA. NEMA has confirmed that they are comfortable with the completion of a single ESIA assessment that addressed the requirements from applicable national legislation and the IFC Performance Standards.

4.1.5.3 Project report stage consultation

In accordance with Regulation 11 of L.N. 101: Environment (Impact Assessment and Audit) Regulations, 2003, the Project Report and ToR will be submitted to NEMA for approval. NEMA will liaise with the relevant lead agencies in the review and approval of the Project Report and ToR.

The Environmental Management and Coordination Act (1999) and the Environmental (Impact Assessment and Audit) Regulations (2003) establish the basis of Kenyan regulatory requirements for stakeholder engagement in ESIA. It is the responsibility of the project proponent to make sure that all the concerned parties (government and non-government) are given adequate opportunity to participate in the ESIA exercise. Regulation 17 of L.N. 101: Environment (Impact Assessment and Audit) Regulations, 2003 states that an applicant shall take all measures necessary to seek the views of the people or communities which are likely to be affected by the project during the scoping exercise.

The main objectives of Scoping consultation is to:

- Provide information on the Project to key stakeholders;
- Align the ESIA approach with national regulations and international lender requirements; and
- Document issues, questions and concerns that need to be considered and addressed during the later stages of the ESIA and reflected in the Terms of Reference (Appendix A).

Scoping consultation was targeted at key national and regional stakeholders. NEMA had stipulated that at scoping, consultation should only occur down to sub county level. Through this process, Golder identified how expanded consultation with potentially affected communities should be facilitated during the later stages.

Early engagement helps test the cultural appropriateness and level of details in materials. The following key outcomes/learnings came from scoping consultation

The EIA Guidelines (2002) state that a Communication Plan must be developed in liaison with NEMA. The preliminary list of stakeholders for scoping consultation was shared with NEMA during the meeting in October 2014 (Section 4.1.5.1). A Communication Plan to complement the preliminary stakeholder list for the

Upstream Project will be submitted to NEMA as a standalone document. The methods of engagement will include, but will not be limited to:

- One-to-one meetings;
- Workshops; and
- Targeted interest groups.

All methods will seek to provide consistent messages about the Project through the presentation or distribution of presentations, maps and documents.

4.1.5.4 ESIA scoping consultation

ESIA Scoping Consultations were initiated in November 2015 and included a series of meetings to disclose the Project concept and explain the ESIA process. Consultations were held with government, international organisations, international, national and regional NGOs and regional media.

The objectives for each meeting were the same:

- Provide information on the Project and details of the ESIA process to key stakeholders;
- Align the ESIA approach with national regulations and international lender requirements;
- Document issues, questions and concerns that need to be considered and addressed during the later stages of the ESIA and reflected in the ToR; and
- Solicit feedback from key national and regional stakeholders on our approach to consultation with a wider group of stakeholders, especially potentially project affected people (PAPs).

Two teams comprised of Golder and Tullow staff facilitated meetings. One team conducted the majority of meetings in Nairobi and the second team helped with meetings in Turkana with regional stakeholders.

The list of stakeholders consulted was drafted in consultation with NEMA. Based on NEMA's advice, Golder was not advised to hold formal public meetings at the community level. The main reason for delaying broader disclosure is to wait until there is a more clearly defined Project Description. However, all stakeholders were encouraged to share information. While none of the meetings were advertised to the general public, participants invited to the non-governmental events received a letter of invitation and were welcome to bring other interested stakeholders.

All meetings were started with two brief presentations. The first outlined the development Project Description as well as the ongoing technical and engineering studies underway to further define the Project design. The second presentation provided information on the ESIA and stakeholder engagement process. Presentations were provided to all stakeholders on request. A copy of the slides is provided in Appendix B.

In addition to the presentations, two Topic Sheets were used on (1) Oil and Gas Life Cycle; and (2) The ESIA Process were provided to all participants in English and Swahili. All presentations were delivered in English, but participants were invited to ask questions in their preferred language. Turkana-speaking Tullow staff were present at all meetings held in Lodwar for the purpose of translation, if desired, however, no translation was requested.

The ESIA presentation stressed the on-going role of the grievance mechanism. All meeting attendees were encouraged to contact the grievance officer in relation to any outstanding complaints.

Table 4-1: ESIA Scoping Meetings – Total Attendees

Date	Meeting / Type	Total Participants
04 Nov 2015	Ministerial Forum - Nairobi	19
04 Nov 2015	Northern Rangelands Trust - Nairobi	1

Date	Meeting / Type	Total Participants
04 Nov 2015	Deputy Governor/Turkana County Ministers - Lodwar	6
05 Nov 2015	Regional National Environment Management Authority (NEMA) Water Resources Management Authority (WRMA) – Lodwar	2
06 Nov 2015	UN Forum - Nairobi	4
09 Nov 2015	International NGOs (Development) – Nairobi	8
09 Nov 2015	International NGOs (Environmental) – Nairobi	9
10 Nov 2015	Kenyan National NGOs – Nairobi	7
10 Nov 2015	Turkana County Commissioner and Police Coordinator - Lodwar	3
10 Nov 2015	National Land Alliance – Nairobi	1
11 Nov 2015	Turkana Media Briefing – Lodwar	10
12 Nov 2015	Turkana NGO Forum - Lodwar	30
12. Nov 2015	International Organisations (General Re-invited) – Nairobi	7
13. Nov 2015	National Assembly Committee on Environment and Natural Resources - Nairobi	1
18 Nov 2015	Turkana Basin Institute - Nairobi	1
Total Attendees		109

Several key meetings did not take place due to scheduling conflicts and many meetings had lower participation that expected. Key government meetings that were cancelled include:

- Parliamentary Committee on Environment & Natural Resources – Nairobi;
- Senate Committee for Environment & Natural Resources – Nairobi;
- Turkana Governor – Lodwar; and
- MCAs, County Speaker – Lodwar.

The Tullow Social Performance and Government and Public Affairs teams will provide disclosure materials to all key government officials and conduct follow-on meetings, as requested.

During the meetings listed above, a total of 188 issues, questions and concerns were documented. They are presented below with the first listed topic being the most commonly raised topic:

- ESIA General Inquiries – 18%
- Engagement – 16%
- Environment – 16%
  - Water – 9%
  - Biology – 3%

- Pollution/Waste – 3%

- Land Access & Acquisition – 15%
- Community Aspects – 11%
  - Benefits – 4%
  - Health, Safety & Security – 3%
- General Project Updates / Inquiries – 8%
- National Content – 5%
- Security – 3%
- Northern Rangelands Trust – 3%

The most commonly raised topic was in relation to the ESIA, its scope and clarity on how the process would be conducted. These issues represented 18% of the total comments made. Attendees also sought clarity on the difference between the development ESIA and previous impact assessments conducted during the exploration and appraisal work.

Both engagement and environment issues represented 16% of the total of all comments. Among environmental issues, the most commonly raised question was in relation to water, where the Project might source water and whether usage might affect local communities. In response, attendees were informed of the process used to consider numerous options for water and that there are currently the following four options under consideration - the Turkwel Dam, Lake Turkana, local ground water and distant ground water.

Questions on engagement underlined the importance and the challenge of including local communities and project-affected people in all ESIA work. All attendees agreed that holding public consultations at the settlement level would be unhelpful unless there was more specific clarity on the Project footprint and associated engineering design. Participants raised the issue of developing various methods for information disclosure, especially in the context of high illiteracy rates. Each meeting highlighted the importance of the Project SEP, which will outline methods for continued engagement and the methods to be used. The SEP will be a public document. Attendees to these meetings will be informed once it is made public. Attendees were encouraged to review and provide feedback on the schedule and methods proposed presented in the SEP.

Land access and acquisition represented 15% of the total issues raised and was a clearly emotive issue for many participants. Several comments highlighted the regulatory challenges in acquiring land while the Kenyan Community Land Bill has not yet been passed into law. Question on land also focused on how land acquisition will take into account the pastoralist livelihoods of local residents near the Project. Numerous participants, especially at the County-level stressed the importance of regional and community participation in the development of the Land Access Framework (LAF). Given the regulatory uncertainty, attendees were told that the land acquisition process and consultation would be on-going and would include inputs from a broad number of stakeholders, including local communities. It was also frequently explained that the LAF and all work related to land acquisition would comply with IFC Performance Standard 5, which would ensure issues related to traditional land use would be taken into consideration.

National content questions, especially those related to employment and procurement opportunities, were especially important in County-level meetings. Many stakeholders explained the acute tension between national content and local content, indicating that employment given to people outside the County of operation needs to be clearly justified. Many general comments stressed that the Project needs to demonstrate that training for more skilled employment will start as early as possible. Responses summarised what TKBV have done to date through support for vocational education in Lodwar and the Enterprise Development Centre.

Inquiries about the Northern Rangelands Trust (NRT) were raised in several meetings. The 28 October 2015 public announcement of a new project supported by Tullow Oil in Turkana led many stakeholders to assume the ESIA might be related to the NRT project. The announced project was linked to a five-year grant agreement with the NRT that will support communities in Turkana and West Pokot Counties to establish and operate six community conservancies. Questions raised during the ESIA Scoping meetings were primarily linked to land access.

The issues raised during the ESIA Scoping meetings are reflected in this Upstream Project Report and accompanying Terms of Reference (Appendix A).

4.1.6 Impact Assessment

The term “effect” will be used when describing the consequence of a change arising from the Project on a receptor. The term “impact” will be used to describe an effect that results in a change which requires mitigation or management to be considered. The types of effect that will be considered in the ESIA include:

- Direct – an effect that arises directly from activities that form an integral part of the Project (e.g. new infrastructure) and is within the control of the developer;
- Indirect – an effect that arises from activities not explicitly forming part of the Project but as a “knock on effect” of it, that may not be within the control of the developer (e.g. changes to water availability due to increased influx of people); and
- Combined – the combination of other direct or indirect effects of the Project on any one or group of receptors.

The impact assessment process will comprise the following main steps:

- Identification of the effects of the Project on receptors taking into account incorporated environmental and social measures (see Section 4.2.5);
- Evaluation of the significance of the effect;
- Development of mitigation measures; and
- Where necessary, prediction of the significance of residual effects.

An overarching framework for the impact assessment of environmental and social topics, based on these steps is provided in Section 4.2. The details of the methodology will however be developed for each topic based on: professional judgement; comparison with topic-specific regulations or standards; comparison with experience on other similar projects; and consultation with stakeholders.

In addition to the standard ESIA methodology the impact analysis for each environmental and social topic will be accompanied with a hazard analysis of malfunction/accidents, which will be reported in a separate chapter and will feed into a hazard management plan.

4.1.7 Environmental and Social Management Plan

An Environmental and Social Management Plan (ESMP) will be prepared, based on the findings in the ESIA. The ESMP will consist of a set of management, mitigation and monitoring measures to be taken during Project construction, operation and maintenance to manage key potential environmental and social impacts identified in the ESIA.

4.1.8 Cumulative Impact Assessment

Cumulative impacts are defined by the IFC as impacts that *“result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted”*. Cumulative impacts will be assessed as part of an analysis of the Project, and will be prepared as a separate report to the ESIAs. The assessment of cumulative impacts will consider the effects of other developments in the vicinity of the Upstream Project which are under construction or have been consented, which when combined with the effects of the Upstream Project may have an incremental effect.

A Cumulative Impact Assessment is not required by NEMA, however, Tullow will undertake such an assessment in accordance with GIIP and IFC Performance Requirements and guidelines. The CIA will consider the cumulative impacts associated with the three components of the Project (Upstream, Pipeline and Port).

4.1.9 Reporting and disclosure

The outputs of the above tasks will be drawn together into an EIA Study Report and accompanying Non-Technical Summary (NTS) for NEMA's approval. Comments received on the Report from NEMA's review, stakeholders' written comments, and the outcome of any public hearings, will be addressed and detailed in an updated EIA Study Report.

4.2 Assessment Methodology

An overarching framework for the impact assessment methodology is provided below. The approach to the analysis of significance of environmental and social impacts has been separated to reflect the different approaches required assess environmental (Section 4.2.3) and social (Section 4.2.4).

4.2.1 Receptor importance and sensitivity

The term 'receptors' will be used to describe features of the environment such as water resources, habitats and species which are valued by society for their intrinsic worth and/or their social or economic contribution; and social groups or PAPs such as individuals and communities that may be affected by the Project.

The importance of a receptor will be determined by the consideration of a range of criteria depending on the topic under consideration, including: the economic, social and cultural value of the receptor, locally, nationally and internationally; any local, national or international designations; and the rarity of the receiving environment; the benefits or services provided.

Receptor sensitivity will be determined by the consideration of a receptors' ability to resist or adapt to changes and its resilience to change. The category of the importance or sensitivity of a receptor will be determined based on professional judgement of technical topic leads. Table 4-2 provides an example of categories of importance and/or sensitivity.

Table 4-2: Illustrative Example for Determining Receptor Importance and/or Sensitivity

Importance/Sensitivity of Receptor	Example of importance of receptors	Example of sensitivity of receptors
Very high	An attribute with a high quality and rarity on an international, regional or national scale with little or no potential for substitution.	Sensitive area or receptor with little resilience to imposed stresses.
High	An attribute with a high quality and rarity on a local scale with little or no potential for local substitution, or with a medium quality or rarity on a regional or national scale with limited potential for substitution.	
Medium	An attribute with a medium quality and rarity on a local scale with limited potential for substitution, or an attribute of low quality and rarity on a regional or national scale.	The receiving environment or receptor has a moderate natural resilience to imposed stresses.
Low	An attribute of low quality and rarity on a local scale with potential for substitution locally.	The receiving environment or receptor has a high natural resilience to imposed stresses.

4.2.2 Identifying the magnitude of environmental effects

The magnitude of effect will be determined by taking into account several factors. This will vary per topic but may include one or several of the following:

- Intensity of change;
- Geographic extent of change;
- Duration of change; and
- Frequency.

It is proposed that probability is not considered as part of the criteria for the prediction of effects. Probability will be considered only when assessing hazard analysis of malfunctions/accidents, which will be addressed separately in the ESIA.

4.2.3 Evaluating the significance of environmental impacts

Impact significance will be determined by consideration of the importance/sensitivity of the receptor in combination with the magnitude of the effect. Table 4-3 demonstrates how these parameters are considered in the assessment of significance.

Table 4-3: Determination of significance of impact

		Magnitude of Impact			
		High	**Medium**	**Low**	**Negligible**
Receptor Sensitivity or importance	**Very High**	Major	Major	Moderate	Minor
	High	Major	Moderate	Minor	Negligible
	Medium	Moderate	Minor	Minor	Negligible
	Low	Minor	Minor	Negligible	Negligible

Predicted significance of impacts will be classified according to whether they are considered to be Major, Moderate, Minor or Negligible; and Beneficial, Adverse or Neutral. Significance criteria will be specific to each environmental and social topic and will be defined in the impact assessment using a combination of environmental standards, guidance and professional judgement.

4.2.4 Evaluating the significance of social impacts

The evaluation of social impacts will differ from the evaluation of environmental impacts. The significance of a social impact will not depend on a characterisation of the magnitude of the effect and the definition of sensitivity or importance. Most social impacts will not be evaluated in the same quantitative way that can be applied to physical and biological impacts. Evaluation of social impacts will rely on a narrative which will bring together the evaluation of the following four criteria to reach a conclusion for the overall social impact:

- Direction, i.e.
  - Positive direction– impact provides a net benefit to the affected person(s);
  - Negative direction – impact results in a net loss to the affected persons(s); and
  - Mixed direction – mixed directions or no net benefit or loss to the affect person(s).
- Consequence, i.e.
  - Negligible consequence – no noticeable change anticipated;

- Low consequence – predicted to be different from baseline conditions, but not to change quality of life of the affected person(s);
- Moderate consequence – predicted to change the quality of life of the affected person(s); and
- High consequence – predicted to seriously change quality of life.

- Geographic extent of change; and
- Duration.

Each impact will be considered in relation to other impact topics and sub-topics. The objective of the narrative in the evaluation of social impacts is to show the relative importance of social impacts.

4.2.5 Incorporated environmental and social measures

Incorporated environmental and social measures, and industry proactive mitigation/management, are those measures that have been incorporated into the design of the Project. These may include:

- Design changes undertaken to remove or minimise effects that are not considered to be mitigation in terms of ESIA; and
- Good operational practice or construction.

The impact assessment will be undertaken assuming that the above are applied as an integral element of the Project design; and these measures will be set out clearly within the ESMP.

4.2.6 Mitigation of impacts

Additional measures will be committed to if, as a result of the ESIA, mitigation is required. Mitigation will be identified in accordance with a hierarchy of options in accordance with good practice and comply with IFC Performance Standards.

- Avoid - making changes to the Project's design or location to avoid adverse effects on an environmental feature or adverse social impacts
- Minimise - reduction of adverse effects through sensitive environmental treatments/design, or different project design to reduce adverse social impacts.
- Restore - measures taken during or after construction to repair/reinstate and return a site to the situation prior to occurrence of impacts.
- Compensate/offset - where avoidance or reduction measures are not available, it may be appropriate to provide compensatory/offsetting measures. Compensatory measures do not eliminate the original adverse effect; they merely seek to offset it with a comparable positive one.
- Improvement measures - projects can have positive effects as well as negative ones, and the Project preparation stage presents an opportunity to enhance these positive features through innovative design.

4.2.7 Identification of residual Impacts

Residual impacts are those that remain following the implementation of the proposed mitigation. These will be identified for each of the specialist topics by reviewing the predicted impacts against the mitigation measure proposed and then identifying any residual impacts. Residual impacts will be defined based on the same process applied to the evaluation of impacts.

5.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

The following chapter provides the relevant policy, legal and institutional framework governing the ESIA. The ESIA will be carried within the Kenyan legislative and regulatory framework and in line with the IFC

Performance Standards on Environmental and Social Sustainability (2012) and IFC's General Environmental, Health and Safety (EHS) Guidelines (2007), and Tullow's corporate standards and policies (refer to Section 5.6). Project standards will comprise the more stringent of Kenyan and GIIP.

5.1 Context

Kenya has undergone regulatory reforms over the past two decades, culminating in the enactment of a new constitution in 2010 replacing that of 1969. This has in turn driven new policies and strategies relating amongst others to environmental management and conservation (including Environmental Impact Assessments), and more generally to the energy sector including oil and gas.

The new constitution establishes the structure of the Kenyan government, the Bill of Rights, and provides the basic and comprehensive principles for environmental protection and management in the country. Under Chapter 5 (Part 1) of the constitution (Land and Environment), it requires that land be used and managed in *"a manner that is equitable, efficient, productive and sustainable, and in accordance with the following principles: (a) equitable access to land; (b) security of land rights; (c) sustainable and productive management of land resources; (d) transparent and cost effective administration of land; (e) sound conservation and protection of ecologically sensitive areas; (f) elimination of gender discrimination in law, customs and practices related to land and property in land; and (g) encouragement of communities to settle land disputes through recognised local community initiatives consistent with this constitution".* Furthermore, Part 2 of Chapter 5 is dedicated to environment and natural resource utilisation, management and conservation, with reference to the establishment of EIA, environmental audit and monitoring of the environment.

The constitution also stipulates that all minerals and mineral oils shall be vested in the national government in trust for the people of Kenya. The constitution also specifies the devolution of powers from the central government to the newly established 47 Counties. County governments are in charge of planning and development among other services, and can enact legislation with possible implications to planned and current projects.

Other recent reforms include the establishment of key administrative and legislative organisations that regulate oil and gas development in Kenya.

5.2 Governance and Administrative Structure

The following key administrative agencies regulate oil and gas development and its environmental implications in Kenya and have a key role in the EIA authorisation process:

Ministry of Environment and Natural Resources (MENR)

The Ministry of Environment and Natural Resources (MENR) mission statement and key objective is to facilitate good governance in the protection, restoration, conservation, development and management of the environment and natural resources for equitable and sustainable development.

Following the passage of the Environmental Management and Coordination Act (EMCA) 1999, now recently amended and referred to as EMCA (amendment) 2015, several administrative structures were established under the MENR. These include the National Environmental Council (NEC), National Environment Management Authority (NEMA), National Environment Tribunal (NET) the National Complaints Committee (NCC), and the Standard and Enforcement Review Committee (SERC).

Following the passage of the Environmental Management and Coordination Act (EMCA) 1999, now recently amended and referred to as EMCA (amendment) 2015, several administrative structures were established under the MENR. These include the National Environment Management Authority (NEMA), National Environment Tribunal (NET) and the National Environment Complaints Committee (NCC).

Ministry of Water and Irrigation

The Ministry of Water and Irrigation (MWI) mission statement is to contribute to national development by promoting and supporting integrated water resource management to enhance water availability and accessibility. The MWI has the following technical departments: Water Services, Water Resources, Water Storage and Land Reclamation, and Irrigation and Drainage.

National Environment Management Authority

NEMA is the administrative body that is responsible for the coordination of the various environmental management activities in Kenya. NEMA is also the principal government authority for implementing all environmental policies.

NEMA is also responsible for granting EIA approvals and for monitoring and assessing activities in order to ensure that the environment is not degraded by such project activities.

Water Resources Management Authority

WRMA is a state corporation, established under the Water Act 2002 and charged with being the lead agency in water resources management. Among other functions, WRMA is responsible for issuing permits for water use.

National Environmental Council

The NEC is the main body under the EMCA, whose key function is to formulate and set national policy and direction for the protection of the environment as prescribed in the EMCA.

National Complaints Committee

The NCC investigates allegations and complaints of suspected cases of environmental degradation. The Committee also prepares and submits to the NEC periodic reports of its activities.

Standard and Enforcement Review Committee

SERC's key function is to advise NEMA on the criteria and procedures for the measurement of environmental standards including but not limited to water quality, effluent discharge, air quality and noise quality.

The National Environment Tribunal

The National Environment Tribunal (NET) has the following functions including to hear and determine appeals from NEMA's decisions and other actions relating to issuance, revocation or denial of Environmental Impact Assessment (EIA) licences or amount of money to be paid under the Act and imposition of restoration orders; to give direction to NEMA on any matter of complex nature referred to it by the Director General; and in accordance with the Forest Act No. 7 of 2005, NET is mandated to review decisions of the board under sections 33 and 63.

Ministry of Energy and Petroleum

The Ministry of Energy and Petroleum is responsible for facilitating the provision of clean, sustainable, affordable, reliable, and secure energy services for national development while protecting the environment.

Relevant departments include the Energy Regulatory Commission (ERC), which was established under the 2006 Energy Act. The ERC's objectives and functions include regulating electrical energy, petroleum and related products, renewable energy and other forms of energy, and setting and reviewing tariffs, regulation enforcement and approval of power purchase agreements. The ERC must be notified of accidents or incidents causing significant harm or damage to the environment or property, which has arisen in Kenya.

Ministry of Sports, Culture and the Arts

The mission of the Ministry is to develop, promote, preserve and disseminate Kenya's diverse cultural, artistic and sports heritage through formulation and implementation of policies which enhance national pride and improve the livelihood of the Kenyan people.

The mandate areas of relevance to the Project include the following:

- National Heritage Policy and Management;
- National Archives/Public Records management;
- Management of National Museums and Monuments; and

- Historical Sites Management.

Following the passage of the National Museum and Heritage Act, the National Museum of Kenya was established under the Ministry, which has the following function:

- Heritage promotion, collection and documentation, research;
- Research;
- Preservation and conservation; and
- Information dissemination.

Ministry of Transport and Infrastructure

The Ministry has two Departments, namely the State Department of Transport and the State Department of Infrastructure. The Ministry is mandated to perform the following functions (among others): National Roads Development Policy Management, Transport Policy Management, National Road Safety Management, Development and Maintenance of Airstrips, National Transport and Safety Policy, and Implementation of LAPSSET Project.

Other Government Agencies

Relevant government agencies to the Project at the national level include:

- Kenya Forest Services;
- Kenyan Wildlife Services;
- National Land Commission; and
- Kerio Valley Development Authority.

5.3 Kenyan Policy and Legislative Requirements

Table 5.1 and Table 5.2 below provide a summary of Kenyan legislation and policy documents respectively, which are applicable to the ESIA.

Table 5.1: Key Kenyan Policy Documents

Policy	Description
The National Water Policy (2012)	The National Water Policy includes details of the national government's policies and plans for the mobilisation, enhancement and deployment of financial, administrative and technical resources for the management and use of water resources.
The Wetland Policy (2013)	The Wetland Policy aims at providing a framework for mitigating the diverse challenges that affect wetlands conservation and use in Kenya. Adoption of the policy also fulfils Kenya's obligations under the Ramsar Convention.
The Wildlife Policy (2012)	The Wildlife Policy makes provision for an overarching framework for the prudent and sustainable conservation, protection and management of wildlife and wildlife resources in Kenya, with incidental provision on access and the fair and equitable distribution of benefits accruing there-from, and its alignment with other sector-specific laws and the environment policy.

Policy	Description
Kenya Vision 2030 (2010)	Kenya Vision 2010 is a national long-term development blue-print to create a globally competitive and prosperous nation with a high quality of life by 2030. The vision is anchored on three key pillars; economic, social and political governance.
National Land Policy (2009)	The Policy was a key component towards addressing questions in the previous regulatory framework and contained the vision to provide Kenyans with “sustainable and equitable” access to and use of land.

Table 5.2: Relevant National Legislation

Name of Legislation	Description
Environmental Management and Coordination Act (EMCA) (1999) and Amendments (2015), and the subsidiary Regulations notably:	The EMCA (Amendment) 2015 and its subsidiary regulations set out requirements and procedures for conducting EIAs, auditing and environmental monitoring in Kenya. Furthermore, they establish environmental standards for water quality, noise, fossil fuel emission, and waste management. It also regulates activities impacting wetlands, river banks, lake/sea shores, and the conservation of biological diversity.
The EMCA (Impact Assessment and Audit) Regulations (EIAAR) (2003)	These Regulations contain rules relative to the content and procedures of an EIA, to environmental audit and to monitoring and strategic environmental assessment. These rules regulate other matters such as the appeal for, and registration of, information regarding EIA. The draft ESIA and EA Guidelines for the Downstream Petroleum Sub-sector (2012) issued by the ERC provide advice on their interpretation to that sector.
The EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management Plan) Regulations (2009)	These Regulations require the protection of wetlands, river banks, lake shore and sea shore areas which provide ecological habitats.
The EMCA - (Fossil Fuel Emission Control) Regulations (2006)	These Regulations set emission standards for internal combustion engines, provide for the licensing of persons responsible for treating fuel, provide for the appointment of environmental inspectors required to inspect emissions, and authorise the NEMA to enter into partnerships in order to conduct emission inspections.

<table>
<tr><th>Name of Legislation</th><th>Description</th></tr>
<tr><td>The EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006)</td><td>These Regulations ensure that activities do not have an adverse impact on any ecosystem.</td></tr>
<tr><td>The EMCA (Water Quality) Regulations (2006)</td><td>These Regulations outline the water quality standards that should be met for different uses including effluent discharge. The following schedules in the Water Quality Regulation set out the relevant standards and monitoring requirements:
■ First Schedule: Quality Standards for Sources of Domestic Water;
■ Second Schedule: Quality Monitoring for Sources of Domestic Water;
■ Third Schedule: Standards for Effluent Discharge into the Environment;
■ Fourth Schedule: Monitoring Guide for Discharge into the Environment;
■ Fifth Schedule: Standards for Effluent Discharge into Public Sewers; and
■ Sixth Schedule: Monitoring for Discharge of Treated Effluent into the Environment.
The Water Resources Management Authority and NEMA are key administering authorities.</td></tr>
<tr><td>The EMCA (Noise and Excessive Vibration Pollution) Control Regulations (2009)</td><td>This regulation establishes environmental standards that should be met for noise. NEMA is a key administering authority. The following schedules in the Noise and Excessive Vibration Pollution Control Regulation set out the relevant standards and monitoring requirements:
■ First Schedule – Maximum Permissible Intrusive Noise Levels.
■ Second Schedule – Maximum Permissible Noise Levels for Construction Sites.
■ Third Schedule – Maximum Permissible Noise Levels for Mines and Quarries.
■ Fourth Schedule– Application for a License to Emit Noise/Vibrations in Excess of Permissible Levels.
■ Fifth Schedule–License to Emit Noise/Vibrations in Excess of Permissible Levels.</td></tr>
</table>

Name of Legislation	Description
	■ Sixth Schedule – Application for a Permit to Carry out Activities. ■ Seventh Schedule - Permit to Emit Noise in Excess. ■ Eighth Schedule - Minimum Requirements for Strategic Noise and Excessive Vibrations Mapping. ■ Ninth Schedule – Minimum Requirements for Action Plans. ■ Tenth Schedule – Improvement Notice.
The EMCA (Waste Management) Regulations (2006)	These Regulations set rules for general waste management and for the management of solid waste, industrial waste, hazardous waste, biomedical waste, radioactive waste, pesticides and toxic waste. These Regulations prohibit the pollution of public places, provide for the granting of licences for waste transportation and waste disposal facilities, and require an EIA to be undertaken on any site disposing of or generating biomedical waste.
The Water Act, (2002) and subsidiary legislation contained including the Water Resources Management Rules (2007)	This Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services. The Rules implement the Act.
The Wildlife Conservation and Management Act (WCMA) (2013)	An Act of Parliament to provide for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes. It also regulates wildlife conservation and management in Kenya, through the protection of endangered and threatened ecosystems. Specifically, it prohibits the disturbance or harm of flora and fauna within public places, community and private land, and Kenyan territorial waters. The Act also establishes Kenya Wildlife Service (KWS) as the implementing agency.
The National Museums and Heritage Act (2006)	An Act of Parliament to consolidate the law relating to national museums and heritage; to provide for the establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya. The Act also establishes a notification of discovery requirement, and sets restrictions on

Name of Legislation	Description
	moving objects of archaeological or paleontological interest.
Physical Planning Act (2012)	An Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purposes.
Occupational Health and Safety Act (2007), and subsidiary legislations and rules.	An Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. This Act includes requirements for the control of air pollution, noise and vibration in every workplace where the level of sound energy or vibration emitted can result in hearing impairment, be harmful to health or otherwise dangerous.
Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005	These rules require that where the noise level is above ninety dB(A), the employer shall post conspicuous signs reminding employees that hearing protection must be worn, supply hearing protection and ensure all employees wear hearing protection.
Prevention, Protection and Assistance to Internal Displaced Persons and Affected Community Acts (2012)	An Act of Parliament on internal displacement in Kenya that includes vital provisions to secure the participation of displaced people in decision-making that affects them.
Agriculture, Fisheries and Food Authority Act (2013)	The Agriculture, Fisheries and Food Authority Act consolidate the laws on the regulation and promotion of agriculture and makes provision for the respective roles of the national and county governments in agriculture and related matters.
Traffic Act (2014)	The Traffic Act relates to traffic on all public roads.
Kenya Roads Act (2007)	An Act of Parliament to provide for the establishment of the Kenya National Highways Authority, the Kenya Urban Roads Authority and the Kenya Rural Roads Authority, to provide for the powers and functions of the authorities and for connected purposes.
Petroleum (Exploration and Production) Act,1984	An Act of Parliament to regulate the negotiation and conclusion by the government on petroleum agreements relating to the exploration, development, production and transportation of petroleum and for connected purposes.

Draft legislation and guidelines which are expected to be relevant to this study are provided in Table 5.3.

Table 5.3: Draft Legislation and Guidelines

Name of Legislation	Description
The Energy Bill, 2014	The Energy Bill provides for a National Energy Policy and for the establishment of energy related entities and will provide for the regulation of midstream and downstream activities.
The Petroleum Exploration, Development and Production Bill, 2014, and subsidiary regulations: ■ Petroleum Exploration, Development and Production (Local Content) Regulations, 2014	The Bill once it comes into force is to provide a framework for the contracting, exploration, development and production of petroleum and cessation of upstream petroleum operations. The local content regulation will apply to local content with respect to the upstream petroleum operations.
The Water Bill, 2014	The Water Bill provides for the regulation, management and development of water resources and water and sewerage services in line with the constitution. The Bill will provide for the repeal of the Water Act, 2002.
The EMCA (Air Quality Standards) Regulations, 2008	This Regulation's objective is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries). The Regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas.
The Forest Conservation and Management Bill, 2014	The Bill provides for the declaration and management of forest areas and for the protection of such areas by establishing management boards to regulate all activities in such areas.
Draft Community Land Bill (2013)	The draft bill provides a legislative framework to give effect to Article 63 of the Constitution and makes provision for the recognition, protection, management and administration of community land. The proposed legislation allows a community to register ownership of an area of community land. The NLC administers the registration process.

5.4 International Guidance and Standards

The following international guidance, representing international best practices and standards, will be incorporated in all aspects of the ESIA. More specifically, the ESIA will comply with the IFC Performance Standards and EHS Guidelines.

- IFC (2012). Performance Standards for Environmental and Social Sustainability and accompanying Guidance Notes.

- **Performance Standard 1: Assessment and Management of Environmental and Social Risk and Impacts.** This standard aims to identify and evaluate all environmental and social risks of the Project and to promote improved environmental and social performance through effective use of management systems. The standard also promotes adequate engagement throughout the Project cycle.
- **Performance Standard 2: Labour and Working Conditions.** The objectives of Performance Standard 2 are to promote the fair treatment, non-discrimination and equal opportunity of workers in accordance with national laws and international conventions and instruments, specifically the core conventions of the International Labour Organisation and United Nations conventions related to rights of the child and migrant workers.
- **Performance Standard 3: Resource Efficiency and Pollution Prevention.** The objectives of Performance Standard 3 include avoiding or minimising pollution from project activities in order to avoid or minimise impacts on human health and the environment. This performance standard aims to promote the sustainable use of resources including energy and water and to reduce project-supplied GHG emissions.
- **Performance Standard 4: Community Health, Safety and Security.** The objectives of Performance Standard 4 include avoiding or minimising risks and impacts relating to the health and safety of the local community during the Project life cycle from both routine and non-routine circumstances. This performance standard aims to ensure that the safeguarding of people and property is conducted in a legitimate way which avoids or minimises risks to the community's safety and security.
- **Performance Standard 5: Land Acquisition and Involuntary Resettlement.** The objectives of Performance Standard 5 include the avoidance or minimisation of displacement and the avoidance of forced eviction. The responsible party should anticipate and avoid or minimise adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets and ensuring resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected. The performance standard requires the improvement or restoration of the livelihoods and standards of living of the displaced persons. Living conditions among physically displaced persons should be improved through the provision of adequate housing with security of tenure at resettlement sites.
- **Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.** This standard aims to protect and conserve biodiversity. The standard promotes the utilisation of practices which integrate conservation needs and development priorities to promote the sustainable management and use of natural resources.
- **Performance Standard 7: Indigenous Peoples.** The objective of this Performance Standard is to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture and natural resource-based livelihoods of Indigenous Peoples.
- **Performance Standard 8: Cultural Heritage.** This standard aims to protect cultural heritage from adverse impacts of project activities and support its preservation; and also promotes the equitable sharing of benefits from the use of cultural heritage in business activities.

- IFC (2007a). EHS General Guidelines.
  - **EHS Guidelines: Wastewater and Ambient Water Quality.** These guidelines apply to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment, which may have implications for the Project's water treatment requirements. The guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. The guidelines also state that if sewage from an industrial facility is to be discharged to surface water, treatment to meet

national or local standards for sanitary wastewater discharges is required. In their absence, indicative guideline values are provided by the IFC for sanitary wastewater discharges.

- **EHS Guideline: Air Emissions and Ambient Air Quality.** These guidelines apply to facilities or projects that generate emissions to air at any stage of the Project's life-cycle.
- **EHS Guideline: Occupational Health and Safety**. These guidelines apply to workers exposed to chemical and physical (i.e. noise) hazards whilst at work.
- **EHS Guideline: Noise**. These guidelines apply to projects that have noise impacts beyond the property boundary of the facilities. These guidelines establish noise standards that should not be exceeded, and also stipulates that noise levels should not result in a maximum increase in background levels of 3dB at the nearest receptor location offsite.
- **EHS Guidelines for Water and Sanitation.** These guidelines include information relevant to the operation and maintenance of potable water treatment and distribution systems, and collection of sewage in centralised systems, decentralised systems, and treatment of collected sewage at centralised facilities.
- **EHS Guidelines for Onshore Oil and Gas Development.** These guidelines include information on industry-specific impacts, management performance indicators, and monitoring related to seismic exploration, exploration and production drilling, development and production activities, transportation activities including pipelines, other facilities including pump stations, metering stations, pigging stations, compressor stations and storage facilities, ancillary and support operations, and decommissioning.
- **EHS Guidelines for Thermal Power Plants.** These guidelines may apply if the total power quantity generated at the CPF is greater than 50MWth.

Good Practice guidelines which will be referred to throughout the ESIA include but are not limited to the following:

- Business and Biodiversity Offsets Programme (2012). BBOP Standard on Biodiversity Offsets Guidance.
- IFC (2013). Good Practice Handbook: Cumulative Impact Assessment and Management – Guidance for the Private Sector in Emerging Markets.
- International Petroleum Industry Environmental Conservation Association (IPIECA) (2005).
- IPIECA (2007). An ecosystem approach to oil and gas industry biodiversity conservation.
- IPIECA (2010). Alien invasive species and the oil and gas industry Guidance for prevention and management.
- IPIECA (2014). Cross Sector Biodiversity Initiative Guidance.
- The Energy and Biodiversity Initiative (2006). Integrating Biodiversity into Environmental and Social Impact Assessment Processes and associated guidance.
- The Energy and Biodiversity Initiative (2006). Negative Secondary Impacts from Oil and Gas Development; www.theebi.org.
- The Energy and Biodiversity Initiative (2006). Biodiversity Indicators for Monitoring Impacts and Conservation Actions; www.theebi.org.
- The Energy and Biodiversity Initiative (2006). Opportunities for Benefiting Biodiversity Conservation; www.theebi.org.
- The Energy and Biodiversity Initiative (2006). Good Practice in the Prevention and Mitigation of Primary and Secondary Biodiversity Impacts; www.theebi.org.

- The Energy and Biodiversity Initiative (2006). Framework for Integrating Biodiversity into the Site Selection Process; www.theebi.org
- World Resources Institute (WRI) (Landsberg F, Treweek J, Stickler MM, Henninger N and Venn 0) (2013). Weaving ecosystem services into impact assessment: A Step-By-Step Method.
- WHO (2011). Drinking Water Quality Guidelines – 4th edition.
- WHO (2005). Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines.
- WHO (1999). Guidelines for Community Noise.

5.5 International Conventions

Relevant international agreements, treaties and conventions that have a social and/or environmental aspect to which Kenya is a signatory/acceded or ratified to are detailed in Table 5.4 below. Refer to Chapter 6.0 for applicability to each of the technical disciplines.

Table 5.4: International Conventions

Convention	Date Ratified/Acceded to
African Convention for the Conservation of Nature and Natural Resources (2003)	Ratified (12 May 1969)
Convention on Biological Diversity (1992)	Ratified (26 July 1994)
Vienna Convention for the Protection of the Ozone Layer (1985)	Acceded to (9 November 1988)
UNESCO Convention for the Protection of the World Cultural and Natural Heritage (1972)	Acceded to (1 May 1964)
Convention on the Conservation of Migratory Species of Wild Animals (1985) ■ The African-Eurasian Water-bird Agreement (AEWA). ■ The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA).	Acceded to (26 February 1999)
Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	Acceded to (13 December 1978)
Convention on Wetlands of International Importance (the Ramsar Convention 1971)	Only signatory
Convention on Persistent Organic Pollutants (2001)	Ratified (24 September 2004)
Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1995)	Acceded to (1 June 2000)
Bamako Convention on the Ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa (1991)	Only signatory
Convention on Biological Diversity (2006)	Ratified (26 July 1994)

Convention	Date Ratified/Acceded to
Convention on Climatic Change and the Kyoto Protocol (1997)	Ratified (25 February 2005)
Lusaka Agreement on the Cooperative Enforcement Operations Directed against Illegal trade in Fauna (1994)	Ratified (17 January 1997)
Nile Basin Initiative (1999)	N/A

5.6 TKBV Policy

Tullow environmental and social internal policies and standards will also apply, including, but not limited to:

- EHS policy statement;
- Tullow Integrated Management System; and
- Tullow Oil Shared Prosperity Commitment.

5.7 Required Authorisations

Prior to project development, a number of permits and consents must be obtained from various government agencies. NEMA is one government agency with a key role in issuing such authorisations as projects with potential environmental impacts must be approved by NEMA in accordance with the EMCA (Amendment) 2015, and associated regulations.

One relevant environmental licence required by the Project proponent is an EIA Licence. An application for an EIA License is submitted to NEMA in the form of a Project Report. A project that NEMA considers should be subjected to an EIA study must first undergo a Scoping Study, followed by a full EIA study, which includes public and stakeholder consultation.

NEMA will review the EIA once submitted and will rely on technical advice from other government agencies and organisations when approving a new project. NEMA also receives guidance on local issues and advice from surrounding communities and stakeholders.

Other relevant key environmental, health and safety permits, licences and authorisations required include:

- Air emissions licence;
- Waste disposal licences;
- Water use, swamp drainage and discharge permits;
- Effluent discharge licence;
- Noise and/or vibrations licence;
- Temporary noise permit;
- Access to land;
- Consents for drain connection and water flow obstruction;
- Permit for movement of heritage items;
- National safety and security fund registration;
- Registration of workplace; and
- Work injuries and benefits registration.

6.0 TECHNICAL TOPICS

This chapter describes applicable standards, baseline conditions, the key data gaps, and the proposed assessment approach for each of the following technical topics:

- Biodiversity;
- Ecosystem Services;
- Soil, Terrain and Geomorphology;
- Water;
- Seismicity and Geology;
- Air and Climate;
- Noise and Vibration;
- Landscape and Visual;
- Cultural Heritage; and
- Social, which includes:
  - Administrative Divisions and Governance Structure
  - Demographics
  - Infrastructure and Services
  - Economics
  - Land Use and Ownership
  - Community Health and Safety
  - Education
  - Social Maladies
  - Social Capital and Conflict

Whilst waste is not included in the above list as a specific technical topic, the ESIA will assess potential impacts from the generation of hazardous and non-hazardous waste from the project under each technical topic, and describe the proposed treatment and disposal technologies that are to be used.

The ESIA will also assess potential impacts arising from commissioning under each technical topics, where relevant.

6.1 Biodiversity

6.1.1 Introduction

The elements and activities of the Upstream Project that are likely to affect biodiversity include:

- The land take required to accommodate and construct project facilities could lead to the direct loss of protected areas, land cover and/or habitats from clearing and site preparation;
- Direct effects resulting from project construction and operation activities include;
  - Air emissions and dust deposition;

  - Sensory disturbance (light, noise, vibration, odour);
  - Direct mortality of fauna (e.g. on roads, in open trenches), changes to surface water runoff and flood regimes;
  - Spillages of contaminants due to catastrophic failure of project infrastructure;
  - Discharge of unacceptable concentrations of contaminants;
  - Population influx;
  - Surface water and/or groundwater abstraction affecting water quality and quantity and any subsequent impacts on riparian habitat and species downstream of abstraction; and
  - Barriers to movement.
- Indirect effects resulting from project construction and operation activities include:
  - Population influx;
  - Introduction of weed, pest and disease species during the construction, operation and decommissioning of the Project, which could affect vegetation communities and fauna and flora populations, resulting in changes to habitat quantity and quality; and
  - Increased access to areas of biodiversity value, via development of new roads.

6.1.2 Applicable standards and guidance

A detailed list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the biodiversity assessment in the ESIA.

National Policy and Legislation

The following national policy and legislation are considered relevant to be applicable to the ESIA:

- The Republic of Kenya. The Wildlife Conservation and Management Act, 2013;
- The Republic of Kenya. The Environmental Management and Co-ordination Act (Wetlands, River Banks, Lake Shore and Sea Shore Management) Regulations, 2009;
- The Republic of Kenya. The Environmental Management and Co-ordination Act (Conservation of Biological Diversity and Resources, Access to Genetic and Benefit Sharing) Regulations, 2006; and
- Ministry of Forestry and Wildlife. The National Wildlife Conservation and Management Policy, 2012.

International Guidance and Standards

The following Performance Standards and guidelines are specifically applicable to the assessment of biodiversity in the Upstream Area:

- International Finance Corporation. Performance Standard 6: 2012. Biodiversity Conservation and Sustainable Management of Living Natural Resources. IFC, 2012;
- International Petroleum Industry Environmental Conservation Association and the International Association of Oil and Gas Producers. A guide to developing biodiversity action plans for the oil and gas sector. IPIECA and OGP, 2005;
- International Petroleum Industry Environmental Conservation Association and the International Association of Oil and Gas Producers. An ecosystem approach to oil and gas industry biodiversity conservation. IPIECA and OGP, 2007;
- International Petroleum Industry Environmental Conservation Association (2007). An ecosystem approach to oil and gas industry biodiversity conservation. http://www.ipieca.org;

- International Petroleum Industry Environmental Conservation Association (2010). Alien invasive species and the oil and gas industry Guidance for prevention and management. http://www.ipieca.org.The Energy and Biodiversity Initiative (2006). Integrating Biodiversity into Environmental and Social Impact Assessment Processes; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Integrating Biodiversity into Environmental and Social Impact Assessment Processes; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Negative Secondary Impacts from Oil and Gas Development; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Biodiversity Indicators for Monitoring Impacts and Conservation Actions; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Opportunities for Benefiting Biodiversity Conservation; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Good Practice in the Prevention and Mitigation of Primary and Secondary Biodiversity Impacts; www.theebi.org; and
- The Energy and Biodiversity Initiative (2006). Framework for Integrating Biodiversity into the Site Selection Process; www.theebi.org.

International Conventions

The following conventions, to which Kenya is a signatory as well as a party to, relate to the protection of natural environment (i.e. ecosystems), and are considered to be applicable to the ESIA for the Upstream Area:

- The African Union. African Convention for the Conservation of Nature and Natural Resources. The African Union, 2003;
- United Nations. Convention on Biological Diversity. United Nations, 1992;
- Convention on the Conservation of Migratory Species of Wild Animals, 1985;
- Convention on International Trade in Endangered Species (CITES);
- The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) (1999);
- Convention on Wetlands of International Importance (the Ramsar Convention), 1971; and
- The World Heritage Convention, 1972.

6.1.3 Baseline

6.1.3.1 Available data

The following data/data sources were identified as available during the scoping stage:

- Integrated Biodiversity Assessment Tool (IBAT) data, including Red List species extents of occurrence and/or areas of occupancy, Key Biodiversity Areas (KBA), Endemic Bird Areas (EBA), Important Bird Areas (IBA), protected areas, wetland areas (IBAT, 2014);
- Regional vegetation communities and underlying geology of Northern Kenya (ILRI, 2011);
- Regional vegetation communities (White, 1983);
- Semi-supervised land-cover classification of Lokichar development area (ERA, 2014);
- Records of species presence and distribution held by the Global Biodiversity Information Facility (GBIF);
- Local records of species presence and distribution provided by National Museum of Kenya;

- Extensive literature library comprising information sourced for literature review component of critical habitat screening report;
- Ground truthing of desk top data including visual observations but no sampling, completed during a brief (less than one week) scoping visit in December 2014, attended by Golder representative Ruth Golombok and Bernard Agwanda of NMK; and
- Results of critical habitat screening exercise completed in March 2015.

6.1.3.2 Area of influence and study area

The biodiversity AOI will be similar to the AOI for the Upstream Project (Figure 1) because of the potential for the Project to affect biodiversity features in the wider area. Although it is subject to the outcome of the ongoing water abstraction and transport optioneering processes, the current biodiversity AOI will encompass the southern portion of Lake Turkana, the sub-counties of Loima, Turkana Central, Turkana South, Turkana East, as well as the potential pipeline route from the Turkwel Gorge Reservoir, and the A1 Lokichar to Kitale Highway. The current AOI covers the Kerio and Turkwel Rivers within whose river basins the Upstream Area lies.

The potential AOI currently includes the following protected areas:

- Lake Turkana National Parks World Heritage Site;
- South Turkana National Reserve;
- Nasalot National Reserve;
- Sekerr Forest Reseve;
- Kamatiri Forest Reserve;
- Lelan Forest Reserve; and
- Sogotio Forest Reserve.

The biodiversity Study Area will focus on the footprint of all the Upstream Project components and the oil fields. It will also encompass the potential pipeline route from the Turkwel Gorge Reservoir as well as the area of the potential abstraction point, and the Turkwel River downstream of the abstraction point.

6.1.3.3 Baseline conditions

Critical Habitat determination is a requirement under IFC Performance Standard 6 (PS6) to manage risk and avoid or mitigate and, where necessary, offset impacts to areas of high biodiversity value. A Critical Habitat Assessment Area (CHAA, refer to Figure 3) has been defined for the preliminary screening of potential triggers of critical habitat at the species, ecosystem and landscape level. Potential triggers are screened against both quantitative and qualitative criteria for the determination of critical habitat as identified in IFC PS6, and are listed below:

- Criterion 1 - Habitat of significant importance to critically endangered and/or endangered species.
- Criterion 2 - Habitat of significant importance to endemic and/or restricted-range species.
- Criterion 3 - Habitat supporting globally significant concentrations of migratory species and/or congregatory species.
- Criterion 4 - Highly threatened and/or unique ecosystems.
- Criterion 5 - Areas associated with key evolutionary processes.
- Criterion 6 - Areas required for seasonal refugia for critically endangered and/or endangered species.
- Criterion 7 - Ecosystems of known special significance to critically endangered or endangered species for climate adaptation purposes.

- Criterion 8: Concentrations of vulnerable species in cases where there is uncertainty regarding the listing, and the actual status of the species may be critically endangered or endangered.
- Criterion 9 - Areas of primary/old-growth/pristine forests and/or other areas with especially high levels of species diversity.
- Criterion 10 - Landscape and ecological processes (for example, water catchments, areas critical to erosion control, disturbance regimes) required for maintaining critical habitat.
- Criterion 11 - Habitat necessary for the survival of keystone species; that is, species that act as ecosystem engineers and drive ecosystem process an functions, for example, elephants in savannah woodlands and their foraging behaviours that maintain vegetation structure.
- Criterion 12 - Areas of high scientific value, such as those containing concentrations of species new and/or little known to science.
- Criterion 13 - An area of known high concentrations of natural resources exploited by local people.
- Criterion 14 - Areas that meet the criteria of the IUCN's Protected Area Management Categories Ia, Ib and II, although areas that meet criteria for Management Categories III-VI may also qualify depending on the biodiversity values inherent to those sites.
- Criterion 15 - KBAs, which encompass inter alia Ramsar Sites, IBAs, Important Plant Areas (IPA) and Alliance for Zero Extinction Sites.
- Criterion 16 - Areas determined to be irreplaceable or of high priority/significance based on systematic conservation planning techniques carried out at the landscape and/or regional scale by governmental bodies, recognized academic institutions and/or other relevant qualified organisations (including internationally-recognised NGOs).
- Criterion 17- High Conservation Value (HCV) areas, as defined by IFC PS6

The Critical Habitat screening identifies:

- 66 species of concern that could trigger critical habitat in the CHAA, including:
  - 2 insect species;
  - 1 macro-invertebrate species;
  - 17 fish species;
  - 2 amphibian species;
  - 1 reptile species;
  - 27 bird species, and
  - 16 mammal species.

Many plant and invertebrate species have not yet been assessed by the IUCN. Very few records exist for those species in the CHAA. Therefore, the screening of such species is not exhaustive and, hence, a potential exists for such species to occur in the CHAA.

- Four vegetation communities that could trigger critical habitat include:
  - Deciduous wooded annual grassland;
  - Evergreen and semi-deciduous bushland;
  - Evergreen and semi-deciduous woodland; and
  - Undifferentiated evergreen forest.

These potential triggers of critical habitat will be brought forward and fully assessed as part of the ESIA. They will form the basis of a more detailed assessment using expert opinion and targeted surveys. Furthermore, as mentioned, it is recognised that many plant and invertebrate species have not yet been assessed by the IUCN. Hence, the possible presence of triggers from these two groups should not be discounted. The ESIA will seek to confirm if such species exist in the CHAA.

Figure 4 (Sensitivity Map of CHAA) presents ecosystems of concern and available spatial records of species of concern (GBIF, 2014; NMK, 2015) within the CHAA, based on available information to date.

There are notably scarce records for plants and invertebrates - until dedicated field surveys are conducted during the baseline, there is little available data on what plant/invertebrate species may occur within the CHAA at this stage.

It can be expected that additional species records for plants and invertebrates will be added as further information becomes available during the ESIA.

6.1.3.4 Key data gaps

Primary data gathering in potentially affected areas is the key data gap, which will be addressed through an extensive suite of field survey planned for 2015/2016:

- Aquatic Ecosystems: quantitative and qualitative characterisation of riparian (lugga) systems in the vicinity of the proposed development and downstream of the proposed water abstraction point on the Turkwel River, and any temporary pools and wadis within the footprint of the Upstream Study Area.
- Wetland Ecosystems: characterisation of the boundaries of wetlands located downstream of proposed abstraction points. Other gaps include determining attributes relating to habitat condition, adjacent land use, and levels of disturbance.
- Vegetation and Flora: flora and habitat inventory for the Upstream Study Area.
- Birds, Herpetofauna and Invertebrates: Identification and characterisation of species in the Study Area, including distribution, relative abundance, populations, communities and habitat associations.
- Large and Small Mammals: Identification and characterisation of mammals in the study area, including distribution, relative abundance, populations, communities and habitat associations.

6.1.4 Identification of potentially significant effects

The following presents the environmental aspects that have been identified as potential effects that the Upstream Project could have on biodiversity features (ecosystems and species). The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Direct loss/conversion of natural ecosystems, features of biodiversity value (including critical habitat, species of concern) or habitat due to:
  - Clearing and earthmoving for construction, operation and closure of project infrastructure and pipelines – scoped in;
  - Project infrastructure located in legally protected areas including Mount Elgon Biosphere Reserve, Mount Kulal Biosphere reserve and Lake Turkana WHS – scoped out, since infrastructure avoids these areas although will be scoped in if Lake Turkana is the selected source of make-up water used for water injection;
  - Project infrastructure located in potential critical and/or important habitats or environmentally sensitive areas – scoped in;
  - Project infrastructure located in riparian vegetation – scoped in;

- Project infrastructure located in wetland areas - scoped out, since infrastructure avoids wetlands;
- Changes in surface water runoff and flooding regimes – scoped in;
- Groundwater abstraction – scoped in;
- Contamination from increased airborne/waterborne contaminants, noise, vibration, light and odour during construction and operation, and following closure of the Project – scoped in;
- Contamination from a catastrophic failure of project infrastructure– scoped out of biodiversity, but assessed in design of the Project and project hazards analysis;
- Water abstraction during construction and operations – scoped in; and
- Water abstraction following closure of the Project – scoped out, since water supply required only during operations and construction.

- Direct loss of palaeo-ecology – scoped out, since there is no evidence of palaeo-ecology observed during scoping site visit.
- Indirect loss/conversion of legally protected areas (including Outstanding Universal Value of Lake Turkana WHS) due to influx of opportunity seekers– scoped in.
- Indirect loss of areas of biodiversity value due to:
  - Harvesting of medicinal plants, bush meat, fishing, increased fuel wood harvest – scoped in;
  - Introduction of invasive species that could out-compete indigenous species – scoped in;
  - Changes to hydrological and sedimentation regimes – scoped in; and
  - Increased access, via development of new roads – scoped in.
- Loss of migration routes due to:
  - Barriers formed by power line – scoped in;
  - Barriers formed by pipelines once in place during operations – scoped in; and
  - Air-borne contamination and sensory disturbance, odour, noise, light – scoped in.

6.1.5 Summary of approach to the ESIA

A summary of the approach to the biodiversity component of the ESIA is provided in Table 6-1.

Table 6-1: Analysis of potential effects (Biodiversity)

Receptor	Potential Effect	Next Steps in the ESIA
Vegetation and flora	■ Direct loss of natural ecosystems and flora species (including species of concern) within the Upstream Area, due to Project construction, operation decommissioning activities. ■ Indirect/induced loss/conversion of natural habitat due to Project facilities.	*Baseline data gathering –* ■ Assessment of the extent, condition and quality of the vegetation communities within the Upstream Area. ■ Vegetation and flora studies of the vegetation communities within the proposed oil fields and CPFs. ■ Vegetation mapping of CHAA, including mapping of modified and natural habitat, to inform the

Receptor	Potential Effect	Next Steps in the ESIA
	■ Indirect/induced loss/conversion of natural habitat as a result of spontaneous settlement, agricultural conversion, and increased demand for ecosystem services (e.g. harvest of timber) associated with population influx. ■ Harvesting of medicinal plants, fibre and wood ■ Introduction of invasive species. ■ Direct/indirect losses of riparian vegetation. ■ Increased access, via development of new roads. ■ Fragmentation and edge effects. ■ Changes to hydrological regimes. ■ Increased erosion and sedimentation.	determination of modified, natural and critical habitats. *Impact Assessment –* ■ The vegetation and flora impact assessment analysis will be largely habitat-area based using GIS, focussing on select ecosystem or community-level indicators, as identified during the baseline habitat and vegetation mapping study.
Birds	■ Direct loss of nesting and foraging habitat within the Upstream Area. ■ Mortality of individuals and/or local populations. ■ Indirect/induced loss/conversion of preferred and/or critical habitat through sensory disturbance.	*Baseline data gathering –* ■ Three seasonally representative field surveys will be undertaken to identify bird species use of the Upstream Area, and establish distribution, relative abundance, populations, communities and habitat associations. *Impact Assessment –* ■ The impact assessment will be based on analysis of population effects and habitat-area based analysis using GIS, and will focus on bird species of concern identified during the baseline.
Herpetofauna	■ Direct loss of basking sites, refugia and foraging habitat, breeding habitats within the Upstream Area.	*Baseline data gathering –* ■ A survey of herpetofauna will be conducted within the Upstream Area and areas identified as being of high

Receptor	Potential Effect	Next Steps in the ESIA
	■ Mortality of individuals and/or local populations. ■ Sensory disturbance. ■ Introduced diseases.	potential to support species of concern. *Impact Assessment –* ■ The impact assessment will be based on analysis of population effects and habitat-area based analysis using GIS, and will focus on reptile and amphibian species of concern identified during the baseline that will be measurably affected by the Project.
Invertebrates	■ Direct loss of refugia and foraging habitat within the Upstream Area. ■ Mortality of individuals and/or local populations. ■ Sensory disturbance.	*Baseline data gathering –* ■ A survey of terrestrial invertebrates will be conducted within the Upstream Area and areas identified as being of high potential to support species of concern. *Impact Assessment –* ■ The impact assessment will be based on analysis of population effects and habitat-area based analysis using GIS, and will focus on invertebrate species of concern identified during the baseline that will be measurably affected by the Project.
Large mammals	■ Direct loss of refugia and foraging habitat within the Project infrastructure footprint. ■ Mortality of individuals and/or local populations. ■ Indirect/induced loss/conversion of preferred habitat. ■ Indirect/induced loss through increased bush meat hunting pressure from population influx. ■ Sensory disturbance. ■ Introduced diseases. ■ Barriers to movement.	*Baseline data gathering –* ■ Transect surveys will be conducted in the Upstream Area and selected control sites. ■ A remote camera trapping scheme will be deployed across the Upstream Area and selected sites. *Impact Assessment –* ■ The impact assessment will be based on analysis of population effects and habitat-area based analysis using GIS, and will focus on large mammal species of concern identified during the baseline that will be measurably affected by the Project.

Receptor	Potential Effect	Next Steps in the ESIA
Small mammals	■ Direct loss of nesting and foraging habitat within the Project infrastructure footprint. ■ Mortality of individuals and/or local populations. ■ Indirect/induced loss/conversion of preferred habitat. ■ Indirect/induced loss through increased bush meat hunting pressure from population influx. ■ Sensory disturbance. ■ Introduced diseases. ■ Barriers to movement.	*Baseline data gathering –* ■ A small mammal trapping scheme will be deployed across the different vegetation communities of the Upstream Area. ■ Bat species usage of the Upstream Area will be assessed through installation and rotation of passive acoustic monitors, and analysis of echolocating bat call signatures. *Impact Assessment –* ■ The impact assessment will be based on analysis of population effects and habitat-area based analysis using GIS, and will focus on small mammal species of concern identified during the baseline that will be measurably affected by the Project.
Aquatic and Wetland ecosystems	■ Direct loss/conversion of natural lugga and wetland ecosystems and habitat. ■ Indirect/induced loss/conversion of natural habitat. ■ Contamination from increased waterborne pollutants. ■ Change to hydrological regimes. ■ Introduced pests and diseases.	*Baseline data gathering –* ■ Fish and macro-invertebrates will be sampled at selected sites on the Turkwel River downstream of the proposed water abstraction point. Should sufficient flow occur in the Kalabata during the long wet season, sampling will also be conducted downstream of the Upstream Area. ■ Wetland ecosystems associated with the Turkwel River will be surveyed at selected sites. *Impact Assessment –* ■ The impact analysis will enable effects on aquatic flora and fauna to be assessed, through the examination of stressor indicators, habitat indicators, response indicators, and valued receptors (e.g. regionally/locally endemic fish species, Ramsar wetlands) and will focus on quantifying potential Project effects relative to baseline conditions.

6.1.6 References

ERA, 2014. Semi-supervised land cover classification – Lokichar development areas, Kenya. GIS dataset generated during scoping stage for the Project.

IBAT, 2014. GIS shapefiles including WDPA polygon boundaries for Kenya, Key Biodiversity Areas in Kenya including Important Bird Areas, Boundaries of Alliance for Zero Extinction sites, Regional biodiversity hotspot areas, endemic bird areas, and IUCN Red List species density grid.

ILRI, 2011. Vegetation types of Northern Kenya. International Livestock Research Institute (ILRI) spatial data.

White, F. 1983. *Vegetation of Africa - a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa*. Natural Resources Research Report 20; U. N. Educational, Scientific and Cultural Organization; 7 Place de Fontenoy, 75700 Paris, France.

6.2 Ecosystem Services

6.2.1 Introduction

Ecosystem services consist of all the natural products and processes that contribute to human well-being, as well as the personal and social enjoyment derived from nature (Landsberg, Stickler, Henninger, Treweek, & Venn, 2013). They are the benefits that people, including businesses, derive from ecosystems. The broad categories of ecosystem services as defined by the *Millennium Ecosystem Assessment* (MA, 2005), their definition, and their context in terms of the Upstream Area is presented in Table 6-2.

Table 6-2: Defining Ecosystem Services in the Context of the Study Area

Broad category	Definition	Example in the Upstream Area
Regulating services	Ecosystem control of the natural environment, including air quality, climate, water flow timing, erosion control, and water purification.	Regulation of water timing and flows; for instance permeable soils like lugga sands facilitate fast aquifer recharge
Provisioning services	The goods or products obtained from ecosystems, such as medicinal plants and minerals, water sources, fishing grounds, fire wood	Wild foods such as the fruits of the duam palm, bushmeat (dikdik) and honey supplement the diet of pastoralist people of the region
Cultural services	Aesthetic, spiritual, recreational, and other cultural values supplied by ecosystems; such as sacred sites, recreation areas, sense of place	Certain trees (e.g. *Maytenus* sp.) are used by Turkana people as meeting places and forums. In many cases, these trees are considered sacred and may not be cut down
Supporting services	Natural processes essential to resilience, and functioning of ecosystems, that maintain the other ecosystem services	Primary production – growth of grass within the Upstream Area dictates the presence of pastoralists in the area

Ecosystem Services are therefore intrinsically linked with Biodiversity and the Social topics and as such its characterisation and assessment of impacts are highly dependent on biodiversity baseline data, as well as a strong understanding of the socio-economic context and cultural heritage linkages

6.2.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. Ecosystem services are largely addressed by IFC PS6; nevertheless the assessment of ecosystem services is spread throughout the environmental and social Performance Standards (PS) because the potential effects of a project on ecosystem services relates to all aspects of peoples' relationship with the environment, including health and safety risks, land ownership or usage, and cultural heritage. The specific PS that contain provisions for ecosystem services assessment are PS1, PS3, PS4, PS5, PS7 and PS8.

In addition, the following generally accepted best practise guidance provides additional assessment approaches specific to ecosystem services assessment in the ESIA:

International Guidance and Standards

- International Petroleum Industry Environmental Conservation Association and the International Association of Oil and Gas Producers 2007. An ecosystem approach to oil and gas industry biodiversity conservation. IPIECA and OGP.
- International Petroleum Industry Environmental Conservation Association 2007. An ecosystem approach to oil and gas industry biodiversity conservation. http://www.ipieca.org.
- International Petroleum Industry Environmental Conservation Association (2010). Alien invasive species and the oil and gas industry Guidance for prevention and management. http://www.ipieca.org.
- International Petroleum Industry Environmental Conservation Association (2011). Ecosystem Services Guidance: Biodiversity and Ecosystem Services Guide and Checklists. http://www.ipieca.org.
- World Resources Institute (2013). Weaving ecosystem services into impact assessment: A Step-By-Step Method.

International Conventions

The following conventions relating to the protection of natural resources and cultural heritage are specifically applicable to the assessment of ecosystem services:

- The Convention for the Protection of the World's Cultural and Natural Heritage, 1972
- The Convention for the Safeguarding of the Intangible Cultural Heritage, 2003

6.2.3 Baseline

6.2.3.1 Available data

Available data for use in the preliminary assessment of ecosystem services supply within the Upstream Area includes the biodiversity data outlined in Section 6.1.3.1; available data on cultural services supplied by the ecosystems within the Upstream Area including NMK data holdings on locations of all archaeological, palaeontological and cultural sites; and some limited socio-economic information for the area (reports from Kenya National Bureau of Statistics).presents known data relevant to ecosystem services.

6.2.3.2 Area of influence and study area

The ecosystem services AOI will generally align with the AOI used for the socio-economic baseline assessment because of the potential for the project to affect ecosystem services in the wider area. It will encompass the three sub-county administrative units or Constituencies of Turkana East, Turkana South and Turkana Central, as well as the area extending to the border of Uganda and the town of Kitale.

6.2.3.3 Baseline conditions

Section 6.1.3 presents baseline conditions relevant to ecosystem services.

6.2.3.4 Key data gaps

Although the use of ecosystems by local people within the region is generally understood, little empirical information exists on the extent to which people use or rely upon ecosystem services supplied within the region. This lack of information will be addressed by the data baseline gathering for technical topics including Biodiversity, Soils, Water, Cultural Heritage and Social, which will be influenced by the Ecosystem Services specialists to ensure the correct information is gathered to inform the Ecosystems Services Assessment.

6.2.4 Identification of potentially significant effects

The following presents the potentially significant effects specific to ecosystem services. Ecosystem services may be affected by significant effects presented in Sections 6.1.4, 6.3.4, 6.4.4, 6.9.4and 6.10.4. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Influx of opportunity seekers during construction and operation whose activities and demands could affect processes, functioning and integrity of ecosystems, which could lead to a loss in the capacity to supply services – scoped in;
- Direct or indirect loss of ecosystem services through ecosystem alteration/loss due to construction and operation of the project – scoped in; and
- Indirect loss of ecosystem services through alteration of ecosystem processes, functioning and integrity, which could lead to a loss in the capacity to supply services – scoped in.

6.2.5 Summary of approach to the ESIA

The approach presented in Sections 6.1.5, 6.3.5, 6.4.5, 6.9.5, and 6.10.5 will inform the Ecosystem Services assessment, however
Table 6-3 presents a summary the approach which is specific to ecosystem services.

Table 6-3: Analysis of potential effects (Ecosystem Services)

Receptor	Potential Effect	Next Steps in the ESIA
Vegetation and flora	■ Direct loss of habitats and vegetation communities within the Upstream Area, due to Project construction, operation decommissioning activities affecting the systems' capacity to supply services. ■ Indirect/induced loss/conversion of natural habitat due to Project facilities affecting the systems' capacity to supply services. ■ Direct and/or indirect changes to ecosystem processes, functioning and integrity affecting the systems' capacity to supply services. ■ Population influx during construction and operation increasing the demand for ecosystem services. ■ Harvesting of medicinal plants, fibre and wood ■ Introduction of invasive species for use as medicinal plants, fibre and fire wood.	■ Baseline vegetation and flora study, including recording of plant species used as food resources, medicinal resources and for construction of traditional houses. ■ Stakeholder engagement to understand current demand for ecosystem services by local people, such as tree harvest for charcoal production, home building and kraal construction. ■ Inventorying, mapping and assessing the condition of vegetation communities in order to understand their capacity to

Receptor	Potential Effect	Next Steps in the ESIA
		supply ecosystem services
Wildlife (birds, herpetofauna, invertebrates, large and small mammals)	■ Indirect/induced loss through increased bush meat hunting pressure from population influx. ■ Direct and/or indirect changes to ecosystem processes, functioning and integrity affecting the systems' capacity to support populations of wildlife.	■ Baseline faunal biodiversity studies. ■ Stakeholder engagement to understand current demand for bush meat by local people. ■ Inventorying, mapping and assessing the condition of areas of ecosystem services supply
Water	■ Indirect and direct loss of water resources for livestock and human consumption due to groundwater abstraction. ■ Indirect and direct loss of water resources for project consumption due to groundwater abstraction and surface water abstraction. ■ Indirect losses of water supply for local livestock and wildlife due to altered hydrological regimes resulting from the construction, operation and decommissioning of the project. ■ Contamination of water by project activities. ■ Restriction of access to water resources by livestock and people due to construction, operation and decommissioning of the project. ■ Indirect and direct changes to the hydrological regimes resulting from the construction, operation and decommissioning of the project.	■ Review of baseline surface and groundwater data for the AOI ■ Community engagement (focus group or key informant) to understand current demand for water by local people, and important areas of supply. ■ Understanding the project's requirements for water supply. ■ Inventorying, mapping and assessing the condition of priority water supply areas /hydrocensus
Soil	■ Direct and induced loss of soil through construction, operation and decommissioning of the project. ■ Direct and/or indirect changes to soil processes, functioning and integrity affecting the systems' capacity to supply services.	■ Review of baseline soil and land use data for the AOI and understanding of its condition and potential to provide regulating and

Receptor	Potential Effect	Next Steps in the ESIA
	■ Restriction of access to arable areas by the local people.	supporting ecosystem services
Tangible and intangible cultural heritage	■ Direct and indirect loss of ecosystems linked to tangible cultural heritage. ■ Direct loss of access to areas linked to tangible and intangible cultural heritage. ■ Direct and indirect changes to the character of the landscape of the Upstream Area, through the construction, operation and decommissioning of the project, linked to intangible and tangible cultural heritage.	■ Collaboration with cultural heritage team and land use team to ensure that data pertaining to ecosystem service use is gathered during their baseline work ■ Community engagement (focus group or key informant) to understand current use of natural features for cultural services by local people. ■ Inventorying, mapping and assessing the condition of areas of cultural ecosystem services supply.

6.3 Soil, Terrain and Geomorphology

6.3.1 Introduction

The following elements of the Project may affect soil and terrain during construction and operations:

- The geographical extent of project facilities (e.g. well pads, CPF, water supply, feeder pipelines, transport infrastructure (roads, airstrip, helipad), integrated waste management facility and accommodation camps) that could lead vegetation clearing and the loss/conversion of terrain and soil;
- Leaks and spills resulting in soil contamination and compaction during construction and operations; and
- Influx of people to the region and associated changes in land use, agricultural practices and soil management.

6.3.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key guidance which will be applicable to and guide the soils assessment in the ESIA.

International Guidance and Standards

Field Soil survey methodology and data collected at individual soil inspection sites will follow internationally recognised pyogenic soil classification methods as described in FAO (2006), FAO (2007), USDA (1993) or USDA (1999).

6.3.3 Baseline

6.3.3.1 Available data

The following data/data sources have been identified as available during the scoping stage:

- Relationships between soils types and land uses practiced have been identified; and
- Soil chemistry and particle size results (specifically particle size analysis, pH and carbonate).

A geotechnical investigation for both the soil conditions and material investigation has been undertaken by Worley Parsons. This included drilling and test pitting in the Upstream Area including the field areas, CPF sites, and access roads. Samples of the soils have been taken and sent to a soils laboratory in Nairobi for testing.

6.3.3.2 Area of influence and study area.

The soil AOI and baseline Study Area for soil are the same. It is a smaller area than the project AOI for the Upstream Project shown in Figure 1, and will comprise the footprint of the project infrastructure with approximately a 2 km buffer around it. This is the area in which ground disturbance, earthmoving and stockpiling may occur.

6.3.3.3 Baseline conditions

From data gathered by Worley Parsons, it is understood that soil in the AOI for the Upstream Project are derived from tertiary volcanic and sedimentary materials, recent alluvial deposits and windblown sands. Soils are generally clay loam to loamy sand textured and include neutral, calcareous, saline and sodic soil reaction.

A low resolution soil map is included in Figure 5 (Soil Map). This map and data from the Worley Parsons work will be used to target Golder field studies for the ESIA baseline.

6.3.3.4 Key data gaps

The soils sampling described in Section 6.3.3.3 provides a high level understanding of the soil quality in the affected area. This data will be used to provide context to the ESIA baseline, however, the existing data describes particle size and soil chemistry in the upper 1.5 to 3.0 m, as opposed to the soil horizons in the upper 1 m to 1.5 m, which would feed into an ESIA baseline.

The gathering of primary data in the project affected areas is the key data gap for soils. The following briefly describes the survey work which will be completed to fill the key data gaps:

- Soil sampling and laboratory analysis, pedogenic description of representative soil profiles;
- Soil samples will be taken and laboratory analysis will likely include Particle size distribution, pH Cation exchange capacity (CEC); Exchangeable aluminum; Major cations and anions (Ca Mg K, Fe, NO3, PO4, SO4, Cl); and Organic matter (OM); and
- Soils, land use and erosion hazard map including:
    - Soil and surficial materials maps at a 1:30,000 to 1:50,000 scale; and
    - Agriculture suitability maps.

6.3.4 Identification of potentially significant effects

The following presents the environmental aspects have been identified as potential effects the Upstream Project could have on soil receptors. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Erosion (water and wind based) from vegetation clearance – scoped in;
- Changes in soil salinity, sodicity, organic matter and structure due to disturbance of natural state – scoped in;
- Soil compaction from earthworks, structure placement and vehicular traffic during operations – scoped in;
- Contamination from increased airborne/waterborne contaminants during construction and operation – scoped in;
- Contamination from a failure to a pipeline or CPF, i.e. spill – scoped in, and addressed in the emergency response plan;
- Changes in distribution of agriculture type, due to influx, Socio-economic changes and/or land use– scoped in;
- Change in topography during construction and operations – scoped in;
- Loss of agricultural quality productivity on reinstatement of land where earthworks are required during construction – scoped in;
- Change in topography following decommissioning – scoped in, and covered in closure plan; and
- Contamination of soils used in burying pipelines – scoped out, covered by appropriate management practices in construction management plan.

6.3.5 Summary of approach to the ESIA

A summary of the approach to the soil assessment is provided in Table 6-4.

Table 6-4: Analysis of potential effects (Soils)

Receptor	Potential Effect	Next Steps in the ESIA
Terrain	■ Change in topographic assemblages. ■ Erosion of soils. ■ Compaction of soils.	*Baseline data gathering –* ■ Soil/terrain data collection will include descriptions of terrain types (topography, slope gradient, surface expression) and their associated characteristics. *Impact Assessment –* ■ The impact assessment will compare changes in terrain assemblages from baseline to development and will account for construction, operation and reclamation activities.
Soil quality	■ Change in soil quality (e.g. soil contamination,	*Baseline data gathering –*

Receptor	Potential Effect	Next Steps in the ESIA
	compaction, structure, infiltration, soil water storage, fertility, organic matter, sodicity and salinity).	■ Soil data collection will describe soil types and their characteristics. *Impact Assessment –* ■ The impact assessment will compare changes in soil quality from baseline to development and will account for direct and indirect changes to soil quality based on changes in soil types. The assessment will utilise both quantitative changes in soil type distribution and inferred changes based on literature.
Agricultural land suitability	■ Change in soil land suitability.	*Baseline data gathering –* ■ Collected soil data will be used to assess agricultural land suitability. *Impact Assessment –* ■ The impact assessment will compare changes in agriculture land suitability from baseline to development.

6.3.6 References

FAO. 2006. Soil Description Guidelines. 4th edition. Rome, Italy.

FAO. 2007. World Reference Base for Soil Resources. IUSS Working Group WRB. World Soil Resources Reports No. 103. FAO, Rome, Italy.

USDA. 1993. Soil survey manual. U.S. Department of Agriculture Handbook 18.

USDA. 1999. Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys. U.S. Department of Agriculture Handbook 436.

6.4 Water

6.4.1 Introduction

The operation of the Upstream Project has substantial water needs, particularly given the arid environment. Therefore the project has the potential to affect the water environment and local water users.

The following elements of the Upstream Project may affect surface water and groundwater:

- Project construction and operation activities which could affect water include:
  - Surface or groundwater abstraction;
  - Changes to surface water runoff and flood flows;
  - Spillages of contaminants due to catastrophic failure;
  - Discharge of unacceptable concentrations of contaminants; and
  - Population influx.
- The geographical extent of project facilities could lead to the direct loss of land cover and bare earth surfaces would increase erosion and sediment loads of surface water runoff; and
- Construction and operation of surface water abstraction facilities.

6.4.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the water assessment in the ESIA.

National Policy and Legislation

The following national policy and legislation are considered relevant to the Upstream Area:

- The Environmental Management and Coordination Act (Water Quality Regulation), 2006.
- The Republic of Kenya. The National Water Policy, 2012.
- The Republic of Kenya. The Water Bill, 2014 (in draft).

International Guidance and Standards

The following international guidance and standards are relevant to the Upstream Area:

- International Finance Corporation. EHS Guidelines for Wastewater and Ambient Water Quality. IFC, 2007.
- International Finance Corporation. EHS Guidelines for Water and Sanitation. IFC, 2007.
- International Finance Corporation. EHS Guidelines for Onshore Oil and Gas Development. IFC, 2007.
- International Finance Corporation. Performance Standard 3: 2012. Resource Efficiency and Pollution Prevention. IFC, 2012.
- World Health Organisation. Drinking Water Quality Guidelines – 4th edition. WHO, 2011.

International Conventions

The following international conventions are relevant to the Upstream Area:

- United Nations resolution of on the law of transboundary aquifers, 2008.
- United Nations Convention on the Law of the Non-navigational Uses of International Watercourses, 1997.
- Agreement on the Nile River Basin Cooperative Framework, 2010.
- Convention on Wetlands of International Importance (the Ramsar Convention 1971).

6.4.3 Baseline

6.4.3.1 Available data

Water quality data obtained during 2014 and 2015 from approximately 50 groundwater sampling points in proximity to the CPF and well pads, predominantly production wells, is available. Groundwater level data obtained during 2014 and 2015 from approximately ten wells is available. WRMA have an automated way of checking aquifer water levels at specified areas in the region.

A conceptual hydrogeological model is being developed as part of the water resources study, and will be available for use in the ESIA.

Tullow does not currently hold surface water flow or quality data from secondary sources. However data is available from the Water Resources Management Agency (WRMA) from 3 gauging stations: Lake Turkana (Kalokol), Turkwel River (Lodwar Bridge) and Kerio River (Lokori). For security reasons, the Kerio River data has not been captured for a long time. All information from these stations is available in soft copies from 2007. Previous data is still in hard copies.

A flood study on the Kapese catchment and a hydrological model has been completed by Worley Parsons to assess flooding in luggas for siting project infrastructure. The hydrological model used high resolution topographical data and processed rainfall data from Lodwar meteorological station to simulate flows in the luggas and understand flood lines. Data acquired from the Lodwar meteorological station will be used in the ESIA, along with data from two Tullow meteorological stations, which have been installed the project area and started gathering data in December 2015.

6.4.3.2 Area of influence and study area

The water AOI and Study Area for water are the same. It comprises the surface water catchments downstream of the Upstream Area up to and including Lake Turkana and the Upstream Areas of the catchment, including Turkwel Reservoir. Downstream the arid, relatively low lying environment features an extensive dendritic network of wide, shallow, ephemeral streams (luggas) in the vicinity of the Upstream Area, which coalesce within their respective catchments before discharging into Lake Turkana. Upstream of the AOI the ground levels rise to over 1,000 m above sea level, becomes mountainous and the extent of vegetation increases. The catchments have been delineated according to the topographic catchment divides.

The water AOI currently includes the water supply option at the Turkwel Dam, but is not yet informed by distant groundwater options.

6.4.3.3 Baseline conditions

Average annual rainfall is considered to be less than 250 mm, much of which falls during the Long Rains. Rainfall for the remainder of the year is typically low and the area is often at risk of serious drought conditions. In January 2014, according to the NDMA, no rainfall was recorded at Lodwar.

All precipitation over the Upstream Area either returns to the atmosphere via evapotranspiration, recharges to ground or drains to Lake Turkana. It is anticipated that the amount of current groundwater recharge is very low to minimal. The proportion of total inflow from the luggas and Kerio River to Lake Turkana is considered to be less than 5%; the Omo River, on which the Gibe III Dam is being constructed, provides much of the inflow to Lake Turkana (~90%). Turkwel River is significantly larger than the Kerio River.

Flow in the luggas is driven by short duration, intense seasonal rainfall which, given the lack of vegetation, likely leads to extensive erosion, high suspended solids content and rapid channel migration. The luggas within the Upstream Area are part of two separate catchments, both of which eventually discharge into Lake Turkana. The majority of luggas flow eastwards and coalesce, flowing parallel to Lokichar Loperot Road, before discharging into the Kerio River and subsequently to Lake Turkana. The remainder of the luggas flow northwards, coalescing before discharging into Lake Turkana. Riparian vegetation is more prominent for larger catchments, which see larger flows.

Lake Turkana water elevation was at its peak in 1896 at over 380 metres above sea level (masl). Water levels have steadily declined; since the 1920s the water level has typically ranged between 360 masl and 365 masl.

Lake Turkana is a closed lake, where outflow is dominated by evaporation; the annual loss through evaporation is estimated to be 2.4 m (UNEP, 2013). According to UNEP, Lake Turkana's water levels usually show seasonal fluctuations of 3-4 m.

Preliminary information from Tullow states large volumes of groundwater are known or expected to be present in some of the shallow formations in the Lokichar region however permeability is generally low such that borehole yields are poor. Groundwater sources in Kenya are known to have, among others, high fluoride, arsenic and boron concentrations.

6.4.3.4 Key data gaps

Local hydrological and hydro-geological conditions, and groundwater users and uses need to be characterised. Local primary data is the key data gap, which will be addressed through field studies and surveys in 2015/2016:

- Surface water gauging and water quality information in the local watercourses, the catchments for which will include the project infrastructure and activities;
- Groundwater level and groundwater quality data for at least one year concurrent with meteorological data, including data for proposed groundwater supply sources;
- Hydrocensus of the communities in the Project area (as part of socio-economic surveys); and
- Meteorological data in the locality of the Project for at least one year concurrent with hydrological data.

6.4.4 Identification of potentially significant effects

The following presents the environmental issues that have been identified as potential effects the Upstream Project could have on water receptors (assumes make-up water is obtained from The Turkwel River, Lake Turkana, local or distant groundwater sources. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Changes in fluvial flows and fluvial geomorphology (sediment erosion, transport and deposition) due to abstraction of surface water and/or diversion of luggas – scoped in;
- Changes in surface water run-off due to ground clearance, construction of bunds and areas of hard-standing – scoped in;
- Changes in surface water chemistry due to uncontrolled discharge, accidental spills and uncontained leaks from storage facilities – scoped in, and addressed in the emergency response plan;
- Contamination of water obtained from hand dug wells within bed sediments due to accidental spills and uncontained leaks from storage facilities – scoped in, and addressed in the emergency response plan;
- Changes in groundwater chemistry due to failure of the integrity of an injection well – scoped in;
- Changes in surface water chemistry due to known discharges to the environment – scoped in;
- Flood risk to project infrastructure – scoped in, and will be subject to flood management as part of the emergency response plan;
- Flood risk to communities downstream in the affected catchments – scoped in. and will be covered in the community health and safety plan;
- Changes in sediment load, due to changes in ground cover and erosion – scoped in;
- Changes to groundwater levels in local wells or to base flow in luggas due to abstraction from groundwater– scoped in;
- Increased groundwater salinity caused by water abstraction inducing flow from more saline aquifers – scoped in; and

- Contamination of groundwater due to accidental spills and leaks, inadequate well head construction and/or poor well completion resulting in leakage from production wells – scoped in, and addressed in the emergency response plan.

6.4.5 Summary of approach to the ESIA

A summary of the approach to the water component of the ESIA is provided in Table 6-5.

Table 6-5: Analysis of potential effects (water)

Receptor	Potential Effect	Next Steps in the ESIA
Rivers	■ Change in flow and water quality.	*Baseline data gathering –* ■ Surface water quality and flow monitoring and geomorphology. *Impact Assessment –* ■ Assessment of impact on quality and quantity in watercourses for a range of flows (high, medium, low), accounting for seasonality, and direct (abstraction/discharge) and indirect (catchment changes, surface water runoff) influences.
Aquifers	■ Change in flow and water quality.	*Baseline data gathering –* ■ Groundwater level and quality monitoring (ongoing). *Impact Assessment –* ■ Develop model for baseline conditions and adapt for proposed project, accounting for abstraction and injection water. Assessment of impact to level and quality
Local Water Users	■ Change in surface water and groundwater: flow; and quality.	*Baseline data gathering –* ■ Hydrocensus. *Impact Assessment –* ■ Spatial analysis of local water users and potential assessment of impacts to water environment.

6.4.6 References

NDMA, 2014. National Drought Management Authority. Turkana County, Drought Monitoring and Early Warning Bulletin – January 2014.

SWARA, 2014. What Future For Lake Turkana and Its Wildlife? Sean Avery. SWARA, January-March 2014.

UNEP, 2013. Balancing economic development and protecting the cradle of mankind – Lake Turkana basin. United Nations Environmental Programme, June 2013.

6.5 Seismicity (and Geology)

6.5.1 Introduction

The operations of the Upstream Project have the potential to be impacted by earthquakes potentially leading to disruption of operations and loss of containment.

Any elements of the Upstream Project which could affect local seismicity will not be covered in the ESIA, but in the engineering design.

6.5.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the seismicity assessment in the ESIA.

National Policy and Legislation

Ministry of Works, 1973. Code of practice for the design and construction of buildings and other structures in relation to earthquakes. Printed by the Kenya Building Centre.

International Guidance and Standards

US Department of Energy, 2012. Protocol for addressing induced seismicity associated with Enhanced Geothermal Systems. DOE/EE-0662.

6.5.3 Baseline

6.5.3.1 Available data

Data currently available is restricted to regional scale earthquake hazard mapping and regionally identified earthquake data help by the United States Geological Survey.

As part of the siting of infrastructure, Worley Parsons have accessed some high level information on fault lines in the Upstream Project footprint and additional information has been collected from geophysical surveys completed in 2015.

6.5.3.2 Area of influence and study area

The seismic AOI is that area in the immediate vicinity of the wells that may be impacted by induced seismicity including local communities and the CPFs, therefore does not differ from the AOI of the Upstream Project presented in Figure 1. The Study Area incorporates the region as a whole as a source of natural seismicity.

6.5.3.3 Baseline conditions

Turkana and Kenya as a whole is vulnerable to seismic activity associated with the presence of the East African Rift, which runs through the west of Kenya. The East African rift is prone to earthquakes and associated volcanicity. However, the frequency of earthquakes within the Turkana basin is relatively low

The overall hazard level is considered low (DFID, 2013). In the Study Area the natural earthquake hazard is rated by the WHO (2010) as low to medium with peak ground acceleration is the region of 0.2 m/s^2 -2.4 m/s^2 (Plates 6-1 to 6-3). It is however noted that relatively infrequent but significant events do occur with a maximum recorded magnitude event of 7 having an epicentre 300 km south of the development.

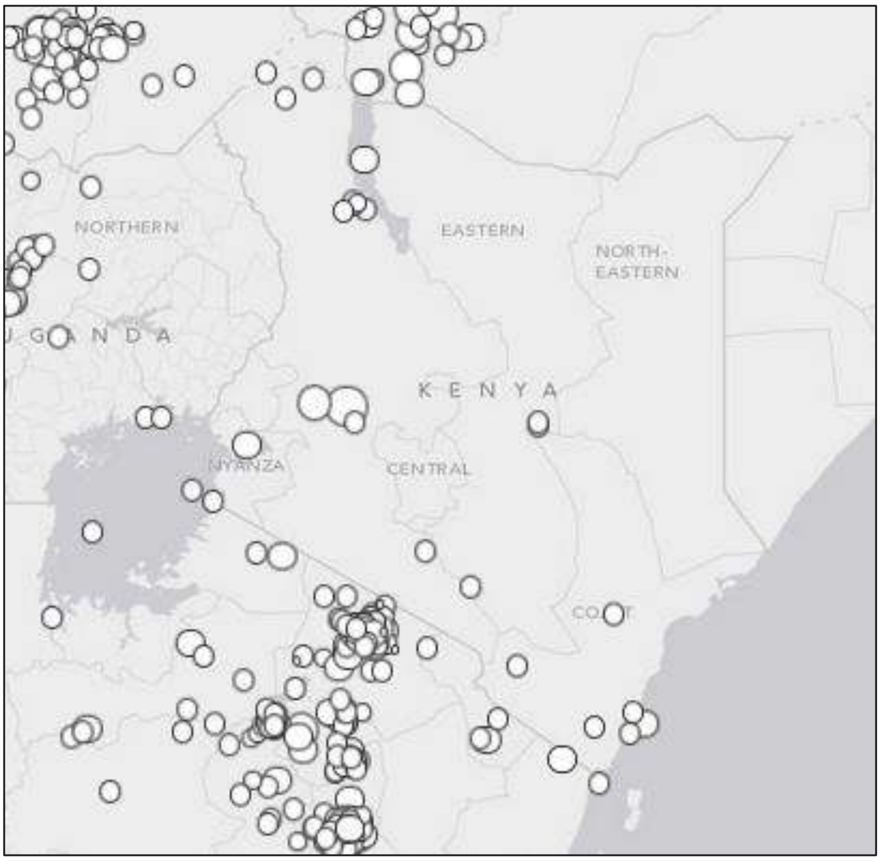

Plate 6-1 Earthquakes recorded in the last ~100 years (source USGS)

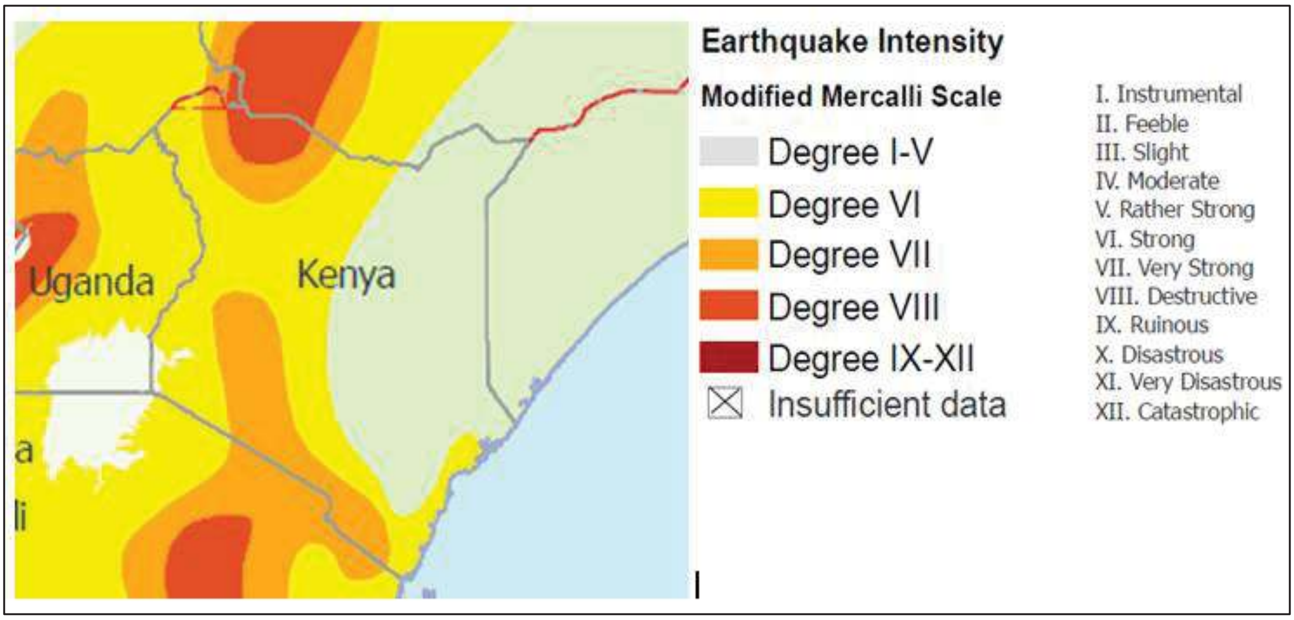

Plate 6-2 Earthquake Hazard (from United Nations Office for the coordination of Humanitarian affairs, 2007)

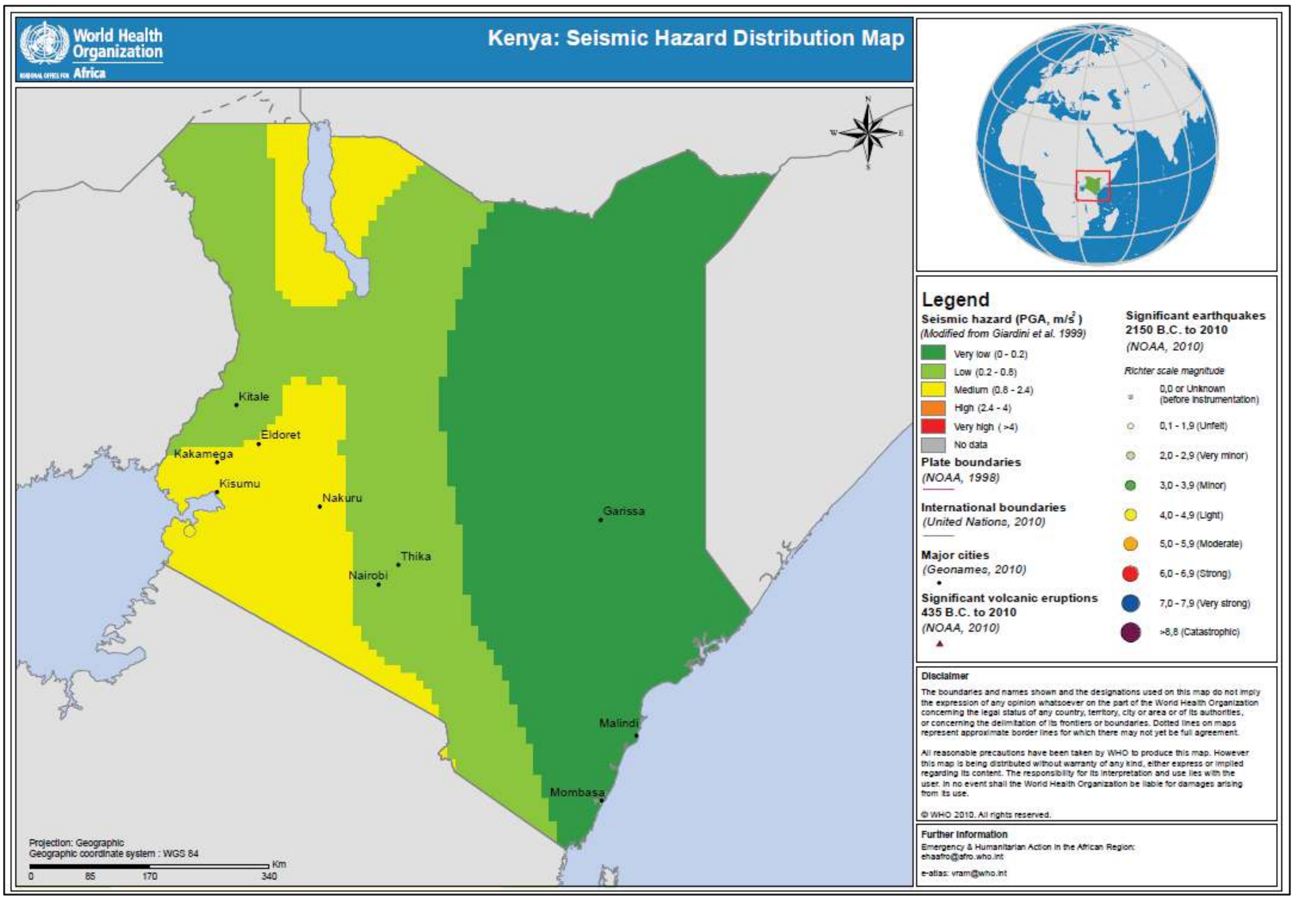

Plate 6-3 Seismic Hazard Distribution (WHO, 2010)

6.5.3.4 Key data gaps

Seismic hazard assessment will be desk based and completed as part of the design for the infrastructure of the Upstream Project. Further details of built structures will be required from aerial imagery analysis and ground truthing.

Gathered information on fault lines will also be accessed from Worley Parsons.

6.5.4 Identification of potentially significant effects

The following presents the environmental issues that have been identified as potential effects the Upstream Project could have on seismicity receptors. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Impact of natural seismicity (earthquakes) on built structures which may lead to loss of containment (pollution via surface water or groundwater pathways), and on vibration sensitive built structures or equipment which may lead to operational failure – scoped in;
- Impacts from induced seismicity resulting in contamination from loss of containment due to failure of casing – scoped in; and
- Impacts from induced seismicity resulting ground vibration impacts on sensitive built structures or equipment which may lead to operational failures – scoped in.

6.5.5 Summary of approach to the ESIA

A summary of the approach to the seismicity component of the ESIA is provided in Table 6-6.

Table 6-6: Analysis of potential effects (Seismicity)

Receptor	Potential Effect	Next Steps in the ESIA
Built structures/water environment	■ Impact on built structures which may lead to loss of containment (pollution via surface water or groundwater pathways). ■ Impact on vibration sensitive built structures or equipment which may lead to operational failure.	*Baseline data gathering –* ■ Desk based review of regional earthquake hazard Impact Assessment – ■ Description of potential impacts and risks to be managed in an emergency preparedness plan
	■ Contamination resulting from loss of containment due to failure of casing. ■ Impact on built structures which may lead to loss of containment or operational failure.	*Baseline data gathering –* ■ Desk based review of potential for microseismicity from reservoir operations Impact Assessment – ■ Description of potential impacts and risks to be managed in an emergency preparedness plan

6.6 Air and Climate

6.6.1 Introduction

The construction and operations stages of the Upstream Project will generate emissions to atmosphere, which have the potential to affect local air quality and contribute to global greenhouse gas emissions.

The following elements of the Upstream Project may affect local air quality:

- Storage and transport of bulk materials, site stripping and excavation, power generation and, engine exhaust emissions from vehicles and construction plant, during construction;
- Direct emissions from combustion sources (such as diesel engines), flaring associated with non-routine and emergency events during operations (no routine flaring is envisaged), fugitive volatile organic compounds (VOCs) from drilling, pipework and storage tanks and waste management during operations;
- Indirect emissions through secondary formation of ozone, fine particulates and nitrogen dioxide (NO_2), during operations; and
- Fugitive release of odorous compounds during operations.

6.6.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the water assessment in the ESIA.

National Policy and Legislation

The following national policy and legislation are considered relevant to the Upstream Area:

- The Republic of Kenya. The Environmental Management and Coordination Act (Air Quality Standards) Regulations, 2008.

International Guidance and Standards

The following international guidance and standards are relevant to the Upstream Area:

- International Finance Corporation. EHS Guidelines: Environmental – Air Emissions and Ambient Air Quality. IFC, 2007.
- World Health Organisation. Air Quality Guidelines Global Updated. Germany: Druckpartner Moser, 2005.

International Conventions

- United Nations. Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations, 1997.
- United Nations. Vienna Convention for the Protection of the Ozone Layer. United Nations, 1985.

6.6.3 Baseline

6.6.3.1 Available data

Digital terrain data has been obtained for air quality modelling which will be completed in the impact assessment.

Meteorological data for the region is available from Lodwar, the only meteorological site in the Turkana region. Meteorological parameters measured at Lodwar include rainfall, wind speed and direction.

A summary of the meteorological conditions, at Lodwar is presented in the *Lamu Marine oil export terminal Metocean and meteorological data study* (HR Wallingford, 2014). The report includes statistical analysis of wind speeds and directions (1957 to present), and rainfall and temperature (1994 – 2003). Data on solar insolation levels, based on modelled data from the Food and Agricultural Organization's CLIMWAT modelling, is also presented in the report in the form of country-wide mapping data which incorporates the development site.

Further reference is made to rainfall and evaporation data for Lodwar from pre-1970 in the Hydrological Year Book 2012 (Water Resources Management Authority, 2013) (report indicates rainfall monitoring at Lodwar since before 1930).

Data acquired from the Lodwar meteorological station will be used in the ESIA, along with data from two Tullow meteorological stations, which have been installed the project area and started gathering data in December 2015.

6.6.3.2 Area of influence and study area

Dust emissions will typically deposit within 1 km of the emission source depending on the particle size. During particularly windy conditions dust may travel further from the site, but typically within 2 km of the point of release. Therefore, the Study Area and AOI for dust emissions will be within 2 km of project activities and therefore the point of release.

The AOI for vehicle emissions will typically have a localised effect occurring within a few hundred metres of sources. For stack emissions the typical AOI will be within 2-3 km of the source, however wider regional effects may occur particularly related to secondary pollutant formation. Therefore a Study Area and AOI of approximately 10 km by 10 km, centred on the site will be considered for point source air emissions.

Effects of emissions of greenhouse gases are calculated on a global basis, therefore emissions are considered from all project associated sources independent of a defined Study Area.

6.6.3.3 Baseline conditions

The National Drought Management Authority (NDMA) classifies the seasons as follows:

- January to March – Dry Season;
- April to June – Long Rains;
- July to September – Dry Cool Season; and
- October to December – Short Rains.

Meteorological data from the Lodwar measurement site indicates that the prevailing wind direction is easterly or north-easterly, with winds from these directions occurring for over 75% of the time. Wind speeds are typically light, with the majority being of less than 4 m/s on average. There is little seasonal variation on wind speeds or direction. A small diurnal variation in wind speeds is experienced in the site, with daytime wind speeds typically 1 m/s higher than night-time winds, on average.

Average rainfall levels are discussed further in Section 6.4, however it is noted that the majority of rainfall occurs during the April to June long rains season, with very low levels of rainfall occurring outside this period.

Temperatures within the study area are high, with minimum air temperatures in excess of 20°C measured. Both air and ground temperatures will vary with the seasons, with the coolest temperatures experienced December to February and highest temperatures in March to May and September to November.

6.6.3.4 Key Data Gaps

Primary local data collection is the key data gap, which will be addressed through field studies and surveys in 2015/2016, include the following:

- Dust deposition and air quality data in the locality of the Upstream Area;
- Meteorological data gathered by project meteorological stations in the locality of the Upstream Area;
- Correlation of locally gathered meteorological data and historic records; and

- Mapping of settlement and other human activity and their nature.

6.6.4 Identification of potentially significant effects

The following presents the environmental issues that have been identified as potential effects the Upstream Project could have on air quality receptors. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Impacts from dust resulting in soiling/nuisance effects (human receptors), deposition on plants/vegetation and increased sediment – scoped in;
- Direct adverse effects of heavy metals in dust on human or ecological receptors – scoped out - dust unlikely to contain significant concentrations of heavy metals;
- Direct adverse health effects from air emissions (human receptors) – scoped in;
- Indirect adverse health effects from air emissions (ground level ozone generation) (human receptors and ecological habitat) – scoped in - to be covered in the community health and safety health impact assessment;
- Direct and indirect acidification, eutrophication, toxicity – scoped in;
- Nuisance effects from odour (human receptors) – scoped in; and
- Impacts and contribution of Green House Gas (GHG) emissions to global warming – scoped in.

6.6.5 Summary of approach to the ESIA

A summary of the approach to the air and climate component of the ESIA is provided in Table 6-7.

Table 6-7: Analysis of potential effects (Air Quality)

Receptor	Potential Effect	Next Steps in the ESIA
Human receptors (villages, cultural sites and areas of regular human activity)	▪ Change in air quality. Adverse effect on human health.	*Baseline data gathering –* ▪ Air quality monitoring of key pollutants: fine particulates, NO_2 (combustion gas marker) and VOCs. *Impact Assessment –* ▪ Evaluate impact to air quality of proposed construction and operation activities, through predictive air dispersion modelling, to determine additional pollutant burden.
Ecological habitat	▪ Direct and indirect acidification, eutrophication, toxicity.	

Receptor	Potential Effect	Next Steps in the ESIA
Human receptors (villages and areas of regular human activity)	■ Fugitive dust deposition leading to soiling or smothering.	*Baseline data gathering –* ■ Monitoring of dust deposition rates. *Impact Assessment –* ■ Evaluate risk of additional dust deposition during proposed construction and operation activities to determine additional pollutant burden.
Human receptors (villages and areas of regular human activity)	■ Odour nuisance	*Impact Assessment –* ■ Evaluate risk of odour emissions and sources during proposed construction and operation activities. Determination of potential effects and required controls.
Global	■ Contribution to global emissions of greenhouse gases	*Impact Assessment –* ■ Quantification of greenhouse gas emissions associated with proposed construction and operation activities.

6.7 Noise and Vibration

6.7.1 Introduction

The construction and operations stages of the Project will generate noise and localised vibrations, which have the potential to affect local noise and vibration sensitive receptors.

The following elements of the Project may affect the local noise environment:

- Storage and transport of bulk materials, site stripping and excavation, piling, power generation and, vehicles, construction plant and human activity, including air transport during construction; and
- Drilling, traffic, operational plant and equipment site stripping and excavation, power generation and, human activity, including air transport during operations.

6.7.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the noise and vibration assessment in the ESIA.

National Policy and Legislation

The following national policy and legislation are considered relevant to the Upstream Area:

- The Republic of Kenya. The Environmental Management and Coordination Act (Noise and Excessive Vibration Pollution) Control Regulations, 2009; and
- The Republic of Kenya. Act No. 15 of 2007. The Occupational Safety and Health Act (Chapter 89 and 90), 2007. Factories and Other Places of Work (Noise Prevention and Control) Rules (Chapter 13), 2005.

International Guidance and Standards

The following international guidance and standards are relevant to the Upstream Area:

- International Finance Corporation. EHS Guidelines: Environmental – Noise. IFC, 2007; and
- World Health Organisation. Guidelines for Community Noise. Geneva: WHO, 1999.

In the absence of national or international standards for vibration, reference will be made to alternative national standards, specifically:

- British Standard BS5228 *Code of practice for noise and vibration control on construction and open sites*. Vibration. British Standards Institute (BSI) December 2008; and
- British Standard BS6472 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting. BSI 2008.

6.7.3 Baseline

6.7.3.1 Available data

No data for the noise and vibration elements of the Upstream Project has been identified.

6.7.3.2 Area of Influence and study area

Noise effects typically occur locally to the source of noise, with the AOI typically within 2-3 km of source. The Study Area for assessment of noise effects will be consistent to the AOI and be set to a 3 km buffer around Upstream Area.

Vibration effects also occur close to source, typically within a few hundred metres, beyond which vibrations will dissipate. The AOI will therefore consider up to 1 km from activities which potentially generate vibrations. The Study Area will be consistent with the AOI.

6.7.3.3 Baseline conditions

There is no data for noise and vibration relating to the Upstream Project. Due to the lack of industry and sparse populations in the Upstream Area, sources of anthropogenic noise are minimal. In the absence of anthropogenic noise, natural noise sources such as wildlife noise, watercourses and wind induced noise through vegetation are typically the main noise sources. In the study area the absence of significant watercourses or vegetation, as well as prolific wildlife (birds or insects particularly) activity indicate that there are limited noise sources, and therefore the ambient noise level is likely to be quiet.

6.7.3.4 Key data gaps

Primary local data is the key data gap, which will be addressed through field studies and surveys in 2015/2016:

- Information on human receptor and faunal receptors (noise);
- Baseline noise data gathering to capture ambient noise levels at representative locations including diurnal variation; and
- Information on local built structures (vibration).

6.7.4 Identification of potentially significant effects

The following presents the environmental issues that have been identified potential effects the Upstream Project could have on noise and vibrations receptors. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Impact from noise and vibrations resulting in loss of amenity/sleep disturbance (human receptors) – scoped in;
- Impact from noise resulting in disturbance or interference on communication, e.g. bird call, mammal communication over medium to long distances – scoped in, although will be scoped out if the absence of such species is confirmed;
- Impact of noise and vibration on Tullow labour force – scoped out, as this potential effect will be covered by occupational health policies and procedures. A separate occupational risk assessment will be undertaken to ensure that the labour force is protected from noise and vibration;
- Impact from vibrations resulting in disturbance (human, livestock and faunal receptors) – scoped in;
- Impact from vibrations resulting in structural damage (built structures) – scoped in; and
- The nuisance effects of noise and vibration on the appreciation of cultural sites (by human receptors) – scoped in.

6.7.5 Summary of approach to the ESIA

A summary of the approach to the noise and vibration component of the ESIA is provided in Table 6-8.

Table 6-8: Analysis of potential effects (Noise)

Receptor	Potential Effect	Next Steps in the ESIA
Human receptors (villages and areas of regular human activity/cultural importance)	■ Change in noise. Loss of amenity/sleep disturbance	*Baseline data gathering –* ■ Ambient noise levels at representative locations including diurnal variation. *Impact Assessment –* ■ Evaluate effects on noise environment of proposed construction and operation activities, through predictive modelling, to determine additional noise burden.
Ecological habitat and livestock	■ Disturbance, interference on communication (faunal receptors).	
Built structures	■ Structural damage.	*Impact Assessment –* ■ Identification of potential vibration sources and prediction of vibration levels to establish any adverse effects to built structures.

6.7.6 References

British Standards Institute, 2008. BS5228-1: 2009 Code of practice for noise and vibration control on construction and open sites. Vibration, December 2008.

British Standards Institute, 2008. BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting 2008.

6.8 Landscape and Visual

6.8.1 Introduction

The landscape and visual assessment will consider the effects the Upstream Project could have on the above ground features, which will be visible from the surrounding area, namely:

- Project activities generating dust (including clearing and earth moving);
- Construction works and the physical presence of the CPF, IWMF, electrical power lines;
- Airstrip; and
- Drilling sites (well pads and drilling rigs).

6.8.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the biodiversity assessment in the ESIA.

National Policy and Legislation

- Kenyan policy and legislation relating to landscape and visual impact assessment has not been identified.

International Guidance and Standards

The methodology proposed for the landscape and visual assessment has been developed by Golder Associates, based on current UK and USA guidance, namely:

- Landscape Institute with the Institute of Environmental Management and Assessment. Guidelines for Landscape and Visual Impact Assessment, Third Edition, 2013 (GLVIA 2013); and
- United States Department of the Interior, Bureau of Land Management. 1986a. Visual Resource Inventory. Bureau of Land Management Manual Handbook H-8410-1, Rel. 8-28. Washington, DC.

6.8.3 Baseline

6.8.3.1 Available data

The following data relating to the landscape and visual topic is available:

- Location of above ground project infrastructure; and
- Broad nature of land cover – vegetaion, built elements in the landscpe land uses and of topography terrain that determine landscape character as derived from satellite imgery, photographic records and a site visit;
- Broad types, nature and locations of potential of receptors for changes on visual amenity; and
- Topography from digital terrain data.

6.8.3.2 Area of influence and study area

The extent of the AOI for the landscape and visual assessment would be limited to those areas from which the project infrastructure will be visible. It would be defined by computer 'viewshed' modelling of the 'above ground' components of the project infrastucture, including the drilling sites in the Amosing, Ngamia, Ekales, Twiga, and Agete fields, along with the central processing facility.

Considering the relatively low height of a drilling rig (typically 35m from ground level) in relation to the topography it is proposed that the study area is limited to a maximum distance of 10 km from project infrastructure locations. Whilst components of the development may be theoretically visible beyond 10 km, it is unlikely they would be prominent features within a sparesely populated large sacle landscape and would be unlikely to give rise to significant adverse effects in ESIA terms.

6.8.3.3 Baseline conditions

The landscape and visual assessment will rely heavily on local data gathering in the baseline phase. No relevant site specific data is currently available.

6.8.3.4 Key data gaps

Key data gaps are all aspects of landscape and visual baseline, which will be addressed through desk studies and, if required, field studies in 2015/2016:

- Zone of Theoretical Visibility (ZTV) mapping and analysis;
- Confirmation of settlements within the study area; and
- Definition of landscape character of project areas.

6.8.4 Identification of potentially significant effects

The following presents the environmental issues that have been identified as potential effects the Upstream Project could have on views and the character of the landscape. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- Adverse effect on views and the visual amenity of local residents, travellers, visitors and workers within the study area due to construction of CPF and associated facilities – scoped in;
- Adverse effect on views and the visual amenity of local residents, travellers, visitors and workers within the study area during the operational period due to vertical structures, removal of vegetation and change in landform – scoped in;
- Adverse effect on views and the visual amenity of local residents, travellers, visitors and workers during the operational period due to light pollution – scoped in;
- Adverse effect on views and the visual amenity of water supply pipeline caused by linear features and the clearance of vegetation along them – scoped in;
- Adverse effect on views and the visual amenity of overhead transmission line along water supply pipeline route during construction, operation and closure – scoped in;
- Adverse effect on views and the visual amenity of the airstrip – scoped out due to lack of vertical structures and light pollution;
- Direct loss of landscape characteristics due to construction of project infrastructure – scoped in; and
- Direct loss of landscape characteristics during the operational period – scoped in.

6.8.5 Summary of approach to the ESIA

A summary of the approach to the landscape and visual component of the ESIA is provided in Table 6-9.

Table 6-9: Analysis of potential effects (Landscape and Visual)

Receptor	Potential Effect	Next Steps in the ESIA
Local population (including inhabitants, travellers, visitors, tourists and workers)	■ Changes to existing views and visual amenity of receptors.	*Baseline data gathering –* ■ Preparation of 3D computer model of the study area to enable: ■ Preparation of ZTV (Zone of Theoretical Visibility) to define the study area (based on preliminary scheme design). ■ Mapping the location and type of visual receptors, using aerial imagery and field observations. ■ Mapping type and extent of landscape character areas within the study area using mapping, results of baseline studies and field observations. ■ If required, photographic recording of receptors and key views during a site visit. *Impact Assessment –* ■ If required, the production of photomontages to illustrate the proposed development; ■ Updated ZTV's based on final scheme design;
Landscape character (Determined by a combination of: landform, land cover/use, pattern, colour, scale, vegetation, water, built-form, cultural associations, condition, rarity, tranquillity and condition)	■ Physical changes to the character and aesthetics of the existing landscape.	

6.8.6 References

Landscape Institute with the Institute of Environmental Management and Assessment. Guidelines for Landscape and Visual Impact Assessment, Third Edition, 2013 (GLVIA 2013); and

United States Department of the Interior, Bureau of Land Management (BLM). 1986a. Visual Resource Inventory. Bureau of Land Management Manual Handbook H-8410-1, Rel. 8-28. Washington, DC.

6.9 Cultural Heritage

6.9.1 Introduction

The Upstream Project has the potential to impact upon archaeological and paleontological remains, as well as historic, cultural, religious and sacred sites. The Upstream Project may also impact upon the intangible cultural heritage of the area, disrupting traditional practices and compromising traditional belief systems. The outputs from the cultural heritage impact analysis will inform elements of the socio economic impact assessment.

The following elements of the Upstream Project have the potential to impact upon cultural heritage; in particular activities involved breaking ground:

- Well pads;
- CPF;
- Personnel camps and accommodation;
- Air strip;
- Roads; and
- Pipelines (for both water abstraction and oil transportation).

6.9.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the cultural heritage assessment in the ESIA.

National Policy and Legislation

The following National policy and legislation are considered relevant to the Upstream Area:

- The Republic of Kenya. Act No. 6 of 2006. The National Museums and Heritage Act, 2006.

International Guidance and Standards

The following Performance Standards are considered to be applicable to the Upstream Area from a Cultural Heritage and Archaeological perspective:

- International Finance Corporation. Performance Standard 8: 2012. Cultural Heritage. IFC, 2012.

International Conventions

The following convention, to which Kenya ratified, is applicable to the Upstream Area:

- United Nations Educational, Scientific and Cultural Organisation. Convention Concerning the Protection of the World Cultural and Natural Heritage. UNESCO, 1972.

6.9.3 Baseline

6.9.3.1 Available data

The following data collection has been undertaken:

- Locations of designated areas, including World Heritage Sites;
- Locations of all archaeological, paleontological and cultural sites and remains recorded in the Study Area by the National Museums of Kenya (NMK) database;
- Literature review by the National Museums of Kenya (NMK);
- Locations of palaeo-surface water bodies (e.g. ancient river courses, lakeshores, luggas) as interpreted from aerial imagery;

- Locations of current and historic settlements and agricultural/pastoral enclosures as interpreted from aerial imagery;
- Topography of the Study Area as interpreted from satellite imagery;
- Surface soils and geology of Study Area; and
- Vegetation and current land cover/use of Study Area as interpreted from Remote Sensing data.

6.9.3.2 *Area of influence and study area*

For tangible and intangible cultural heritage the AOI is a smaller area than the AOI for the Upstream Area shown in Figure 1, and will comprise the footprint of the project infrastructure for the Upstream Project and the local communities. This is the area in which ground disturbance, earthmoving and stockpiling may occur and the local communities whom may be affected.

The Study Area for the ESIA comprises two elements – the area of the field walkover survey and the settlements where community consultations will be undertaken. The latter also includes any sites revealed during the consultation process (e.g. cemeteries, ritual sites). The field walkover survey will specifically focus on the development footprint where ground disturbance is anticipated and where tangible remains, or traditional land use and intangible cultural heritage, including pastoral farming and ritual practices, could occur.

6.9.3.3 *Baseline conditions*

Records of all known archaeological sites within the Upstream Area were obtained from the NMK database, as well as additional data from available literature. Aerial photo mapping was also undertaken to plot the location and density of traditional settlements and land use features, such as brushwood enclosures, within the study area. This information is presented in Figure 6 (Traditional Settlement and Land Use Features) and Figure 7 (Known Archaeological Finds, desktop based).

A brief summary of this information is presented in Table 6-10.

Table 6-10: Summary of Baseline Conditions

Site Type	Distribution within Upstream Area
Burial	Two distinct groups, although both are spread over relatively large areas. The northern group consists of a dense cluster to the west of Twiga and Agete, with slightly less dense clusters north of this. There are some burials recorded within Agete. Except for a small number of isolated examples, the rest of the burials are recorded in a southern grouping, spread across and around Amosing.
Pottery	Densely distributed across the entirety of the Upstream Area. Numerous examples of sites recorded within all prospects.
Lithic (relating to stone tools)	The vast majority are located to the north, with a very dense cluster north of Agete. Outside this cluster, lithic sites are widespread although only sparsely distributed. A slightly denser concentration is located at Amosing, with some lithic sites recorded within the prospect.
Faunal	Relatively sparse distribution, with majority to the north of Agete. Several examples recorded around Agete, Twiga and Ekales, with the reminder recorded south of Amosing.
Paleontological	Relatively sparse distribution. Majority are clustered to the west and south east of Amosing. Several other isolated examples, notably to the west of Agete.
Monument	Three monument sites are recorded north of Agete and one south of Amosing.
Jewellery	One jewellery site recorded to the far north.
Grindstone	One grindstone site is recorded to the west of Agete.

Traditional settlements and land use features were mapped during a brief walkover survey in December 2014. These were generally widespread and commonplace within the landscape, with a dense distribution throughout the entriety of the study area.

6.9.3.4 Key data gaps

Primary local data gathering is the key data gap, which will be addressed through the field survey planned for 2015/2016:

- Location, density and nature of surface archaeological and paleontological receptors within the development footprint;
- Information on tribal groups;
- Intangible cultural heritage in the area, including traditional cultural practices and beliefs; and
- Survey of existing/palaeo- surface water bodies, traditional settlements and enclosures.

6.9.4 Identification of Potentially Significant Effects

The following have been identified as potential effects the Upstream Project could have on cultural heritage receptors. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- The loss or damage to surface or buried remains or the loss of previously unknown features and sites revealed in the area covered by the project infrastructure – scoped in;
- The loss or damage to surface or buried remains or the loss of previously unknown features and sites revealed in the area covered by the water supply pipe line and overhead transmission line – scoped in;
- The loss or damage to sacred or historic places and/or impacts on their setting – scoped in;
- The nuisance effects of noise, dust, and vibration, amongst other elements, on the appreciation of cultural sites (by human receptors) – scoped out of cultural heritage and into air quality and noise and vibration assessments; and
- Changes to culturally distinct patterns of life and traditional cultures – scoped in.

6.9.5 Summary of approach to the ESIA

A summary of the approach to the cultural heritage component of the ESIA is provided in Table 6-11**.**

Table 6-11: Analysis of potential effects (Cultural Heritage)

Receptor	Potential Effect	Next Steps in the ESIA
Archaeological, paleontological and palaeo-ecological sites and associated landscapes	■ Loss or damage to surface or buried remains and/or above-ground features. ■ Loss of previously unknown features and sites revealed during project related activities.	*Baseline data gathering –* ■ Field survey of development footprint is required to identify the location, density and nature of surface remains and to assess the potential for undiscovered remains, if present, to exist below ground. *Impact Assessment –*

Receptor	Potential Effect	Next Steps in the ESIA
		■ Once cultural heritage receptors and potential impacts have been identified the impact assessment methodology is to compare the intensity of the impact with the sensitivity of the receptor.
Cultural and historic sites	■ Loss or damage to sacred or historic places and/or impacts on their setting. ■ Nuisance effects of noise, dust, and vibration, amongst other elements, on the appreciation of cultural sites (by human receptors).	*Baseline data gathering –* ■ Field survey of development footprint and wider area, as well as consultations with local communities and leaders, is required to identify the location and nature of culturally or historically significant sites, as well as traditional practices and beliefs. *Impact Assessment –* ■ Once cultural heritage receptors and potential impacts have been identified the impact assessment methodology is to compare the intensity of the impact with the sensitivity of the receptor. The intangible impact analysis will inform the socio economic impact analysis.
Intangible cultural heritage practices	■ Changes to culturally distinct patterns of life and traditional cultures.	

6.10 Social

6.10.1 Introduction

The development of such a large scale and unprecedented project in Turkana holds significant potential for the entire country, yet it also presents immense challenges. Turkana County, the main area of interest during exploration, has the highest levels of poverty in the country at 87.5% and reaches 93.1% in Turkana East (KNBS and SID, 2013). The area has historically been marginalised from national political activities and now may be hosting the first oil development in the country. The Upstream Project will require significant infrastructure upgrades to allow the project development and transport oil to the proposed export terminal.

Land and water are the two primary resources that must be considered, as the use of these will place strains on areas already at risk of environmental challenges. These challenges were part of the long-standing inter-tribal conflict over natural resources prior to project initiation, but must be managed carefully, especially in light of the importance of natural resources to traditional pastoralist livelihoods. Land and water management are more complicated due to insufficient or unclear legislation that continues to be developed as part of the national process of devolution.

In addition to the physical challenges, the project also must manage extremely high expectations for employment, infrastructure development and other amenities. While local communities greatly desire employment and economic opportunities, the reality is that technical skills and experience needed for the Project will require substantial numbers of outsiders coming to the area, especially during construction.

The ESIA shall describe in the socio-economic baseline, the current status of human rights issues that are present within the AOI. The ESIA shall consider potential changes to these existing issues and identify any additional human rights issues. A separate Human Rights Impact Assessment will not be prepared and Tullow are committed to adhering to the Voluntary Principles on Security and Human Rights.

The main elements of the Project that may cause social impacts are:

- Direct and indirect impacts of substantial economic investment, and associated employment and procurement opportunities, in an area of high poverty and historical detachment from national politics;
- Indirect impacts of investment into an area of existing ethnic conflict, often linked to scarce resources;
- Loss of, or loss of access, to land and other natural resources as a result of infrastructure development;
- Introduction of security personnel to protect facilities and communities;
- Indirect impacts linked to environmental changes (e.g., water abstraction);
- Increased road traffic and associated changes with improved transportation infrastructure; and
- Management of outside workers needed for construction and other service provision, especially as outsiders mix with communities practicing traditional livelihoods.

6.10.2 Applicable standards and guidance

A full list of related legislation and guidance is presented in Chapter 5.0. The following provides the key legislation and guidance, which will be applicable to and guide the social assessment in the ESIA.

National Policy and Legislation

Table 6-12 presents national policy and legislation, which is considered relevant to the Upstream Study Area:

Table 6-12: Social issues covered by the Kenyan Constitution and National Laws

Issue	Kenyan Constitution	National Laws
■ Forced labour ■ Discrimination in workplace ■ Working hours ■ Fair labour conditions ■ Contract (including dismissal)	■ Article 30 ■ Article 40	■ Employment Act (2007)

Issue	Kenyan Constitution	National Laws
■ Leave entitlement ■ Work-related housing ■ Water use and consumption ■ Food consumption ■ Maternity and paternity leave ■ Medical attention		
■ Freedom of association ■ Collective bargaining ■ Recognition of trade union ■ All related trade union activities	■ Article 8 ■ Article 36 ■ Article 37	■ Labour Relations Act (2007)
■ Compensation for work-related injury or occupational diseases including medical treatment, appliances and travel	N/A	■ Work Injury Benefits Act (2007)
■ Safety, health and welfare at work ■ Protection of other individuals at workplace from risks arising from the activities of the employee at work ■ Special provisions for health and welfare of workers, machinery, chemical and safety		■ Occupational Safety and Health Act (2007)
■ Economic and social rights	Article 43	NA

Kenya has ratified seven out of the eight ILO Core Labour Conventions. Kenya has not ratified No. 87 on Freedom of Association and Protection of the Right to Organise, however, this right is protected by Article 36 of the Kenyan Constitution.

Other important legislation related to rights include:

- The Republic of Kenya. Act No. 56 of 2012. Prevention, Protection and Assistance to Internal Displaced Persons and Affected Community Acts, 2012;
- International Convention on the Elimination of All Forms of Racial Discrimination,1969;
- International Covenant on Civil and Political Rights,1976;
- International Covenant on Economic, Social and Cultural Rights,1976;
- Convention on the Elimination of All Forms of Discrimination against Women,1981;
- Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment,1987;
- Convention on the Rights of the Child,1990;
- Optional Protocol to the Convention on the Rights of the Child on the involvement of children in armed conflict, 2002; and
- Convention on the Rights of Persons with Disabilities, 2008.

International Guidance and Standards

The following Performance Standards are considered to be applicable to the Project:

- International Finance Corporation. Performance Standard 1: 2012. Assessment and Management of Environmental and Social Risk and Impacts. IFC, 2012;
- International Finance Corporation. Performance Standard 2: 2012. Labour and Working Conditions. IFC, 2012;
- International Finance Corporation. Performance Standard 4: 2012. Community Health, Safety and Security. IFC, 2012;
- International Finance Corporation. Performance Standard 5: 2012. Land Acquisition and Involuntary Resettlement. IFC, 2012; and
- International Finance Corporation. Performance Standard 7: 2012. Indigenous People. IFC, 2012.

6.10.3 Baseline

6.10.3.1 Available data

Based on the literature and reports reviewed to date, much of the existing socio-economic information will need to be updated and narrowed to focus on the specific study area. Information reviewed to date includes:

- Reports from the Kenya National Bureau of Statistics;
- EIA and socio economic baselines for a number of the exploration phases of the project;
- Community Perception on Conflict, Conflict Mitigation and Security in Turkana and Pokot Regions; and
- Numerous national reports on socio economics, human development, pastoralism, health and development plans from various sources.

The data provided to date, while providing context, does not provide sufficient information that can be transferred easily into the ESIA socio-economic baseline.

6.10.3.2 Area of Influence and Study Area

The Upstream Study Area is located in Turkana, which is defined as the regional AOI for the social impact assessment. The extent of the local AOI would however be limited to the three sub-county administrative units or Constituencies of Turkana East, Turkana South and Turkana Central, which will house various components of the project infrastructure. These three administrative units will therefore also constitute the Study Area.

6.10.3.3 Baseline conditions

6.10.3.3.1 Administrative divisions and governance structure

Within the County, there are six sub-counties as shown in Figure 9 (Administrative Divisions for Turkana County).

Each sub-county is further divided into Divisions, Locations and Sub-locations. All administrative units are outlined in Table 6.13 to Table 6.16. Sub-counties or Constituencies are represented by one Member of Parliament (MP) per county, each sitting in the National Assembly. Within the County, each Constituency is divided into electoral Wards, each being represented by a Member of County Assembly (MCA) in the County Assembly. In addition to the 30 MCAs listed per Constituency, there are an additional ten MCAs nominated by political parties, making a total of 40 MCAs.

Table 6.13: Wards per Constituency in Turkana County

Constituency	*Number of Wards*
Turkana South	5
Turkana East	3
Turkana Central	5
Loima	4
Turkana West	7
Turkana North	6
Total Number of Wards	30

Table 6.14: Sub-county Administrative Units: Turkana South

Turkana South			
Division	*Location*	*Sub-location*	*Ward*
Lokichar	Lokichar	Lokichar	Lokichar
		Kapese	
	Lochwangi Kamatak	Lochwangi Kamatak (Lochwangimatak)	
		Naposumuru (Napusimoru)	
	Kalapata	Kalapata	Kalapata
		Loperot	
		Nakalale (Nakaalei)	
Kainuk	Kainuk	Kainuk	Lobokat
		Kakongu (Kakong)	
		Loyapat	
	Kaputir	Kalomwae	Kaputir
		Nakwamoru	
		Lorogon	
Katilu	Katilu	Katilu	Katilu
		Lokapel	
		Kalemgorok (Kalemgorok)	
		Kanaodon (Kanaodon)	

Table 6.15: Sub-county Administrative Units: Turkana East

<table>
<tr><th colspan="4">Turkana East</th></tr>
<tr><th>Division</th><th>Location</th><th>Sub-location</th><th>Ward</th></tr>
<tr><td rowspan="11">Lomelo</td><td rowspan="2">Lomelo</td><td>Lomelo</td><td rowspan="11">Kapedo/Napeitom</td></tr>
<tr><td>Katir</td></tr>
<tr><td>Napeitom</td><td>Napeitom</td></tr>
<tr><td rowspan="2">Nadome</td><td>Nadome</td></tr>
<tr><td>Ekipor</td></tr>
<tr><td rowspan="2">Kamuge</td><td>Kamuga (Kamuge)</td></tr>
<tr><td>Ngilukia</td></tr>
<tr><td rowspan="2">Kapedo</td><td>Kapedo</td></tr>
<tr><td>Silale</td></tr>
<tr><td rowspan="11">Lokori</td><td rowspan="3">Lokori</td><td>Lokori</td><td rowspan="8">Lokori/Kochodin</td></tr>
<tr><td>Kangitit (Kang'itit)</td></tr>
<tr><td>Lotubae</td></tr>
<tr><td rowspan="2">Kochodin</td><td>Lochodin (Kochodin)</td></tr>
<tr><td>Lopii</td></tr>
<tr><td rowspan="3">Lochakula</td><td>Lochakula</td></tr>
<tr><td>Kakulit</td></tr>
<tr><td>Lokwamosing</td></tr>
<tr><td rowspan="3">Katilia</td><td>Katilia</td><td rowspan="3">Katilia</td></tr>
<tr><td>Elelea</td></tr>
<tr><td>Parkati (Paragati)</td></tr>
</table>

Table 6.16: Sub-county Administrative Units: Turkana Central

<table>
<tr><th colspan="4">Turkana Central</th></tr>
<tr><th>Division</th><th>Location</th><th>Sub-location</th><th>Ward</th></tr>
<tr><td rowspan="8">Kerio</td><td rowspan="3">Kerio</td><td>Kerio</td><td rowspan="8">Kerio Delta</td></tr>
<tr><td>Nakurio</td></tr>
<tr><td>Nadoto</td></tr>
<tr><td rowspan="2">Kangirisaye</td><td>Kangirisaye</td></tr>
<tr><td>Nakoret</td></tr>
<tr><td rowspan="3">Lorengelup</td><td>Lorengelup</td></tr>
<tr><td>Kangagetei</td></tr>
<tr><td>Kakimat</td></tr>
<tr><td rowspan="8">Kalokol</td><td rowspan="3">Kalokol</td><td>Kalokol</td><td rowspan="3">Kalokol</td></tr>
<tr><td>Kapua</td></tr>
<tr><td>Namadak</td></tr>
<tr><td rowspan="2">Namukuse</td><td>Namukuse</td><td rowspan="5">Kang'ototha</td></tr>
<tr><td>Locher Ekeny</td></tr>
<tr><td rowspan="3">Kangatotha</td><td>Eliye (Ille)</td></tr>
<tr><td>Naworos (Naoros)</td></tr>
<tr><td>Lomopus</td></tr>
<tr><td rowspan="5">Central</td><td rowspan="3">Lodwar Township</td><td>Lodwar Township</td><td rowspan="3">Lodwar Township</td></tr>
<tr><td>Nakwamekwi</td></tr>
<tr><td>Napetet</td></tr>
<tr><td rowspan="2">Kanamkemer</td><td>Kanamkemer</td><td rowspan="2">Kanamkemer</td></tr>
<tr><td>Nawoitorong</td></tr>
</table>

Reorganisation associated with changes from the 2010 constitution has caused some challenges in understanding role and responsibilities among various levels of government authorities.

6.10.3.3.2 Demographics

The most recent census data from the Kenya Population and Housing Census (KPHC) in 2009 counted a total population of 855,399. This figure was expected to be over 1 million in 2012, but additional official statistics have not been identified (Turkana County, 2013).

The three Constituencies in the AOI made up approximately 360,000 people with Turkana Central being the most densely populated (Turkana County, 2013). However, Turkana County is often described as having unreliable data given the movement of pastoralist communities, making it difficult to count and track population figures.

Lodwar town, Kakuma and Lokichggio are the three main urban centres in Turkana County. Lodwar town had the largest population of the urban centres with a total of 35,897 people according to the 2009 census. Kakuma is unique in that it hosts a refugee camp sheltering people fleeing from Sudan, Ethiopia, Uganda, Somalia and Burundi (Turkana County, 2013).

The County is characterised by clustered settlements. Rural areas are settled with the nomadic pastoral communities on a temporary basis because of their movement in search of water and pasture for their livestock.

The majority of the people in the county come from the Turkana community, with a few other tribes from different parts of the country. Precise numbers of other ethnic groups are as yet unknown.

There is little existing information on classification of vulnerable and marginalised group, which will be studied further. The Kenyan Constitution, Part 3 – 56, has requirements related to “minorities and marginalised groups” that will need to be considered in the context of project impacts and mitigations.

At this stage, insufficient information is available regarding the appropriateness of referring to any group as “indigenous”, which would trigger further analysis in line with IFC Performance Standard 7 on Indigenous Peoples. Golder will conduct an applicability assessment as part of the baseline analysis and consultation work. Key steps in that assessment include:

- Initial Review of Previous PS7/Indigenous Peoples Applicability;
- Initial Baseline Data Review; and
- PS7 Evaluation of Distinct Social & Cultural Groups in the Project Area

6.10.3.3.3 Infrastructure and services

Socio-economic mapping has been conducted as part of the establishment of exploration wells. This will be expanded to capture infrastructure and services data relating to the Upstream Project.

6.10.3.3.4 Economics

Wage earners constitute only 6% of the population in Turkana County. Unemployment levels are estimated at 70% in contrast to national figures of 42% (Turkana County, 2013).

The majority of Turkana County depends on nomadic pastoralism; fishing and weaving are also common sources of livelihood. Fishing is practiced in Lake Turkana. Goats, donkeys, camels and cattle are the most common livestock and the Kerio River and Turkwel Dam are key sources of water to support animal husbandry (Turkana County, 2013).

Turkana has some of the highest levels of poverty in the country. Such figures need to be considered in context. One way of assessing context may be to assess how far a community is from its water source, although, such questions are more complex among communities travelling with animals and following patterns of seasonal resources.

6.10.3.3.5 Land use and ownership

All land associated with the Project is unregistered community land in Turkana. In accordance with the Constitution, all unregistered community land is held in trust by the County Government (County Council of Turkana) on behalf of the community. Research by USAID has indicated that approximately 70% of land in Kenya is classified as community land (USAID, 2011).

Land rights relate to ownership, access and use and the security of this ownership, access and use. Land formed the basis for the independence movement in Kenya and has symbolic, cultural and historical importance. There are complex political, community, commercial, legislative and contractual factors that influence the preferred mechanisms and consequences for how the Project seeks to secure access to unregistered community land.

To date, exploration and appraisal activities have involved accessing relatively limited areas of land on a temporary basis. This has involved obtaining temporary land leases issued by Turkana County Government, together with provision of community benefits for communities proximate to required sites. To develop the discovered oil resources the development and production phases will require longer-term access for at least 25 years to larger areas of land in upstream oil fields.

The overall approach proposed for securing land for the Project will be done with the government, including the National Land Commission, Turkana County Government and other stakeholders. Tullow works closely with the Ministry of Energy and Petroleum's Land Working Group, who expect to agree on the approach and details of implementation in early 2016. As with all aspects of the Project, the approach will need to meet national requirements, as well as comply with the IFC Performance Standards.

Tullow has initiated baseline data gathering within known land required for the project to assess land ownership, land use, land users and structures and assets. This will inform the ESIA on baseline and potential impacts and be used to change project design to minimise impact associated with land acquisition. This data, as well as other socio-economic research, will be used to develop appropriate a Resettlement Action Plan or Livelihood Restoration Plan, which will form part of the overall Environmental and Social Management Plan.

Beyond the clear indication that local residents use land for pastoralism, there is limited data and information that can be used to analyse land use in the local AOI. Preliminary findings from Tullow's on-going baseline data gathering confirm that all land is community land and there are no indications of land staking within the field areas visited. Regional insecurity has influenced the way land is being used near some areas. This dynamic will be assessed for all fields and baseline information will be collected for wet and dry season variations.

Land is one of the most important aspects of the socio-economic baseline and will be studied in greater detail during baseline data collection.

6.10.3.3.6 Community health and safety

TKBV have mapped some health facilities in the AOI, but little information or data on health trends has been collected.

Turkana County documents report that access to health is low compared to the size of the territory and population. Official information also indicated that health personnel are not sufficient with one doctor for every 70,000 people and one nurse for every 5,200 people (Turkana County, 2013).

The two most common diseases are said to be malaria and respiratory infections. Many areas are favourable environments for mosquitoes and dust is said to contribute to the respiratory ailments (Turkana County, 2013).

Kenya is considered one of six "high burden" countries in Africa in relation to HIV with an estimated 1.6 million people living with the disease in 2011. The most affected population for new infections are married couples, which accounted for 44% of 91,000 new infections in 2009 (UNAIDS, 2012).

More recent statistics and additional qualitative information are expected from key informant interviews.

6.10.3.3.7 Education

In total, there are only 315 primary schools and 32 secondary schools in all of Turkana County. There are polytechnic institutes in Kakuma and Lodwar; two colleges, one focus on health and the second on teacher training. The only campus university sites are in Lodwar and Lokichoggio and a Technical Training Institute is being built in Lodwar (Turkana County, 2013).

Socio-economic mapping has sought to identify only what educational infrastructure is located in villages close to exploration wells. There is limited information on educational achievement, literacy and other aspects that can be compared across the AOI or to understand how these areas compare with similar places within Turkana County and throughout Kenya.

TKBV have planned an industrial baseline survey, which will seek to get further information on local and regional educational capacity and facilities. When complete, the findings from this study will be incorporated into the socio-economic baseline.

6.10.3.3.8 Social maladies

Social maladies have not yet been investigated. These include aspects of alcohol or drug use, crime, commercial sex work, child and forced labour and other work/occupational inequities. While limited data can be expected on these topics, the topics will be investigated through key informant interviews and focus groups.

6.10.3.3.9 Social capital, security and conflict

TBKV has engaged Wasafiri Consulting to conduct conflict analysis of some communities in the local AOI. The group has done preliminary site visits to three villages, two of which (Nakukulas and Loperot) have had contact with Tullow, and one that has had relatively limited contact, Nakabosan.

Preliminary findings include an atmosphere of increasing tension between communities, different ethnic groups, especially the Pokot to the southwest, and with Tullow itself. The findings also indicate that there is increasing tension between traditional community governance structures and elected leaders. This is reportedly linked to disagreements about who represents local communities.

In addition, secondary and primary research has been conducted by Small Arms Survey. Their report on community perceptions of conflict indicates shifts and intensification of armed conflict. Over the past 10 years, a gradual shift has occurred in patterns of livestock raiding and attacks. While raids continue to serve as a means to distribute wealth within a community through the acquisition of assets, particularly animals, the commercialization of livestock theft – in which individuals, and not communities, benefit from raiding – has emerged. Politicians, businessmen and other elites are alleged to be supporting and profiting from commercialized raiding, something that is believed to be eroding elders' authority (Mkutu, 2010; Kaimba, 2011; Griener, 2013; Triche, 2014).

Further baseline research will aim to better understand the general dynamic.

6.10.3.4 Key data gaps

The following are the key data gaps, which will be addressed during baseline data collection:

- Description of roles and responsibilities of administrative units;
- Information on populations of potentially affected communities;
- Information on migration trends, vulnerable groups;
- Information on the business environment (i.e., type of businesses and number of businesses), income, poverty and inequality, livelihoods and occupations, inflation and departmental or sector-specific economic issues;
- Industrial baseline survey;
- Information on community health and safety, such as communicable/non-communicable diseases, health information systems, water and sanitation;

- Data on infrastructure and services;
- Data and information on land ownership and land use;
- Information education, such as literacy and educational achievements, skills sets available;
- Information on social maladies; and
- Information on social capital, security provision and community/conflict dynamics.

6.10.4 Identification of potentially significant effects

The following social issues have been identified as potential effects the Upstream Project could have on socio-economic receptors. The text presents where effects are to be scoped in to the ESIA or whether they do not require further consideration and will be scoped out of the ESIA:

- In-flux and migration: Changes in demographics, mixture of local residents with outsiders and changes to culture and intangible cultural heritage (with inputs from intangible cultural heritage impact assessment). In-flux can also be linked to many indirect changes in social maladies, security and community health – scoped in;
- Taxes and other payments: Changes in government resources – scoped in;
- Direct employment for skilled and non-skilled labour: Employment may be a positive impact. However, the allocation of jobs can also lead to accusations of nepotism, which in turn can lead to opposition to the Project and conflict among residents – scoped in;
- Contractor (indirect) employment for skilled and non-skilled labour: Contractor or "non-employee" workers are considered differently than workers hired directly by TKBV. Workers hired by third parties present different risks – scoped in;
- Business opportunities/local content: As with employment, this can be a positive dynamic, but the perception of fair process is essential to avoid tensions between different groups – scoped in;
- Inflation: Changes in prices for goods, services and labour – scoped in;
- Resettlement and economic displacement: Land is an issue itself, as well as being linked to numerous in-direct issues such as communal land use (i.e., grazing and fishing) and migration and movement of people. The issue is further complicated by an overall lack of legal framework underpinning the access to community land. Devolution from national to county governments has politicised the issue, making it difficult to balance communication with national, county and sub-county stakeholders – scoped in;
- Indigenous peoples: While no final conclusion has been made on determining whether local residents meet the criteria of Indigenous Peoples, further analysis will be required – scoped in;
- Vulnerable and marginalised groups: Vulnerable groups are a key issue touching gender, ethnicity, elderly and the dynamic between various socio-economic levels – scoped in;
- Infrastructure: Changes in infrastructure, including roads, power, water and waste management – scoped in;
- Community health and safety – scoped in;
- Changes in social capital, security provision and conflict – scoped in;
- Education: Changes in the provision of education – scoped in;
- Indirect impacts linked to environmental changes (e.g., water abstraction) – scoped in; and

- Stakeholder expectations: High expectations are linked to all social and many environmental issues. This is overarching for all issues listed above. It is especially relevant to the expectation for "shared benefits" or discretionary social investment – scoped in.

6.10.5 Summary of approach to the ESIA

A summary of the approach to the social component of the ESIA is provided in Table 6.17.

Table 6.17: Analysis of potential effects (Social)

Receptor	Potential Effect	Next Steps in the ESIA
Project Affected People (including individual residents as well as non-organised groups with particular areas of interest or that may be vulnerable (e.g. elderly, people with disabilities, ethnic minorities)	■ Influx and migration. ■ Changes in taxes, profit sharing and other payments. ■ Direct employment for skilled and non-skilled labour. ■ Contractor (indirect) employment for skilled and non-skilled labour. ■ Business opportunities/local content. ■ Inflation, and hence changes in prices for goods, services and labour. ■ Resettlement and economic displacement ■ Impacts on indigenous peoples, and vulnerable groups. ■ Changes in infrastructure. ■ Changes in health and safety ■ Changes in social capital, security provision and conflict. ■ Changes in the provision of education.	*Baseline data gathering -* ■ Review information gathered during stakeholder engagement to inform approach to socio economic baseline data gathering, concerns and questions. ■ Collect more detailed data and information on existing baseline conditions through focus group, key informant interviews at the community and non-community levels and secondary literature research; ■ Collect local and regional health data through database research by medical practitioners and focused key local informant interviews Impact Assessment ■ Using baseline information and stakeholder inputs and more detailed project description, conduct detailed analysis of how the potential effects listed above will impact the main receptor, project-affected people; and ■ Develop reasonable and appropriate mitigation measures to

Receptor	Potential Effect	Next Steps in the ESIA
		reduced negative impacts and maximise potentially positive impacts.

6.10.6 References

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7.0 EMERGENCY PREPAREDNESS AND RESPONSE TO UNPLANNED EVENTS

The ESIA will consider risks that may occur from unplanned events. This is necessary both to meet national EIA requirements and comply with international standards (notably IFC PS 1 and 4, which specify that the environmental and social management measures emerging from the assessment process should incorporate measures for *"emergency preparedness and response"*).

Tullow's Emergency Preparedness Standard (2015) also requires the company to undertake an exercise which involves the Identification and Assessment of credible risks and states that "*credible emergency scenarios*" shall be documented, based on the business unit and operational risk registers/assessments and include an evaluation of the potential likelihood, severity and operational impact of:

1) Medical emergencies (Illness, Injury, Fatality)

2) Road transport incidents

3) Aviation or marine transport incidents

4) Natural disasters

5) Fire and/or explosion

6) Hazardous release to the environment (including well control)

7) Community protest or targeted demonstrations

8) Security incidents (crime, civil disorder, terrorism, kidnap, piracy, war

Management of unplanned events which require an element of environmental or social risk management will be incorporated into the ESIA and its associated Management Plans. The Management Plans will include an Emergency Response and Preparedness Plan, and will:

- Identify and quantify both the likelihood of the occurrence of unplanned events and their environmental and social consequences (i.e. level of hazard should the event occur); and
- Specify both measures for avoiding/minimising risks of occurrence through design, training and allocation of resources and operational procedures, as well as responses to be implemented in the event of an occurrence.

The above approach will meet the requirements of national legislation and international good practice as well commitments within the Tullow polices and provide clear guidelines on the avoidance, response to and management of high consequence, low probability unplanned events. Such events and their consequences are likely to include but not be limited to those outlined below:

- Natural seismicity (earthquakes) on built structures which may lead to loss of containment (pollution via surface water or groundwater pathways), and on vibration sensitive built structures or equipment which may lead to operational failure;
- Induced seismicity (due to oil production/water injection) resulting in risk as per above including loss of containment due to failure of casing;
- Flood or other extreme weather event events putting infrastructure risks with potential for operational failure an possible impacts on communities close to project infrastructure notably the CPF;
- Uncontrolled leaks and spills including from structural or mechanical failure, vehicle/plant collision or other human error;
- Waste handling, storage and transport including drilling muds;
- Run off discharges from systems that are normally isolated (e.g. around drill rig, central part of CPF) during high rainfall or uncontrolled conditions causing potential risks of pollution/contamination;
- Discharges of firefighting foam;
- Well blow out during drilling and workover interventions;
- Well casing/grout integrity failure and down hole collisions during drilling interventions and production;
- Pipeline failure;
- Emergency crude release from CPF;
- Blow out, explosion or integrity failure resulting in emergency releases of gas from wells, the pipeline or CPF;
- Emergency releases from relief systems for control of tank pressure;
- Flaring from emergency and non-routine events; and
- Community protest or targeted demonstrations relating to environmental and/or social issues.

Report Signature Page

GOLDER ASSOCIATES (UK) LTD

Simon Aldrich
Project Director

Andy Morsley
Project Manager

SA/AM/ss

FIGURES

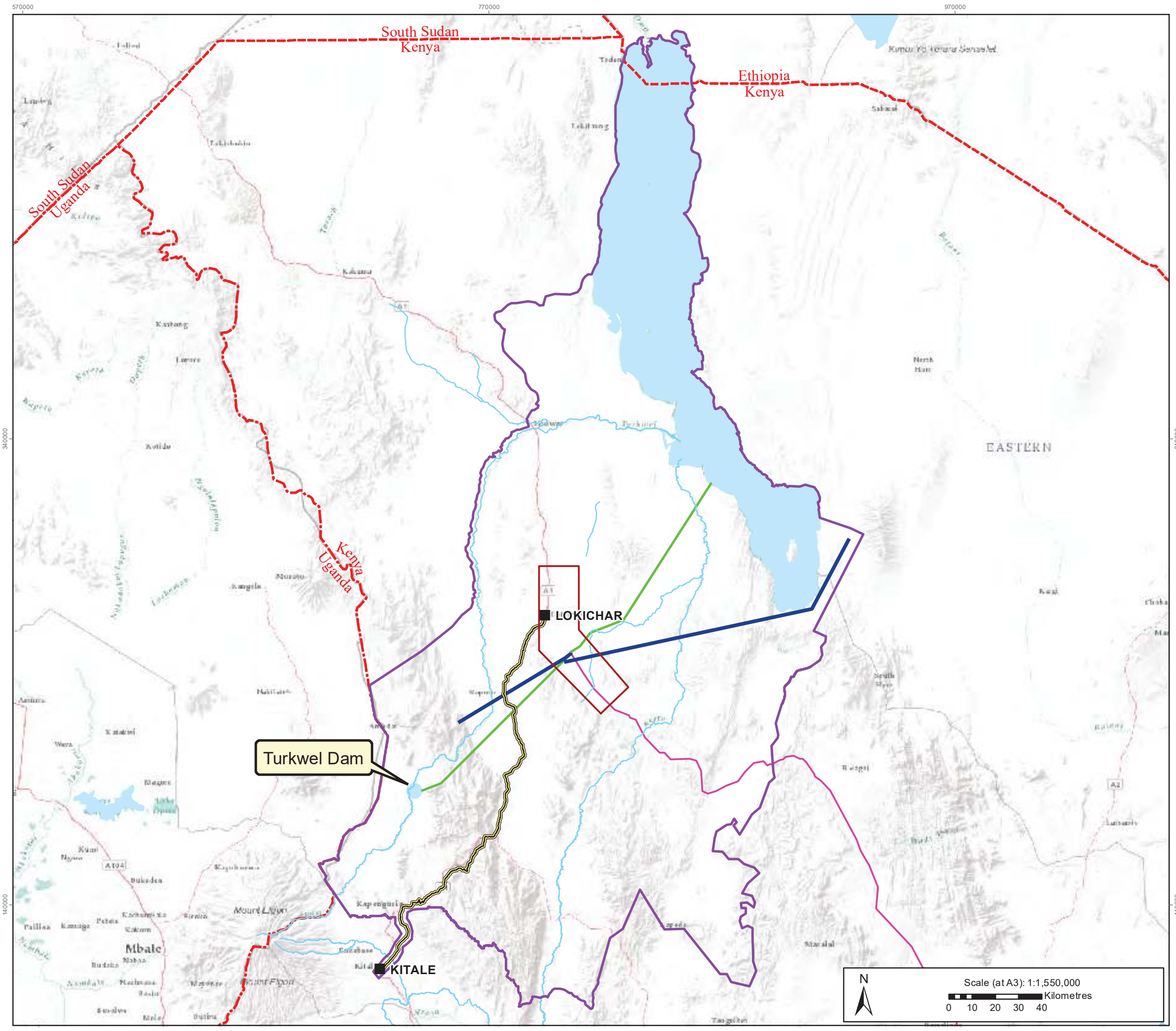

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Figure 1: Likely Area of Influence for the Upstream Project

South Lokichar Development, ESIA Project Report

Key

- Potential Export Pipeline
- Potential Power Line - 132KV
- Potential Source Water Pipeline
- A1 Lokichar to Kitale Highway
- Potential Area of Influence of the Upstream Component
- Upstream Area
- Surface Waterbody
- International Border

Data sources:
Data sourced from client

Coordinate system: WGS 1984 UTM Zone 36N

Project Ref:	Prepared by:	Reviewed by:	Approved by:
14514160360	LDoyle 21/12/2015	JMorgan 10/12/2015	AMorsley 10/12/2015

Company Details: 1 Alie Street London E1 8DE, UK

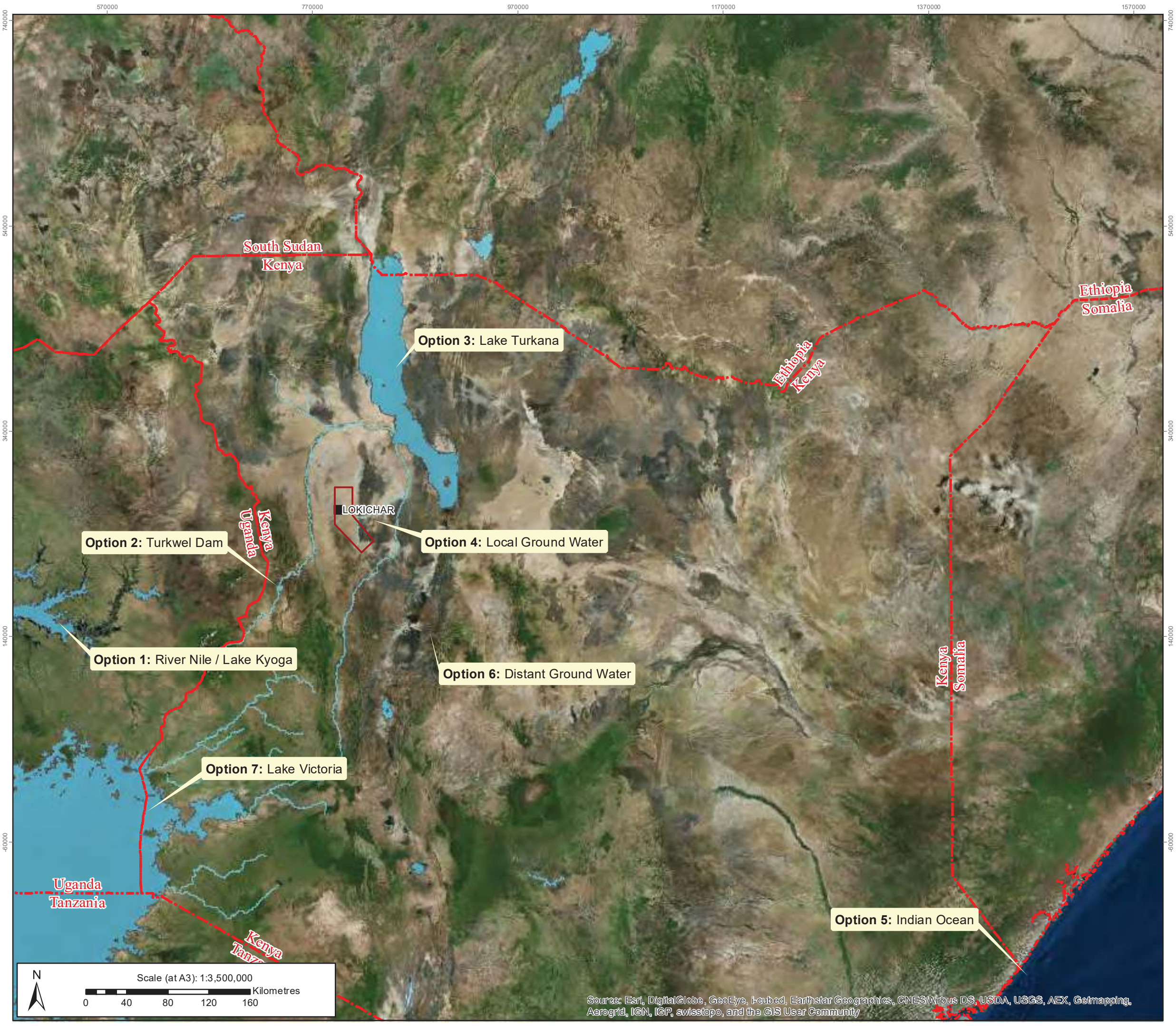

Figure 2: Water Supply Options

South Lokichar Development, ESIA Project Report

Key

Upstream Area

International Border

Data sources:
Data sourced from client

Coordinate system: WGS 1984 UTM Zone 36N

Project Ref: 14514160360	Prepared by: LDoyle 21/12/2015	Reviewed by: JMorgan 10/12/2015	Approved by: AMorsley 10/12/2015

Company Details: 1 Alie Street London E1 8DE, UK

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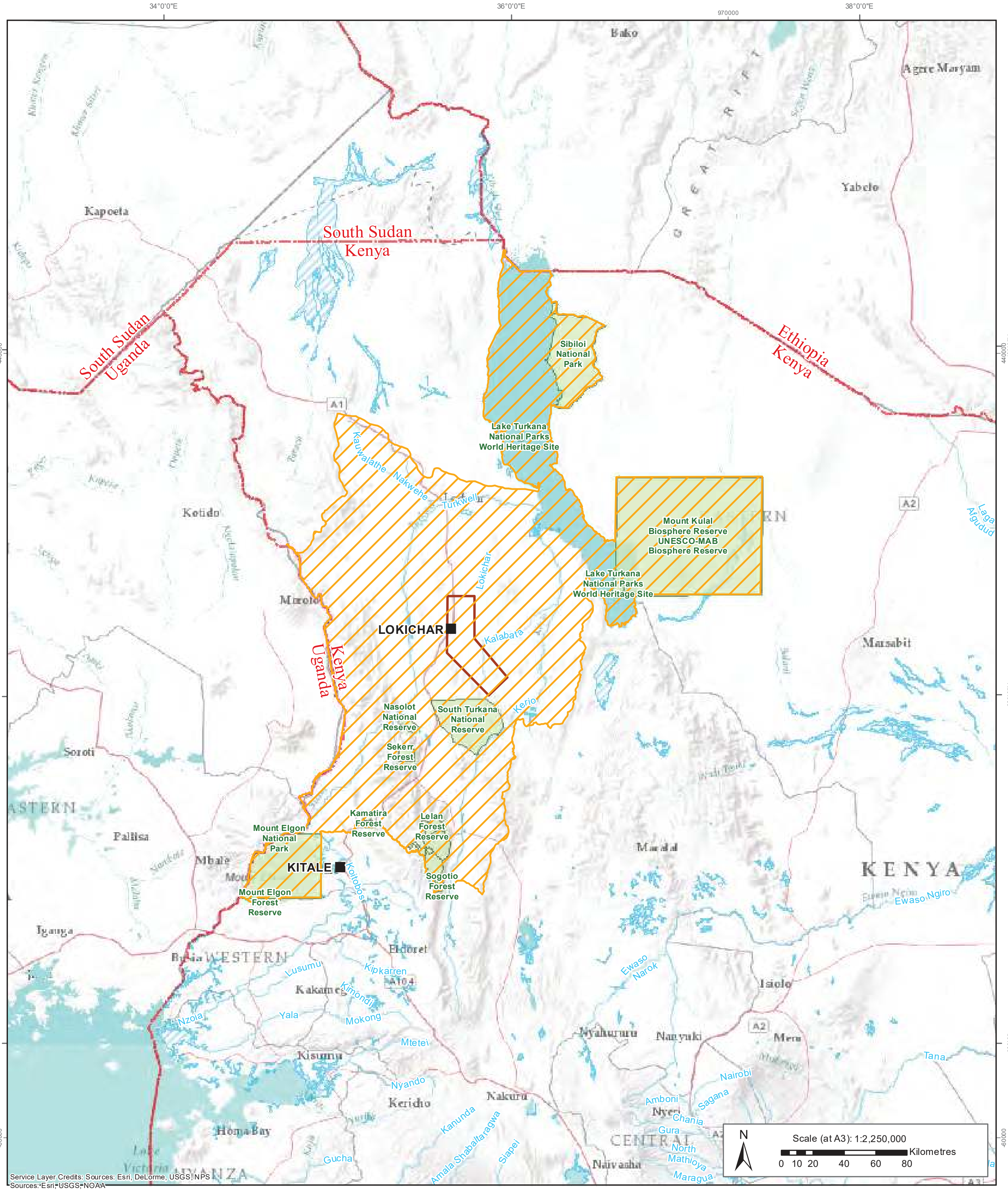

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Key

- Watercourse
- International Border
- Critical Habitat Area of Analysis (CHAA)
- WDPA Global Protected Areas (2012)
- Upstream Component
- Wetlands

Data sources: WDPA (2012)

Figure 3: Critical Habitat Area of Analysis (CHAA)

South Lokichar Development, ESIA Project Report

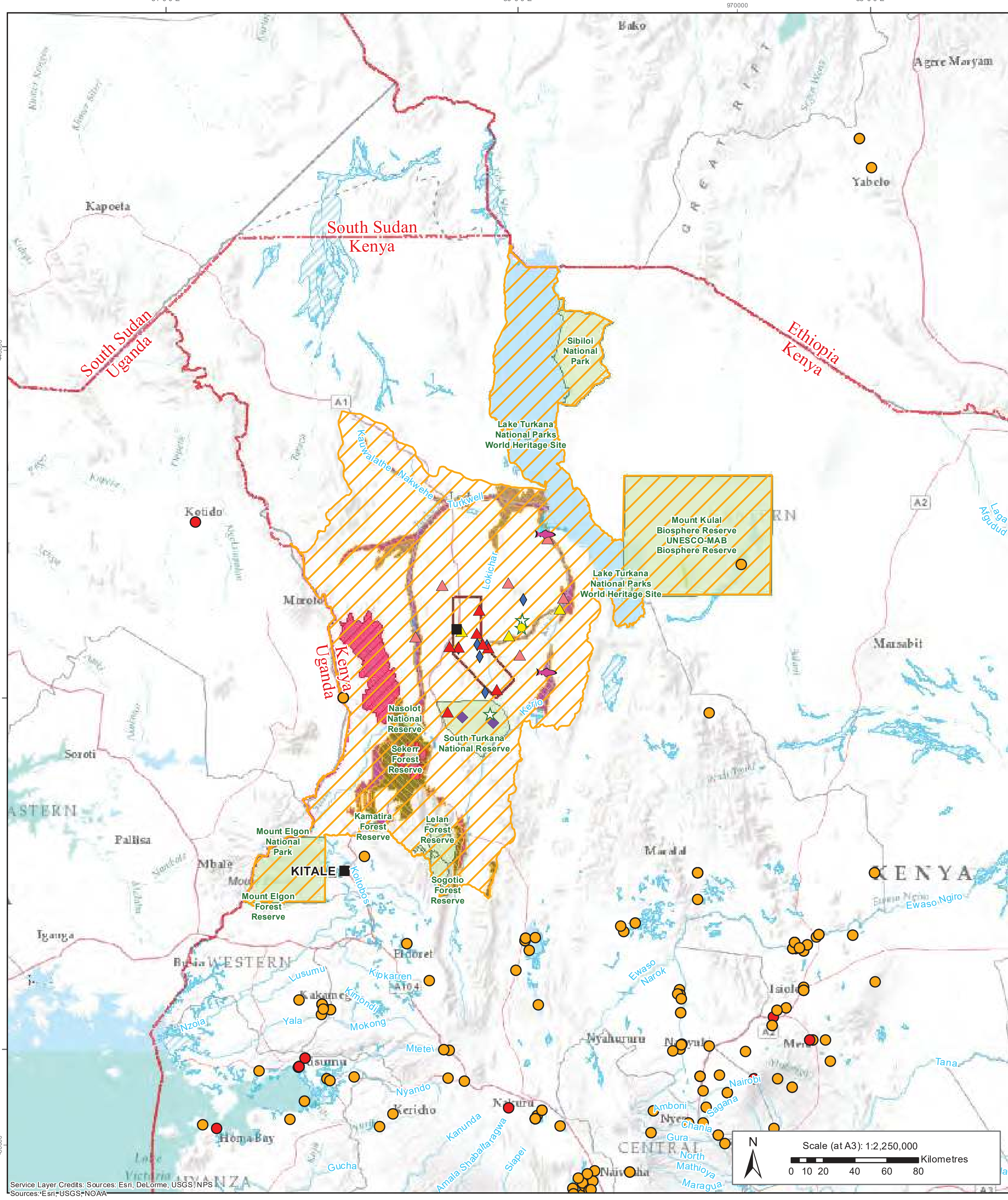
Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared by:	Reviewed by:	Approved by:
14514160360	LDoyle 21/12/2015	JMorgan 10/12/2015	AMorsley 10/12/2015

TULLOW plc

Golder Associates

1 Alie Street. London, E1 8DE UK



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Key

NMK Records of Species
- Olive Baboon
- African Elephant
- Hildegarde's tomb bat
- Jackal (species unknown)
- Leopard
- Migratory birds
- Birds species of concern

- Fish species of concern

GBIF Red List Species
- Critically endangered
- Endangered
- Critical Habitat Area of Analysis (CHAA)
- International Border
- Upstream

- WDPA Global Protected Areas (2012)
- Watercourse
- Wetlands
- Detailed_Water

Potential critical habitat triggers
- Deciduous wooded annual grassland (EN)
- Evergreen and semi-deciduous bushland (EN)
- Evergreen and semi-deciduous woodland (EN)
- Undifferentiated evergreen forest (CR)

Data sources: Biodiversity data sourced from NMK,WDPA and GBIF

Figure 4: Sensitivity Map of the CHAA

South Lokichar Development, ESIA Project Report

Coordinate System: WGS 1984 UTM Zone 36N

Project Ref:	Prepared by:	Reviewed by:	Approved by:
14514160360	LDoyle 21/12/2015	JMorgan 10/12/2015	AMorsley 10/12/2015

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Golder Associates

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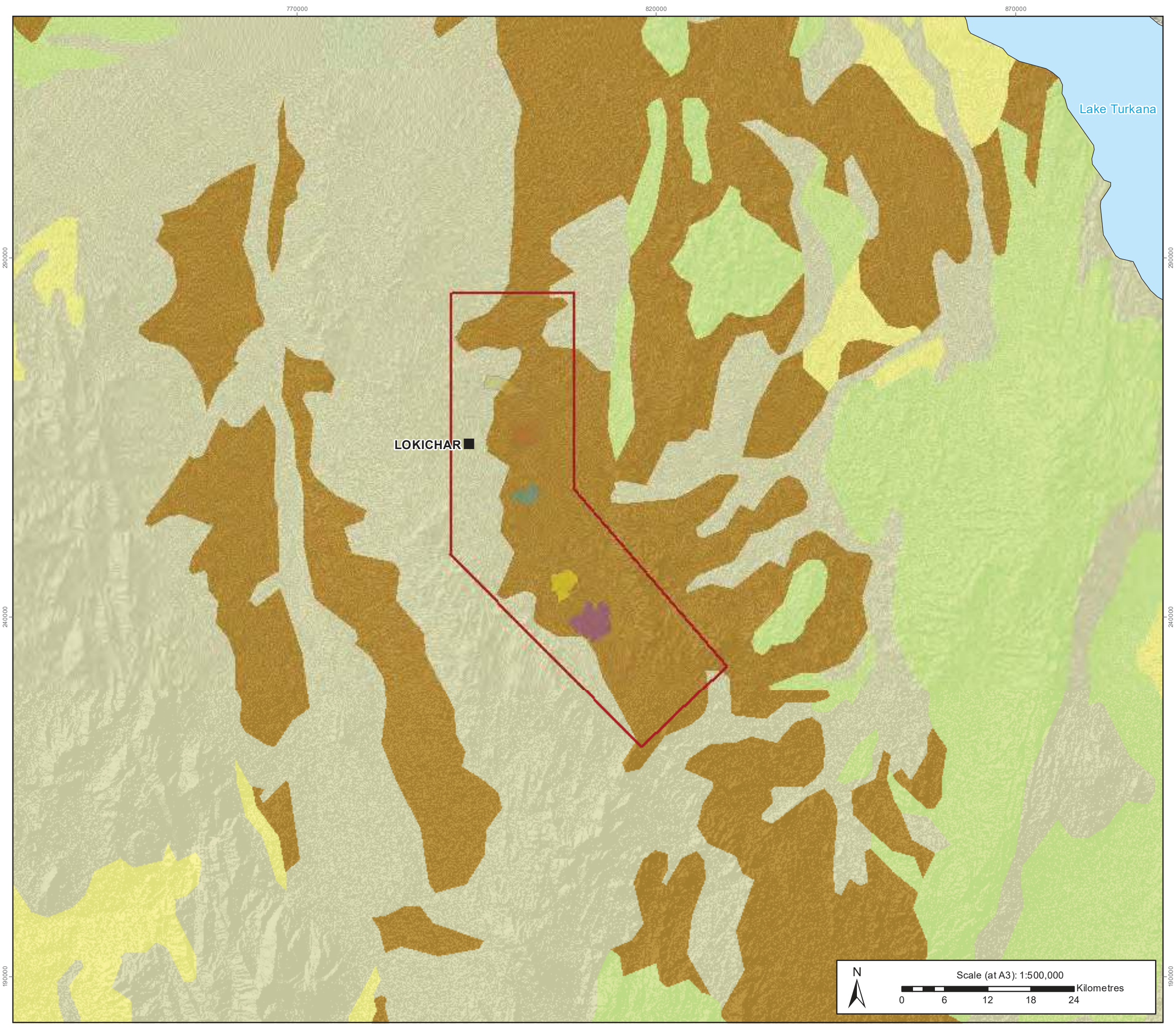
Figure 5: Soil Map

South Lokichar Development, ESIA Project Report



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Key

Upstream Area

Soil Type

- Clayey
- Loamy
- Sandy
- Very clayey

Well Field

- Agete
- Amosing
- Ekales
- Ngamia
- Twiga

Data sources:
Kenya Soils (2002); International Livestock Research Institute

Coordinate system: WGS 1984 UTM Zone 36N

Project Ref:	Prepared by:	Reviewed by:	Approved by:
14514160360	LDoyle 21/12/2015	JMorgan 10/12/2015	AMorsley 10/12/2015

Company Details: 1 Alie Street London E1 8DE, UK

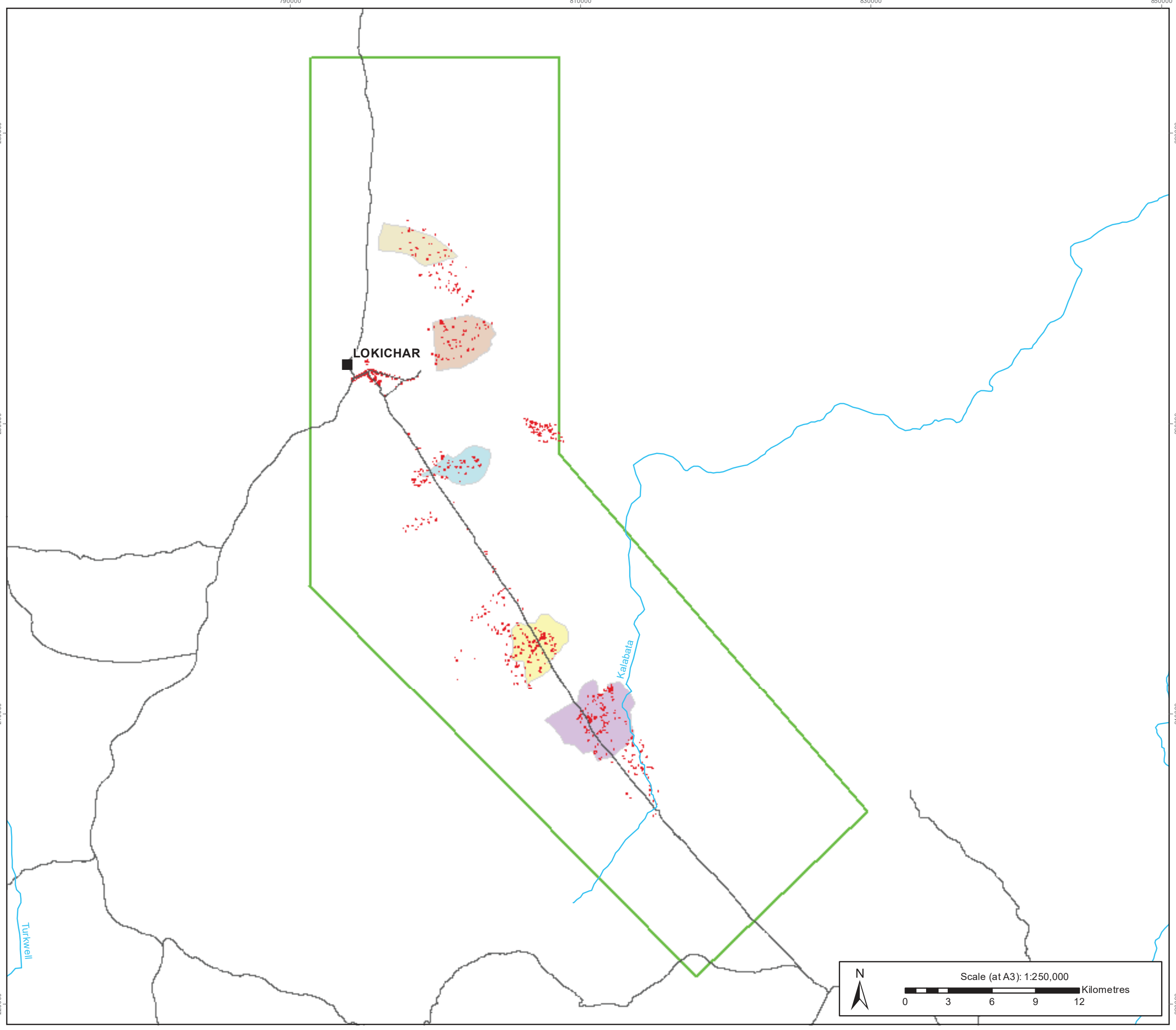

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Figure 6: Traditional Settlements and Land Use Features

South Lokichar Development, ESIA Project Report

Key

- Existing Road
- Upstream Area
- Surface Water Course
- Traditional Settlement & Land Use Feature

Well Field

- Agete
- Amosing
- Ekales
- Ngamia
- Twiga

Data sources:
Basedata sourced from client

Coordinate system: WGS 1984 UTM Zone 36N

Project Ref: 14514160360	Prepared by: LDoyle 21/12/2015	Reviewed by: JMorgan 10/12/2015	Approved by: AMorsley 10/12/2015

TULLOW plc
Golder Associates

Company Details: 1 Alie Street London E1 8DE, UK

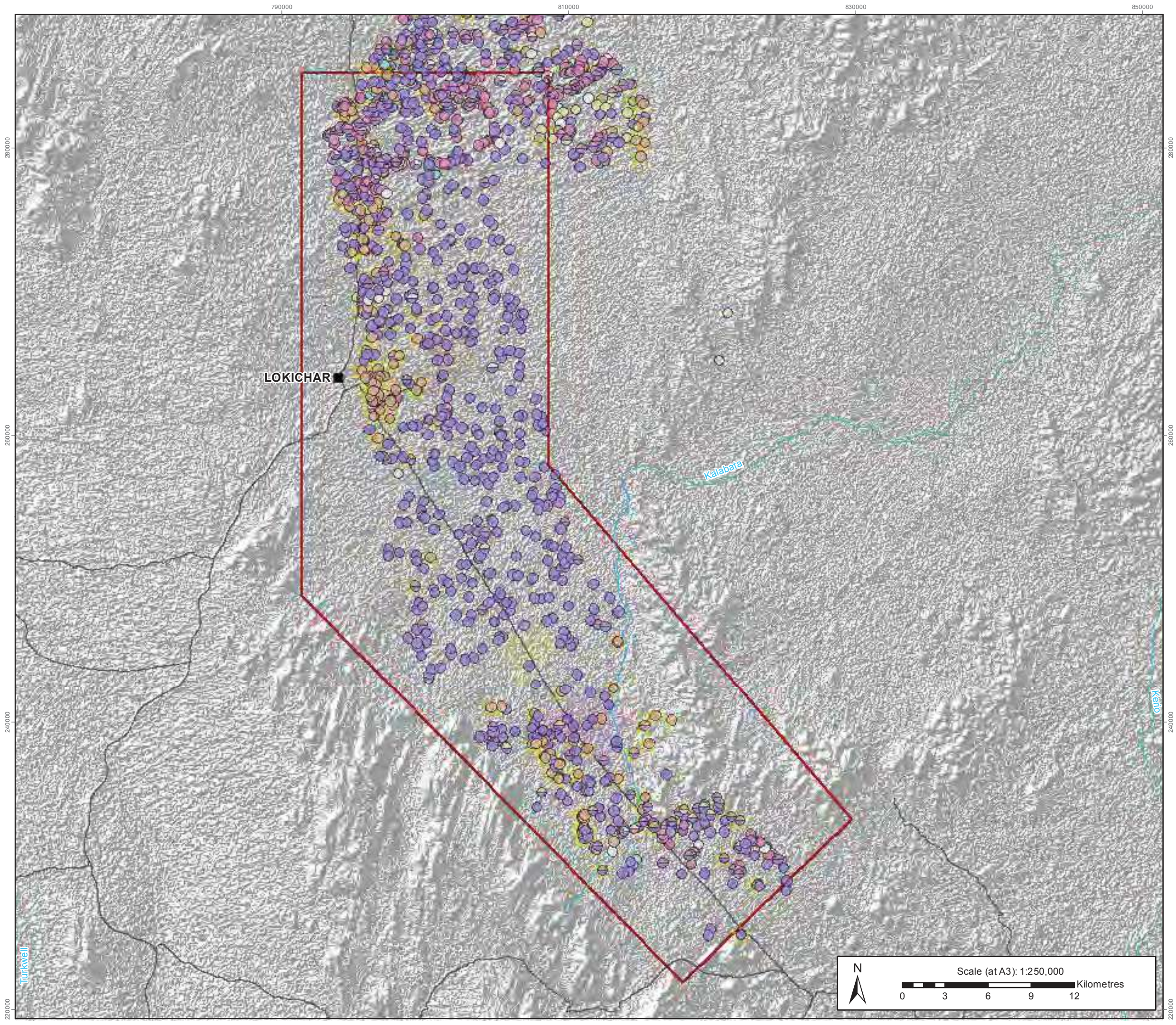

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Figure 7: Known Archaeological Finds (from desktop study)

South Lokichar Development, ESIA Project Report

Key

- Desk study indicates potential constraint high value – to be investigated further
- Site with multiple archaeological finds
- Burial
- Faunal
- Grindstone
- Jewellery
- Lithic
- Monument
- Palaeontological
- Pottery
- Existing Road
- Watercourse
- Upstream Area

Well Field

- Agete
- Amosing
- Ekales
- Ngamia
- Twiga

Data sources:
Basedata sourced from client

Coordinate system: WGS 1984 UTM Zone 36N

Project Ref:	Prepared by:	Reviewed by:	Approved by:
14514160360	LDoyle 21/12/2015	JMorgan 10/12/2015	AMorsley 10/12/2015

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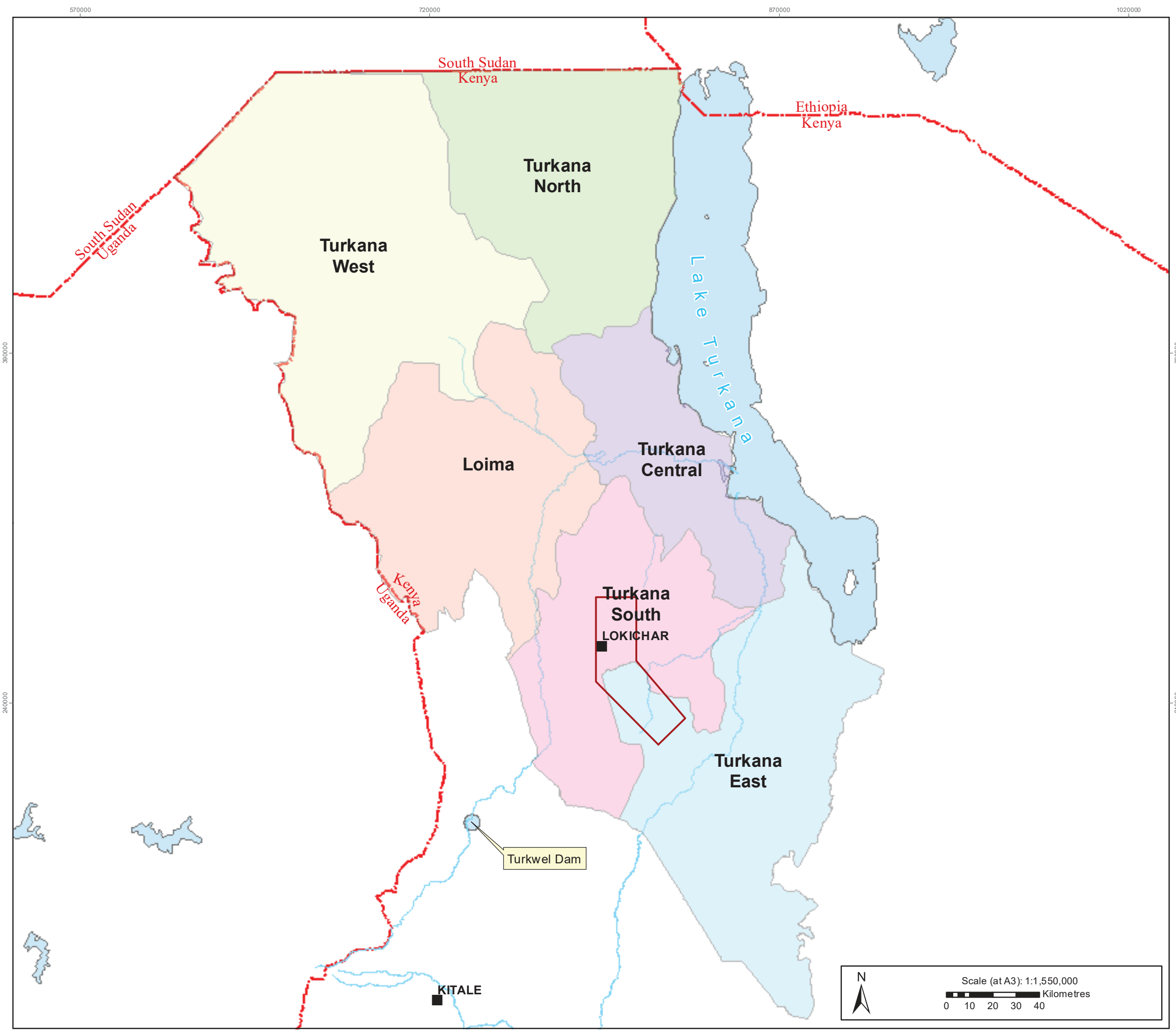

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Figure 8: Administrative Divisions for Turkana County

South Lokichar Development, ESIA Project Report

Key

Upstream Area

Divisions

- Loima
- Turkana Central
- Turkana East
- Turkana North
- Turkana South
- Turkana West

International Border

Surface Waterbody

Data sources:
German Agency for Technical Cooperation (GTZ), Department of Resource Surveys and Remote Sensing (DRSRS) and International Livestock Research Institute (ILRI)

Coordinate system: WGS 1984 UTM Zone 36N

Project Ref:	Prepared by:	Reviewed by:	Approved by:
14514160360	LDoyle 15/04/2015	JMorgan 10/12/2015	AMorsley 10/12/2015

Company Details: 1 Alie Street London E1 8DE, UK

APPENDIX A

Terms of Reference

A1.0 INTRODUCTION

This Terms of Reference (ToR) forms an appendix to the South Lokichar Development, Environmental and Social Impact Assessment (ESIA) Project Report.

The Project Report contains significant detail on the Project Description, the proposed ESIA methodology, the Policy, Legal and Institutional Framework, and data availability, data requirements and potentially significant effects for each technical topic in the ESIA. As such this ToR should be read in conjunction with the Project Report.

A2.0 APPROACH TO THE ESIA

Table A.1 presents a summary of the likely approach to the ESIA Baseline and Impact Assessment per technical topic.

Table A.1: Approach to the technical topic chapters of the ESIA

Topic	Potentially significant effects	Likely Approach
Biodiversity and Ecology	■ Direct loss/conversion of natural habitats ■ Indirect loss, conversion or disturbance of natural habitats ■ Introduction of invasive species, pests or diseases ■ Barriers to movement ■ Contamination ■ Population influx (Harvesting of plants, fibre and wood; bushmeat hunting)	Baseline: ■ Seasonal vegetation and flora surveys ■ Vegetation community mapping, including mapping of modified and natural habitat ■ Seasonal bird surveys ■ Wet season herpetofauna surveys ■ Seasonal terrestrial invertebrate surveys ■ Seasonal large mammal transect surveys ■ Continuous remote camera trapping survey for mammals (up to 1 year) ■ Seasonal small mammal trapping surveys ■ Seasonal bat acoustic monitoring surveys ■ Long wet season fish, macro invertebrate and wetland surveys Impact Assessment: ■ Habitat-area based impact analysis using selected ecosystem or community-level indicators or biodiversity features using GIS ■ Quantification of effects relative to baseline conditions by association of particular species or species groups with mapped vegetation communities or habitat types identified as indicators ■ Specific analysis will be conducted for species of concern identified in the baseline ■ Analysis of predicted changes to any areas identified as Critical Habitat
Ecosystem Services	■ All potential effects presented above for biodiversity ■ Ecosystems affecting capacity to supply services ■ Population influx ■ Changes or restricted access to water resources for livestock and human consumption	Baseline ■ Liaison between biodiversity, cultural heritage and social and land specialists to compile a targeted questionnaire on provisioning ecosystem service demand for use during stakeholder engagement and focus groups ■ Targeted community engagement (focus group or key informant) to understand current

	■ Changes to land uses ■ Changes to cultural heritage links and socio-economic patterns relevant to ecosystem services	ecosystem services and their uses ■ Relevant baseline data will be gathered from review of baseline biodiversity, water, and soil studies to assess the condition and capacity of ecosystems to deliver services Impact Assessment: ■ Identification of priority ecosystem services ■ Analysis of changes to priority ecosystem services
Soil, Terrain and Geomorphology	■ Soil quality ■ Erosion ■ Compaction ■ Land suitability	Baseline: ■ Soil sampling and analysis ■ Terrain descriptions Impact Assessment: ■ GIS soil mapping and land suitability mapping ■ Analysis of changes to soil quality
Water	■ Surface and groundwater quality ■ Surface water flow and runoff regime ■ Groundwater levels	Baseline: ■ Water sampling and analysis ■ Surface water flow and rainfall-runoff characterisation ■ Groundwater levels Impact Assessment: ■ Hydrological modelling of rainfall-runoff and analysis of changes to flow ■ Analysis of changes to surface water quality and groundwater quality ■ Changes to groundwater level ■ Quantification of changes to community water supplies.
Seismicity and Geology	■ Built structures ■ Infrastructure	Baseline: ■ Desk based study using existing data from national institutions and other secondary sources Impact Assessment: ■ Identification of risks and mitigation required from the engineering design team
Air and Climate	■ Air quality ■ Direct and indirect acidification, eutrophication, toxicity ■ Fugitive dust deposition leading to soiling or smothering ■ Odour nuisance ■ Contribution to global emissions of greenhouse gases	Baseline: ■ Air quality monitoring of key pollutants: fine particulates, combustion gases and VOCs ■ Monitoring of dust deposition rates. Impact Assessment: ■ Evaluate impact to air quality through predictive air dispersion modelling ■ Evaluate impact of additional dust deposition ■ Evaluate impact of odour emissions and sources ■ Quantification of greenhouse gas emissions

Noise and Vibration	■ Noise for human and ecological receptors, inc livestock ■ Vibration causing structural damage.	Baseline: ■ Ambient noise levels at representative locations including diurnal variation. Impact Assessment: ■ Evaluate effects on noise environment through predictive modelling ■ Identification of potential vibration sources and prediction of vibration levels
Landscape and Visual	■ Existing views and visual amenity of receptors ■ Physical changes to the character and aesthetics of the existing landscape	Baseline: ■ Preparation of Zone of Theoretical Visibility ■ Mapping the location and type of visual receptors, plus type and extent of landscape character areas ■ If required, photographic recording of receptors and key views during a site visit. Impact Assessment: ■ Updated ZTV's based on final scheme design to provide viewsheds ■ Visual and landscape impact analysis
Cultural Heritage	■ Loss or damage to surface or buried remains, above-ground features and/or sacred or historic places ■ Changes to culturally distinct patterns of life and traditional cultures	Baseline: ■ Review of available information ■ Field survey to gather site specific information ■ Consultations with local communities and leaders to identify culturally or historically significant sites and traditional practices and beliefs. Impact Assessment: ■ Evaluate effects based on baseline findings and develop cultural heritage management plan ■ Intangible impact analysis will inform the socio economic impact analysis
Social	■ Influx and migration. ■ Changes in taxes and other payments. ■ Direct and indirect employment for skilled and non-skilled labour. ■ Business opportunities/local content. ■ Inflation ■ Physical and economic displacement ■ Changes in community health, safety and security provision. ■ Changes in the workforce through skill and training development opportunities. ■ Disadvantaged and vulnerable groups.	Baseline: ■ Data collection through site specific surveys (e.g. land use), focus group, key informant interviews at the community and non-community levels and secondary literature research; ■ Collect local and regional health data through database research by medical practitioners and focused key local informant interviews Impact Assessment: ■ Detailed analysis to evaluate potential effects on project-affected people. Develop mitigation and management plans.

A3.0 TABLE OF CONTENTS OF THE ESIA STUDY

The following presents an indicative Table of Contents of the South Lokichar Development Upstream ESIA Study:

- Non-Technical Executive Summary;
- Introduction;
- Project Description;
- Project Need and Alternatives;
- Approach to the ESIA;
- Scoping;
- Policy, Legal and Institutional Framework;
- Stakeholder Engagement;
- Environmental including:
  - Climate;
  - Soil, Terrain and Geomorphology;
  - Seismicity and Geology;
  - Air and Climate;
  - Noise and Vibration;
  - Water Quality;
  - Water Quantity;
  - Landscape and Visual;
  - Biodiversity and Ecology;
- Social, including;
  - Administrative Divisions and Governance Structure;
  - Demographics;
  - Infrastructure and Services;
  - Economics, employment and livelihoods;
  - Land Use and Ownership;
  - Community Health and Safety;
  - Education;
  - Social Maladies;
  - Social Capital and Conflict; and
  - Cultural Heritage.

- Ecosystem Services;
- Waste Management;
- Occupational Health;
- Emergency, Accidental and Non-Routine Events Accidents;
- Summary of Impacts and Proposed Mitigation;
- Cumulative Impact Assessment;
- Conclusion; and
- Environmental and Social Management Plans.

A4.0 CLOSURE AND APPROVAL

The ESIA team (Golder Associates and EMC) trust that the contents of the ToR and the Project Report meet with the approval of NEMA. This ToR is submitted on behalf of the ESIA team by Mr Tito Kodiaga (Registration No.0160).

Should the contents of the ToR meet with the approval of NEMA, Table A.2 should completed by the appropriate NEMA signatory and returned to Mr Tito Kodiaga at the address: Shelter Afrique Centre, 3rd Floor Wing 3A, Longonot Road, Upperhill, P.O.Box, 9648-00100, NAIROBI.

Table A.2: Approval of the South Lokichar Development Upstream ESIA ToR

Name	Title	Signature	Date

APPENDIX B
Scoping Consultation PowerPoint slides, Nov 2015

South Lokichar Development Project (Phase I)

November 2015

Initial welcome

- Welcome and initial safety moment
- Agenda:
  - Introductions and expected outcomes
  - Objectives of the meeting
  - Overview of the oil and gas life cycle
  - Description of the Development Project
  - Handover to the Upstream ESIA Contractor (Golder and EMC Associates)

Introductions and objectives

- Introductions:
  - Tullow Kenya B.V. and Africa Oil Corp (AOC)
  - Golder Associates
  - EMC Associates
  - ESIA Stakeholders present today

- Objectives:
  - To provide information associated with the Development Project
  - To introduce the Upstream ESIA Contractor
  - Describe the Environmental & Social Impact Assessment (ESIA) process
  - To provide stakeholders with an opportunity to provide feedback on the project and indicate the key issues that should be addressed as part of the ESIA process

Expected outcomes from the meeting

- Stakeholder questions after Tullow's presentation on the project description
- Stakeholder views and opinions on key environmental and social issues that will need to be addressed in the ESIA process

Project Venture Partners

TULLOW

- Global independent oil and gas company
- Publicly listed on the London, Irish and Ghana Stock Exchanges
- The Group has interests in 123 exploration and production licences in 22 countries globally
- Tullow Kenya BV: wholly owned subsidiary pursuing exploration and development in Kenya

AfricaOil Corp.

- Canadian oil and gas company with assets in Kenya and Ethiopia
- East African holdings cover total gross land package in excess of 250,000 square kilometres
- Publicly listed on the Toronto and Stockholm stock exchanges

Oil & Gas Life Cycle

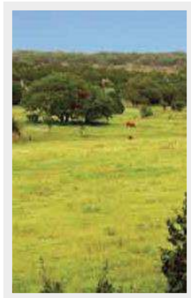
Exploration & Appraisal	Development & Construction	Commissioning & Production	Decommissioning

Seismic Activity	Exploration Drilling & Testing	Central Processing Facility	Crude Oil Pipeline	Marine Terminal	Oil Production	End of Project









5 – 10 years | 5 – 10 years | 20 – 50 years | 5 years

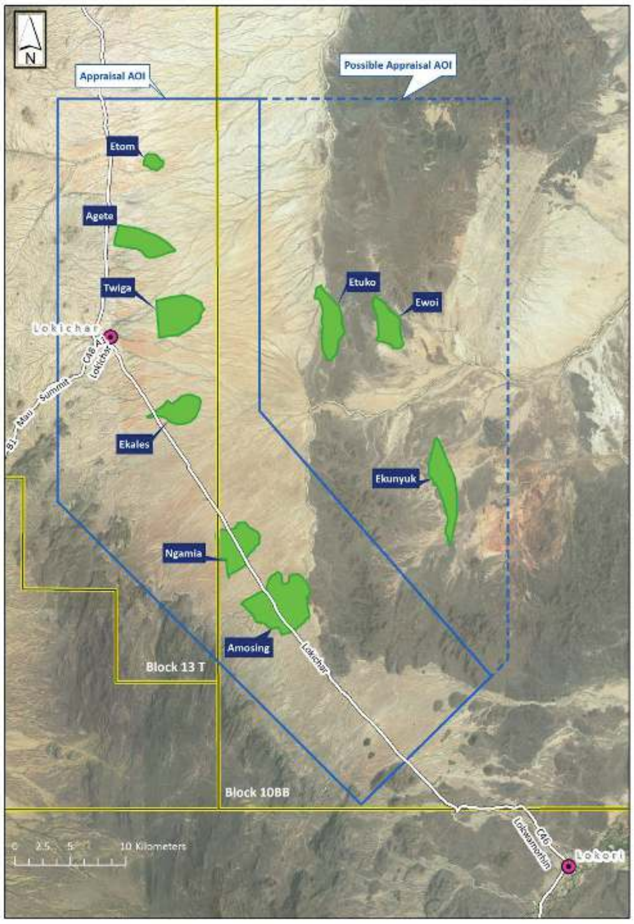
Introduction to the Development Project

- Enough oil has been found in Kenya to start planning for a Development Project
- Exploration & Appraisal in a number of fields since 2012
- Upstream Field Development Project
- Project comprises up to 5 fields:
  - Agete
  - Twiga
  - Ekales
  - Ngamia
  - Amosing
- Project location – Turkana, North West Kenya

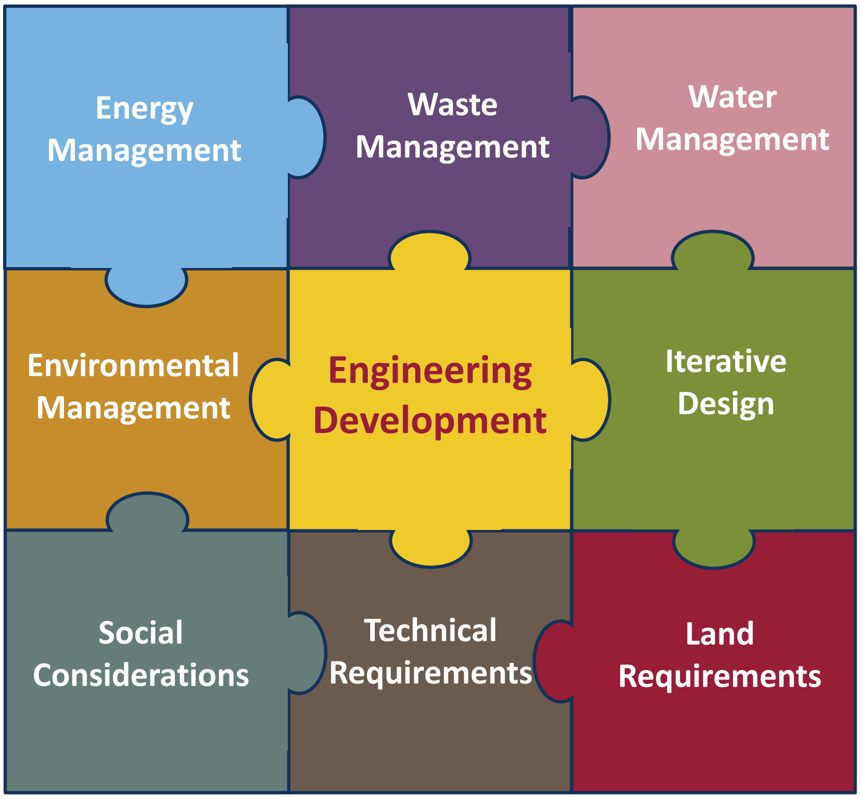
Introduction to the Development Project

- Range of technical studies underway to optimise design:
  - Which oil fields to start with
  - Location of Central Processing Facility (CPF)/well pads
  - How many wells, how many per pad
  - Location of interconnecting flowlines
  - Source(s) of water
  - How oil is transported to international markets
  - Workforce requirements and timing

- Current schedule – Upstream:
  - Concept + Front End Engineering Design (FEED): **FEED expected to start in 2016**
  - Permitting & ESIA: **2015 - 2016**
  - Field Development Plan submission & Final Investment Decision (FID): **2016/2017**
  - Construction start following FID



Project Development Key Considerations



Environmental & Social Impact Assessment (ESIA)

- Compliance with applicable Kenyan legislation and to meet the International Finance Corporation (IFC) Environmental & Social Sustainability Performance Standards (PSs)
- Framework for the future management of environmental and social performance
- Condition of external finance from international lenders

Historical approach:

- Block-wide Environmental Impact Assessments
- Site-Specific Assessments

Approach to the ESIA for the Development Project:

- Upstream component (Central Processing Facility (CPF), well pads, flowlines, etc.) – ***focus of this meeting***
- Midstream component (pipeline and terminal) – awaiting agreement on pipeline
- Partnerships between Kenyan experts and international ESIA contractors:
  - Maximum use of Kenyan knowledge and expertise
  - Use of Kenyan experts to assist baseline data gathering activities

Land access approach for development

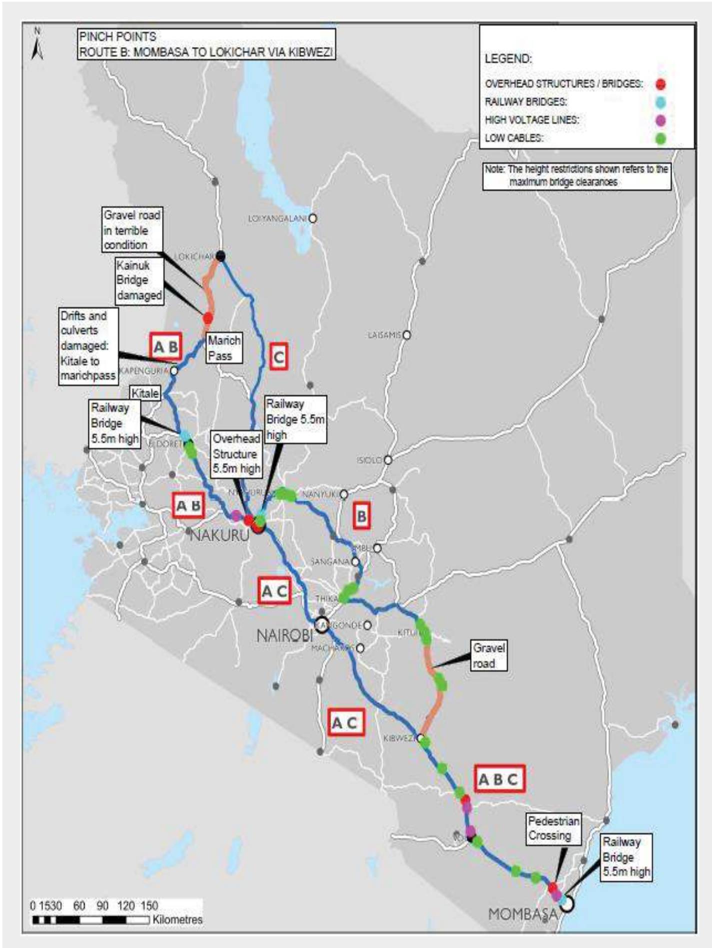
- Ministry of Energy & Petroleum (as the responsible ministry) has convened a Government Working Group on land matters specifically for the Development Project
- Tullow Kenya is working with the Working Group to define the Development Phase land access approach, initially focusing on upstream areas
- It will need to meet applicable national land laws and International Finance Corporation (IFC) requirements - notably IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement
- The land access approach needs to be identified by early 2016 and presented in a Land Acquisition Framework (LAF)

Water required for the Development Project

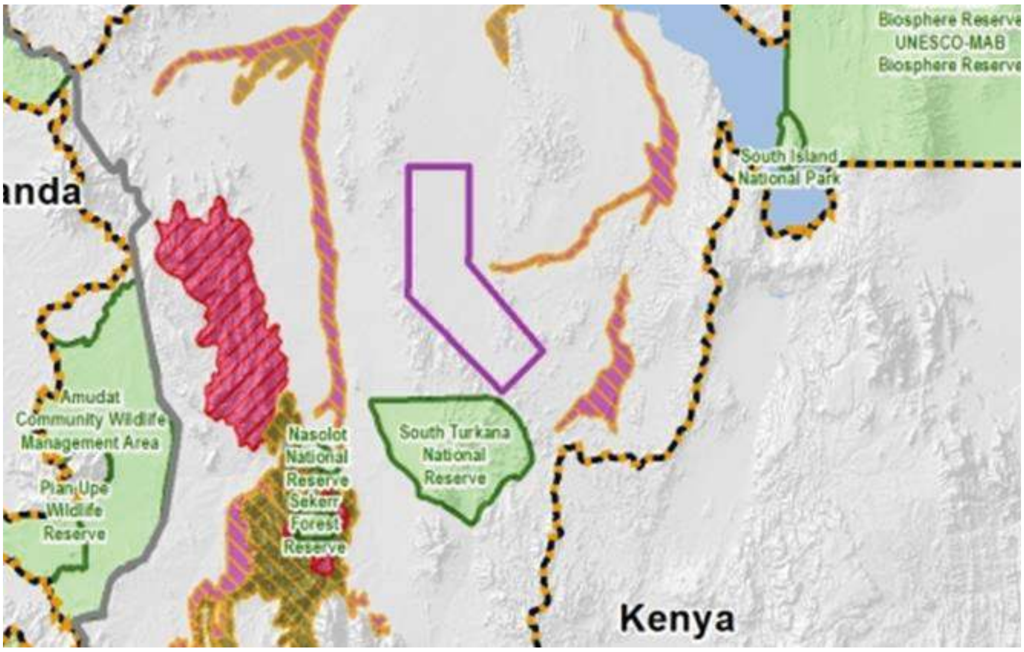
- Water is required for both the construction and production phase
- Construction phase water expected to be derived from groundwater boreholes
- Production phase water demand is higher and a range of sources are currently being considered.
- Various options have been identified and short-listed (groundwater and surface water sources).
- A variety of technical hydrological and hydrogeological studies are ongoing to identify the optimum source(s) of production phase water.

Road and Rail Logistics Study

- Aim was to determine the optimum transportation solution(s) to transport approximately 2 million tonnes of equipment and materials, a Road/Rail logistics study was conducted.
- The main logistics corridor runs from Mombasa to Lokichar via Eldoret.
- Two road routes may be used, Route A for in gauge loads and Route B for out of gauge loads.
- Rail transportation will be used from Mombasa to Eldoret.
- Air transportation will be from Nairobi and/or Eldoret to and airfield in the South Lokichar Basin.
- Government logistics upgrades are required to support the development.



Stakeholder Questions on the Development Project



SOUTH LOKICHAR DEVELOPMENT PROJECT (PHASE 1)
SCOPING CONSULTATION

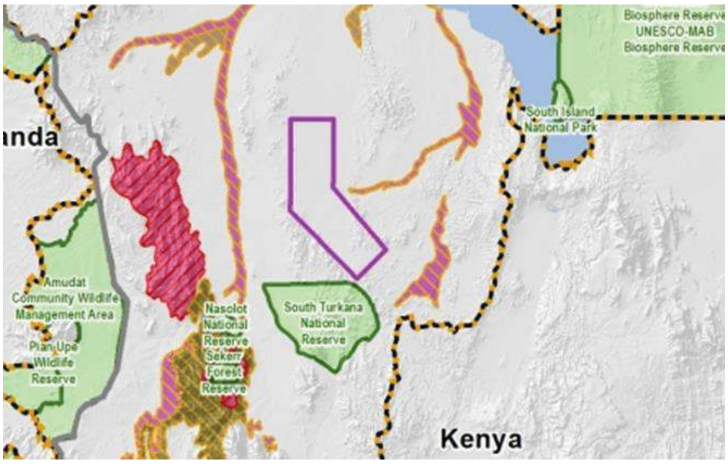
November 2015

EMC Consultants
ENVIRONMENTAL KNOWLEDGE IN PRACTISE

Golder Associates

Objectives of the presentation / meeting

- Introductions – Golder and EMC
- Describe the Environmental and Social Impact Assessment (ESIA) process
- Listen to and record any opinions and questions from stakeholders
- Solicit feedback on future stakeholder engagement



Introductions

A global environmental organisation providing consulting, design, and construction services since 1960.

Specialised in Environmental and Social Impact Assessments (ESIA) for the extractive industry to international and national guidelines/standards to lender and regulator requirements.

Golder's project team is based in the UK with technical support from Kenyan specialists (EMC).

EMC Consultants

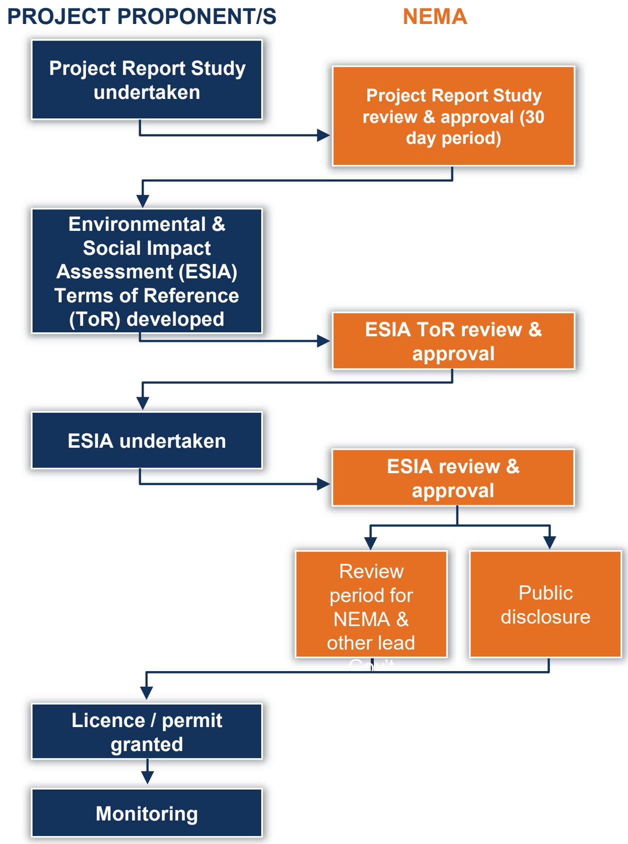
ENVIRONMENTAL KNOWLEDGE IN PRACTISE

EMC Consultants is a Kenyan consulting firm, based in Nairobi, specializing in environmental engineering, social analysis and environmental management services.

EMC is made up of specialist consultants from diverse environmental and social disciplines with extensive experience delivering to Kenyan legislation and IFC standards.

Environmental & Social Impact Assessment

- ESIA Approach
  - Scoping (Stage 1)
  - Baseline studies (Stage 2)
  - Impact assessment (Stage 3)
  - Impact mitigation and benefit enhancement (Stage 3)
  - Cumulative impact analysis (Stage 3)
  - Monitoring and management



ESIA Legislation and Guidelines

- Compliance with Kenyan Constitution and relevant legislation
- Tullow corporate policies
- Compliance with International Finance Corporation (IFC) Performance Standards on environmental and social sustainability
- IFC Environmental, Health and Safety Guidelines
- Investor driven to meet Kenyan legislation and IFC

nema
mazingira yetu | uhai wetu | wajibu wetu

WATER RESOURCES MANAGEMENT AUTHORITY

IFC International Finance Corporation
World Bank Group

IFC Performance Standards

- PS 1: Social and Environmental Assessment and Management System
- PS 2: Labour and working conditions
- PS 3: Pollution prevention and abatement
- PS 4: Community health, safety and security
- PS 5: Land acquisition and involuntary resettlement
- PS 6: Biodiversity conservation and sustainable natural resources management
- PS 7: Indigenous peoples
- PS 8: Cultural heritage

IFC International Finance Corporation World Bank Group

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ESIA Stage 1 - Scoping

Deliverables:

- Scoping Report
  - Project description
  - Project need and alternatives
  - Policy, legal and institutional framework
  - Approach to the ESIA
  - Potential effects of the project
- Stakeholder Engagement Plan
- Terms of Reference
  - Approach to the ESIA
  - Table of contents of ESIA

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ESIA Stage 2 and 3

- Stage 2 - Baseline Studies
  - Socio-economics
  - Land
  - Community health and safety
  - Cultural heritage
  - Biodiversity
  - Ecosystem Services
  - Soil
  - Geology and seismicity
  - Water
  - Air Quality and climate
  - Noise and vibration
  - Landscape and visual
- Stage 3 - Impact Assessment
  - GIS and computer prediction software
  - Professional judgement + past experience
  - Receptor identification
  - Design of mitigation measures
  - Design of an impact monitoring framework
  - Management Plans
  - Environmental and Social Management System (ESMS)

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Expected Upstream Basin ESIA Schedule

- Stage 1 - Scoping phase – to be completed Dec 2015
- Stage 2 - Baseline studies – Q4 2015 to end of 2016
- Stage 3 - Impact analysis and mitigation – late 2016
  - Environmental and social management plans prior to ESIA submission

Key focus areas for the ESIA

- Key areas where robust data gathering and impact assessment will be required:
  - Land use and ownership
  - Livelihoods and quality of life
  - Education and employment
  - Demographics and population
  - Community health, safety and security
  - Cultural heritage (including archaeology)
  - Water resources (including community water supplies and aquatic resources)
  - Biodiversity and habitats
  - Ecosystem Services (reliance on natural resources)
  - Air quality, dust and noise

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Stakeholder input to ESIA

Stakeholder Inputs

Environmental and Social Scoping (Stage 1)

Baseline Studies (Stage 2)

Environmental and Social Impact Assessment (Stage 3)

Environmental and Social Management Plan (Stage 3)

Documented Outputs

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ESIA Stakeholder Engagement

- Describe the Project and the ESIA process
- Solicit feedback to inform ESIA
- Build on stakeholder engagement undertaken during exploration and appraisal activities
- Upstream basin scoping stage will involve consultation to county (MCA) level (Stage 1)
- Produce a Stakeholder Engagement Plan (SEP) for the ESIA
- Engagement planned in future stages with County & community level affected and interested stakeholders as well as national and international stakeholders
- Commitment to informed consultation & participation and meeting Kenya ESIA requirements

Grievance Mechanism

- On-going management tool
- Free to use, widely available
- Policy of “non-retaliation” (nobody punished for submission of a grievance)
- Overseen by Grievance Management Committee
- Results track in a management system with monthly reporting

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Questions?

- Do you have any questions about:
  - South Lokichar Project
  - ESIA process
  - Stakeholder engagement process

Contact Information

- infokenya@tullowoil.com
- Community Resource Offices (Lodwar, Lokichar and Lokori)
- Development Project Team

  Tullow Kenya BV

  P.O. Box 63298-00619

  Nairobi, Kenya

  +254 (0)20 428 6000

Golder Associates

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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EMC Consultants
ENVIRONMENTAL KNOWLEDGE IN PRACTISE

Terms of Reference

A2

14 March 2016

Project No. 1433956.517/A.0

David Ongare
National Environment Management Authority
P.O. Box 67839 - 00200
Popo Road
Nairobi
Kenya

ENVIRONMENTAL IMPACT AND SOCIAL ASSESSMENT (ESIA) TERMS OF REFERENCE FOR THE PROPOSED SOUTH LOKICHAR UPSTREAM DEVELOPMENT PROJECT SOUTH LOKICHAR, NORTH EAST TURKANA COUNTY

The following presents a redrafted Terms of Reference (TOR) for the Environmental and Social Impact Assessment (ESIA) for the proposed South Lokichar Upstream Development Project South Lokichar. This TOR has been redrafted in a format according to NEMA's request. It supersedes the ToR presented as an appendix to our Project Report (14514160360.516/A.2, dated December 2015).

The ToR should be read in conjunction with the Project Report, which contains significant detail on the Project Description, the proposed ESIA methodology, the Policy, Legal and Institutional Framework, and data availability, data requirements and potentially significant effects for each technical topic in the ESIA.

The objective of the TOR is to prepare the ESIA for the proposed South Lokichar Upstream Development Project South Lokichar, north east Turkana County. The ESIA will be prepared incompliance with national legislation to commence environmental and social assessments that will be required for permitting and other authorization purposes of the proposed Project.

The ESIA will describe impacts of the proposed project activities and infrastructure within the project area and investigate cumulative impacts.

The ESIA will assure stakeholders that environmental impacts associated with the proposed development are taken into consideration, that stakeholders have been effectively consulted and that mitigation measures and future monitoring have been agreed.

Attached please find the draft Terms of Reference for your review and approval

Yours Faithfully

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1.0 INTRODUCTION

Tullow Kenya B.V. (TKBV), a subsidiary of Tullow Oil plc (Tullow), is evaluating the Development of a series of oil discoveries in the South Lokichar Basin, northeast Kenya. Tullow is planning to develop its discoveries to enable production and further exploration to proceed in parallel. The South Lokichar Development Project includes oil discoveries within Blocks 10BB and 13T and represents the Full Field Development (FFD). The intention is to construct an Export Pipeline to the Kenyan coastline, with a Marine Export Terminal.

In accordance with the *Environmental (Impact Assessment & Audit) Regulations 2003 (as amended)* TKBV will need approval from the National Environment Management Authority (NEMA) before the project can proceed. In order to obtain this approval, an Environmental Impact Assessment (EIA) is required.

This Terms of Reference (TOR) covers the Upstream activities of oil production and export, excluding the oil export pipeline to the Kenyan coastline and Marine Export Terminal. Separate ESIAs will be prepared for the Export Pipeline and Marine Export Terminal.

2.0 PROJECT DESCRIPTION

Description of the Project and Project Components

This Project Description in the ESIA will follow a similar approach to the presentation of project description in the Project Report. It will focus on the development of wells, a gathering system, a CPF and associated infrastructure. The Upstream Project Area of the South Lokichar Development Project spans several oil fields and each field has multiple compartmentalised reservoirs.

The project description will draw upon information generated by various infrastructure and logistics studies commissioned by Tullow to study options associated with the provision of power, location of key facilities and the use of existing road and rail routes for the transport of goods and materials to project locations.

The Project Description will describe the following:

- The environmental and social setting;
- Design Parameters;
- Infrastructure during construction and operations including:
  - Well pads;
  - Central Processing Facility;
  - Water;
  - The integrated waste management facility;
  - Transportation;
  - Power;
  - Accommodation;
  - Interface with the proposed oil pipeline;
  - Infield pipelines; and
  - Fuel storage.
- Decommissioning; and
- Associated facilities.

The Upstream activities include the following key components:

- Well pads in different fields within the South Lokichar Basin;
- Interconnecting flowlines;
- A Central Processing Facility (CPF); and
- Support facilities and infrastructure.

Justification for the Project

The South Lokichar Development Project will generate significant capital economic flows that will support financial and socio-economic policies of the Government of Kenya (GoK). Kenya is aiming to become an East African hub for the export of oil to international markets, where crude oil from Uganda and potentially other countries, is channelled through a Marine Export Terminal on the Indian Ocean coast of Kenya.

The Project requires the direct (and indirect) employment of national citizens and businesses, many of whom will receive training and skill development opportunities which will increase the technical and vocational capacity of Kenyans within the rapidly emerging oil and gas sector. The use of national citizens to the maximum extent possible during the ESIA, completion of technical studies and during construction and operation of the South Lokichar Development Project, is also in alignment with national government policy.

Glossary of terms

A glossary of technical project terms, acronyms and abbreviations included in the ESIA will be provided before the main text of the ESIA report.

Project proponent

This section of the ESIA will provide details of the project proponent including details of joint venture partners associated with the project.

Project objectives and scope

This section of the ESIA will outline the project objectives and events which have contributed to the formation of the project including: project alternatives, the timescale for implementation, the projected project life time, construction and establishment costs, and any actions undertaken to date within the project area. The current status of the project will be described including the relationship of the project to other developments or actions which could affect the project now or at a later date. Implications of not proceeding with the proposed project will also be discussed.

3.0 METHODOLOGY OF PREPARING FULL STUDY ESIA

The ESIA methodology will describe each stage of the project and the process, timing and decisions involved at each stage. A brief description of studies which have been undertaken to develop the project and inform the ESIA will be provided. Baseline studies undertaken before the ESIA process started will be described.

This section will ensure that the relevant legislation is addressed, that the process to be followed by the reader is clear, and that stakeholders are aware of opportunities for input and participation.

The ESIA and the scope of work under these TOR also will be carried out through two phases and will have two main deliverables: **(i) Project Report);(ii) Environmental and Social Impact Assessment (ESIA).**

4.0 PROJECT REPORT

The Project report (14514160360.516/A.2, dated December 2015) has been completed and has been delivered to NEMA.

Table of Contents of the Project Report

1.2 Purpose of the Project Report

1.3 Developer and the Project Team

1.4 Structure of Project Report

2.0 PROJECT NEED AND ALTERNATIVES

2.1 Need for the Project

2.2 Main Alternatives

3.0 PROJECT DESCRIPTION

3.1 Environmental and Social Setting

3.2 Design Parameters

3.3 Provisional ESIA Schedule

3.4 Operational Infrastructure

3.5 Construction

3.6 Decommissioning

3.7 Associated facilities

4.0 APPROACH TO THE ESIA

4.1 The ESIA process

4.2 Assessment Methodology

5.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

6.0 TECHNICAL TOPICS

6.1 Biodiversity

6.2 Ecosystem Services

6.3 Soil, Terrain and Geomorphology

6.4 Water

6.5 Seismicity (and Geology)

6.6 Air and Climate

6.7 Noise and Vibration

6.8 Landscape and Visual

6.9 Cultural Heritage

6.10 Social

7.0 Emergency Preparedness and Response to Unplanned Events

Identification of Potentially Significant Effects

Under each of the subsections in Section 6 of the Project Report, potentially significant effects are described based on a literature search and current understanding of the project description and likely environmental and social effects of the Project. Section 6 of the Project Report also presents the next steps for baseline data gathering and impact analysis of the potentially significant effects identified.

Stakeholder Engagement

The objective of this engagement is to ensure that legislative requirements are met; sources of information and expertise are identified; stakeholder concerns and expectations are registered and addressed; and affected communities have the opportunity to discuss Project risks and impacts, and proposed mitigation and monitoring measures.

This section of the Project Report describes early engagement with NEMA, the project report stage consultation and provides results. It includes the identification of the relevant stakeholders, identifying the range of community, public and (international) stakeholders concerns about the proposed project as recorded in consultations.

5.0 BASELINE ENVIRONMENTAL AND SOCIAL INFORMATION AND DATA

Table 1 presents a summary of the likely approach to the ESIA Baseline per technical topic.

Table 1: likely approach to ESIA baseline data gathering

Topic	Potentially significant effects	Likely Approach
Biodiversity and Ecology	Direct loss/conversion of natural habitats Indirect loss, conversion or disturbance of natural habitats Introduction of invasive species, pests or diseases Barriers to movement Contamination Population influx (Harvesting of plants, fibre and wood; bush meat hunting)	Baseline: Seasonal vegetation and flora surveys Vegetation community mapping, including mapping of modified and natural habitat Seasonal bird surveys Wet season herpetofauna surveys Seasonal terrestrial invertebrate surveys Seasonal large mammal transect surveys Continuous remote camera trapping survey for mammals (up to 1 year) Seasonal small mammal trapping surveys Seasonal bat acoustic monitoring surveys Long wet season fish, macro invertebrate and wetland surveys
Ecosystem Services	All potential effects presented above for biodiversity Ecosystems affecting capacity to supply services Population influx Changes or restricted access to water resources for livestock and human consumption Changes to land uses Changes to cultural heritage links and socio-economic patterns relevant to ecosystem services	Baseline Liaison between biodiversity, cultural heritage and social and land specialists to compile a targeted questionnaire on provisioning ecosystem service demand for use during stakeholder engagement and focus groups Targeted community engagement (focus group or key informant) to understand current ecosystem services and their uses Relevant baseline data will be gathered from review of baseline biodiversity, water, and soil studies to assess the condition and capacity of ecosystems to deliver services
Soil, Terrain and Geomorphology	Soil quality Erosion Compaction Land suitability	Baseline: Soil sampling and analysis Terrain descriptions
Water	Surface and groundwater quality Surface water flow and runoff regime Groundwater levels	Baseline: Water sampling and analysis Surface water flow and rainfall-runoff characterisation Groundwater levels

Topic	Potentially significant effects	Likely Approach
Seismicity and Geology	Built structures Infrastructure	Baseline: Desk based study using existing data from national institutions and other secondary sources
Air and Climate	Air quality Direct and indirect acidification, eutrophication, toxicity Fugitive dust deposition leading to soiling or smothering Odour nuisance Contribution to global emissions of greenhouse gases	Baseline: Air quality monitoring of key pollutants: fine particulates, combustion gases and VOCs Monitoring of dust deposition rates.
Noise and Vibration	Noise for human and ecological receptors, inc livestock Vibration causing structural damage.	Baseline: Ambient noise levels at representative locations including diurnal variation.
Landscape and Visual	Existing views and visual amenity of receptors Physical changes to the character and aesthetics of the existing landscape	Baseline: Preparation of Zone of Theoretical Visibility Mapping the location and type of visual receptors, plus type and extent of landscape character areas If required, photographic recording of receptors and key views during a site visit.
Cultural Heritage	Loss or damage to surface or buried remains, above-ground features and/or sacred or historic places Changes to culturally distinct patterns of life and traditional cultures	Baseline: Review of available information Field survey to gather site specific information Consultations with local communities and leaders to identify culturally or historically significant sites and traditional practices and beliefs.
Social	Influx and migration. Changes in taxes and other payments. Direct and indirect employment for skilled and non-skilled labour. Business opportunities/local content. Inflation Physical and economic displacement Changes in community health, safety and security provision. Changes in the workforce through skill and training development opportunities. Disadvantaged and vulnerable groups.	Baseline: Data collection through site specific surveys (e.g. land use), focus group, key informant interviews at the community and non-community levels and secondary literature research; Collect local and regional health data through database research by medical practitioners and focused key local informant interviews

6.0 POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

This section will describe the applicable legislation, regulations, policies and standards which will apply to the project including:

- Governance and Administrative Structure
- Kenyan Policy and Legislative Requirements
- International Guidance and Standards
- International Conventions
- TKBV Policy
- Required Authorisations

This section will outline procedures, which will be followed to obtain the relevant permits to begin construction and define future steps including the timeline of the permitting process.

7.0 ENVIRONMENTAL AND SOCIAL ISSUES

Table 2 presents a summary of the likely approach to the impact analysis per technical topic.

Table 2: likely approach to impact assessment

Topic	Potentially significant effects	Likely Approach
Biodiversity and Ecology	Direct loss/conversion of natural habitats Indirect loss, conversion or disturbance of natural habitats Introduction of invasive species, pests or diseases Barriers to movement Contamination Population influx (Harvesting of plants, fibre and wood; bush meat hunting)	Impact Assessment: Habitat-area based impact analysis using selected ecosystem or community-level indicators or biodiversity features using GIS Quantification of effects relative to baseline conditions by association of particular species or species groups with mapped vegetation communities or habitat types identified as indicators Specific analysis will be conducted for species of concern identified in the baseline Analysis of predicted changes to any areas identified as Critical Habitat
Ecosystem Services	All potential effects presented above for biodiversity Ecosystems affecting capacity to supply services Population influx Changes or restricted access to water resources for livestock and human consumption Changes to land uses Changes to cultural heritage links and socio-economic patterns relevant to ecosystem services	Impact Assessment: Identification of priority ecosystem services Analysis of changes to priority ecosystem services
Soil, Terrain and Geomorphology	Soil quality Erosion Compaction Land suitability	Impact Assessment: GIS soil mapping and land suitability mapping Analysis of changes to soil quality
Water	Surface and groundwater quality	Impact Assessment:

Topic	Potentially significant effects	Likely Approach
	Surface water flow and runoff regime Groundwater levels	Hydrological modelling of rainfall-runoff and analysis of changes to flow Analysis of changes to surface water quality and groundwater quality Changes to groundwater level Quantification of changes to community water supplies.
Seismicity and Geology	Built structures Infrastructure	Impact Assessment: Identification of risks and mitigation required from the engineering design team
Air and Climate	Air quality Direct and indirect acidification, eutrophication, toxicity Fugitive dust deposition leading to soiling or smothering Odour nuisance Contribution to global emissions of greenhouse gases	Impact Assessment: Evaluate impact to air quality through predictive air dispersion modelling Evaluate impact of additional dust deposition Evaluate impact of odour emissions and sources Quantification of greenhouse gas emissions
Noise and Vibration	Noise for human and ecological receptors, inc livestock Vibration causing structural damage.	Impact Assessment: Evaluate effects on noise environment through predictive modelling Identification of potential vibration sources and prediction of vibration levels
Landscape and Visual	Existing views and visual amenity of receptors Physical changes to the character and aesthetics of the existing landscape	Impact Assessment: Updated ZTV's based on final scheme design to provide viewsheds Visual and landscape impact analysis
Cultural Heritage	Loss or damage to surface or buried remains, above-ground features and/or sacred or historic places Changes to culturally distinct patterns of life and traditional cultures	Impact Assessment: Evaluate effects based on baseline findings and develop cultural heritage management plan Intangible impact analysis will inform the socio economic impact analysis
Social	Influx and migration. Changes in taxes and other payments. Direct and indirect employment for skilled and non-skilled labour. Business opportunities/local content. Inflation Physical and economic displacement Changes in community health, safety and security provision. Changes in the workforce through skill and training development opportunities. Disadvantaged and vulnerable groups.	Impact Assessment: Detailed analysis to evaluate potential effects on project-affected people. Develop mitigation and management plans.

8.0 MITIGATION/MONITORING AND ALTERNATIVE DEVELOPMENT

The section will present a comprehensive description of the mitigation and monitoring measures and alternatives that will be considered for project activities and infrastructure.

Environmental and Social Management Plan

The consultant will prepare an Environmental and Social Management Plan (ESMP) for construction, operational and decommissioning phases to identify:(a) these to mitigation responses to potentially adverse impacts;(b) management processes and benefit enhancement to be developed throughout construction, operation and at closure to manage adverse impacts; and(c) the monitoring program to implement to verify compliance with the recommended mitigation, and measure the level of impacts produced by the proposed project.

9.0 PUBLIC CONSULTATIONS AND COMMUNICATION

A Stakeholder Engagement Framework has been prepared by TKBV for the Development Project and a Stakeholder Engagement Plan (SEP) has been prepared for the Upstream ESIA. The stakeholder engagement process has been discussed with NEMA to comply with Kenyan EIA Regulations; and to provide NEMA with an opportunity to comment on the consultation and disclosure activities that will be conducted during the ESIA process.

10.0 ESIA TABLE OF CONTENTS

The following presents an indicative Table of Contents of the South Lokichar Development Upstream ESIA Study:

- Non-Technical Executive Summary;
- Introduction;
- Project Description;
- Project Need and Alternatives;
- Approach to the ESIA;
- Scoping;
- Policy, Legal and Institutional Framework;
- Stakeholder Engagement;
- Environmental including:
  - Climate;
  - Soil, Terrain and Geomorphology;
  - Seismicity and Geology;
  - Air and Climate;
  - Noise and Vibration;
  - Water Quality;
  - Water Quantity;
  - Landscape and Visual;
  - Biodiversity and Ecology;

- Social, including;
  - Administrative Divisions and Governance Structure;
  - Demographics;
  - Infrastructure and Services;
  - Economics, employment and livelihoods;
  - Land Use and Ownership;
  - Community Health and Safety;
  - Education;
  - Social Maladies;
  - Social Capital and Conflict; and
  - Cultural Heritage.
- Ecosystem Services;
- Waste Management;
- Occupational Health;
- Emergency, Accidental and Non-Routine Events Accidents;
- Summary of Impacts and Proposed Mitigation;
- Cumulative Impact Assessment;
- Conclusion; and
- Environmental and Social Management Plans.

11.0 TIME SCHEDULE OF EXECUTING THE ESIA

The environmental and baseline data collection required for the ESIA will take place during 2016 for a duration of not less than 12 months. Following this, the ESIA report will be developed in parallel with the Front End Engineering Design (FEED) phase.

12.0 QUALIFICATIONS AND EXPERIENCE REQUIRED

Experts to execute the Environmental and Social Impact Assessment should comply with NEMA requirements. Key staff in the technical complement may include but not limited to the following:

- **Environmental Specialist/Team Leader** - (with 10 yrs experience). He/she will be well familiar with IFC and World Bank Environmental and Social safeguards policies.
- **Social Development expert**- (with 10 yrs experience). She/he will establish the socio-economic environment of the proposed project area, including land use; assess likely impact of the project and proposed mitigation or management.
- **Ecologist/Natural Resources Management expert** (with 10 yrs experience) - will review the ecosystem, and other biophysical aspects of the project area and assess the likely impact of the project, including cumulative, induced ecosystem wide impacts within the area of influence.

We attach a selection of CVs for key specialists in the ESIA team.

EMC/GOLDER ASSOCIATES (UK) LTD

Andrew Morsley
ESIA Project Manager

Tito Kodiaga
ESIA Asst Project Manager

AJM/ss

Attachments: Curriculum Vitae

Curricula Vitae (CV)

1.	Proposed Position	**Environmental Specialist**
2.	Name of Firm	**EMC Consultants Limited**
3.	Name of Personnel	**Tito Joel Kodiaga**
4.	Date of Birth	14th April, 1977 Nationality: Kenya
5.	Education	PhD Candidate, Environmental Policy and Law, University of Nairobi, Centre for Advanced Studies in Environmental Law and Policy (CASELAP) Kenya, 2012 September-to Date. Master of Environmental Planning and Management, Nairobi University, 2005. Bachelor of Environmental Studies/Planning and Management, Kenyatta University, 2000.
6.	Membership in Professional Associations	• International Association for Impact Assessment-IAIA • International Association for Public Participation IAP2 • Eastern Africa Association for Impact Assessment-EAAIA (Board Member and Deputy Secretary General) • Capacity Development and Linkages for Environmental Assessment in Africa-CLEAA • East African Wildlife Society-EAWLS • National Environment Management Authority Registered Expert
7.	Other Training	• International Certificate in Public Participation in Environmental Assessment and Management organized by the International Association for Public Participation and conducted by Golder Associates in South Africa, 2007. • Certificate in Public Participation in Environmental Assessment and Management from IAIA Stavanger, Norway, 2006. • Certificate Course on Strategic Environmental Assessment from International Association for Impact Assessment (IAIA) in the Czech Republic. Training funded by Swedish International Development Agency, 2005. • Certificate course on Environmental Impact Assessment for Community Driven Small-Scale Activities, Southern Sudan funded by USAID/REDSO, 2004. • Certificate Course in Public Participation in Environmental Assessment and Management from the Southern Africa Institute for Environmental Assessment (SAIEA). Training course funded by the World Bank under the Calabash project, 2004. • Certificate course on Environmental Impact Assessment for Community Driven Small-Scale Activities USAID/REDSO Training course, 2003. • Certificate Course on Strategic Environmental Assessment in accordance to World Bank Operational Procedures and Guidelines; Course organized by World Bank jointly with Southern Africa Institute for Environmental Assessment (SAIEA) and CSIR South Africa, 2003. • Attended all World Bank Group Day events in the annual International Association for Impact Assessment meetings and in effect has become conversant with several of the policies of World Bank and IFC including the Equator Principles and Extractive Industry Transparency Initiative, 2002-2006.

8. Countries of Work Experience

Country	**Dates**
Kenya	2002, 2006, 2008, 2010, 2012,2013
Rwanda	2005-2006
Burundi	2007-2011
Tanzania	2007-2011

Mali	2007-2011
Benin	2007-2011
Zambia	2007-2011
Mozambique	2007-2011
Ethiopia	2007-2011
Angola	2007-2011
Iraq	2013
Senegal	2007-2011
Southern Sudan	2005
Somalia	2013
Madagascar	2007-2011
DRC Congo	2005
Central African Republic	2006
South Africa	2007-2011
Uganda	2007-2011
Ghana	2007-2011
Liberia	2007-2011

9. Languages

Language	Speaking	Reading	Writing
English	Good	Good	Good
Swahili	Good	Good	Good
French	Fair	Fair	Fair

10. Employment Record

From: January 2012 To: present
Employer: EMC Consultants
Position(s) held: Principal and Team Leader

From: September 2008 To: December 2011
Employer: Research Triangle International (RTI)
Position(s) held: Africa Regional Technical Consultant and Advisor for Environmental Compliance

From: April 2001 To: May 2004
Employer: PACT
Position(s) held: Regional Environmental Assessment Specialist

From: December 1999 To: March 2001
Employer: Climate Network Africa
Position(s) held: Environment Officer

11. Key Qualifications

Mr. Kodiaga brings over 13 years of international and resident experience in Environmental Planning, Social Assessment and Management and has conducted several Environmental and Social Impact Assessments (ESIA's) including public stakeholder engagement in over 19 African countries including Kenya, Rwanda, Burundi, Tanzania, Mali, Benin, Zambia, Mozambique, Ethiopia, Angola, Iraq, Senegal, Southern Sudan, Somalia, Madagascar, DRC Congo, Central African Republic, South Africa, Uganda, Ghana, and Liberia.

Throughout his 13-year career, he has managed, implemented, designed, and evaluated large multi-sectoral donor-financed and government implemented natural resources related projects and led large, diverse multi-disciplinary technical teams in the Environmental Assessment and Social Safeguards process in Africa.

He possesses excellent report writing and training skills in Environmental Assessment and Management and has been engaged extensive report writing and in offering training courses in Environmental Assessment and Management (EA&M) in several countries in Africa. Mr. Kodiaga has been involved as a consultant in implementing several projects in Africa funded by the World Bank, IFC, USAID, DANIDA, UNDP, UNEP and European Union. He remains highly conversant with the national and international legislative requirements, policies and procedures on Environmental Assessment and Management of several African countries.

He has been a Technical Advisor to several World Bank funded projects namely the; Environmental Assessment and Capacity Building in Southern Africa (The CALABASH Project) and in another project aimed at establishing the Ethiopian Association for Impact Assessment. He has also previously worked as a coordinator of Community Based Impact Assessment Network for Eastern Africa USAID/REDSO funded and is currently the Deputy Secretary General of the professional network of EA experts in Eastern Africa called Eastern Africa Association of Impact Assessment. He is also a member of the Capacity Development and Linkages for Environmental Assessment in Africa (CLEAA), a project running in Africa on EIA/EA and supported by World Bank and USAID/REDSO.

Mr. Kodiaga is an accomplished Organizational and Institutional Strengthening specialist having worked for PACT Inc., an international capacity building and institutional strengthening organization for over 4 years in Africa, where he was engaged in conducting Environmental Assessments, Initial Environmental Examinations and Organizational Capacity Assessments for various institutions implementing USAID funded project in the Greater Horn of Africa.

Kodiaga is also extremely versed in undertaking public participation and stakeholder dialogue/community involvement in Environmental Assessment and Management after having been trained on application of Public Participation in Environmental Management in Norway and South Africa. He has co-trained jointly with the Southern Africa Institute for Environmental Assessment (SAIEA) and Norwegian Planning Institute in Public Participation in the EIA process in Namibia and Norway.

He is also well versed with the World Bank and African Development Bank's Operational policies especially the World Bank's Environmental and Social Safeguards Policies and has received training on Strategic Environmental Assessment (SEA) in accordance to World Bank Operational Policies and Procedures on Environmental Safeguards.

Mr. Kodiaga is a registered **Lead Expert** with NEMA Kenya and is highly familiar with the environmental regulations and policies for Kenya.

Mr. Kodiaga has strong facilitation skills and is able to assist multi-party groups to pool their diverse views into collective wisdom and consensus.

12. Work undertaken that best illustrates capability to handle the tasks assigned:

Name of Assignment or project: Training Employees of Equity Bank on IFC's/World Bank Performance Standards

Year: 2013 – Ongoing

Location: Kenya, Uganda, Tanzania, Rwanda and South Sudan

Client: Equity Bank Group and IFC

Main project features: Equity Bank Group is a major financial institution headquartered in Kenya with country offices in Uganda, Kenya, Tanzania, Rwanda and South Sudan. Equity Bank Group has received 100 million USD from the IFC for private sector lending across several sectors including oil and gas, roads, energy, agriculture among others. This project involves training employees of Equity Bank on IFC Performance Standards including World Bank EHS guidelines.

Position held: Principal Trainer

Activities performed: Designed Training Manual on environmental due diligence; Conducted training for

Equity Bank staff in all countries, specifically staff who are engaged in credit and lending. Provided training on environmental and social due diligence, IFC Performance Standards, World Bank safeguard policies, and local host country environmental and social regulations.

Name of Assignment or project: Environmental and Social Impact Assessment and Management Plan For Mwache Multipurpose Dam Development Project
Year: December 2013-April 2014

Client: World Bank and Ministry of Environment, Water and Natural Resources
Main project features: The proposed Mwache Dam was identified by the Government of Kenya (GoK) as a flagship project under the Kenya Vision 2030, and also as a necessary facility to supplement water supply for Mombasa City and the adjacent areas in Kwale County and Kilifi County. It was given high priority by the Ministry of Environment, Water and Natural Resource (MEWNR), the Coast Development Authority (CDA), and the Coast Water Services Board (CWSB) and Ministry of Finance (MoF).

The project is being closely coordinated with the Water Supply Master Plan for the Coast/Mombasa, supported under the Water and Sanitation Service Improvement Project (WaSSIP). The dam is considered to be a viable and necessary long-term option to supply water to areas on the coast (in particular Mombasa). It is envisaged that harnessing the fluctuating flows in Mwache River and the seasonal waters from its tributaries would also provide water for irrigated farming, meet the needs for local livestock development, and support other socio-economic activities. The proposed dam is 73.5 m high, with a reservoir capacity of 118 million m^3. The Mwache Multipurpose Dam Development Project seeks to improve the living standards of Kwale, Kilifi and Mombasa county residents through poverty alleviation and sustainable development. The project has three major project components: i) Water Supply Component – to meet the residential and industrial demand of bulk water to Mombasa city; ii) Irrigation Component – 2000ha of land in Mwache with water pumped from the dam reservoir; iii) Rural Development Component – that will grant development benefits beyond the project area to the residents Kwale County.
Position held: **Environmental and Social Specialist**
Activities performed: Preparation of Environmental and Social Impact Assessment including Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP) for the Dam. The Environmental and Social Impact Assessment (ESIA) study includes an irrigation component as well as bulk water supply, transmission and sewerage disposal components. Since more than 400 households will be affected as a result of this project, Mr. Kodiaga is leading the preparation of the EIA and RAP.

Name of Assignment or project: Environmental and Social Services for the Kenya Water Security and Climate Resilience Project (KWSRP)
Year: 2012 – Date
Location: Kenya
Client: Ministry of Environment; Water and Natural Resources; World Bank
Main project features: The objective of the proposed project is to support the institutionalization of processes and water-related investments to strengthen climate-resilient water resources development and management in Kenya. The Project is expected to have three components: (i) investments in water resources development; (ii) water sector reforms planning and management; and (iii) support to project implementation. Eligible investment projects must fall under at least one of the below categories: (i) infrastructure for bulk water supply – single or multipurpose; (ii) surface water or groundwater development; (iii) water services/productive uses – irrigation, water supply, or hydropower; (iv) infrastructure for flood management or drought mitigation including upstream activities to ensure the sustainability of investments (e.g., catchment management for selected sites, community outreach, etc.) Mr. Kodiaga prepared the Environmental and Social Management Framework (ESMF) for this World Bank-financed project that will support major water infrastructure and climate change resilience.

Position held: **Senior Environmental and Social Safeguards Specialist**

Activities performed: Conducted field site visits, collected environmental and social baseline data, undertook stakeholder mapping and consultation, prepared ESMF, Resettlement Policy Framework and ESMP. Was also engaged in training and capacity building of the GoK counterparts on environmental and social safeguards, and was responsible for conducting/implementing the environmental and social management and monitoring plan for subprojects under this program, including developing terms of references for contractors.

Name of Assignment: ESMF/RAP for the Infrastructure Finance and Public Private Partnership Project (IFPPP)

Year: 2012

Location: Kenya

Client: World Bank and Government of Kenya, Ministry of Finance

Main project features: This World Bank-funded program is aimed to spur infrastructure growth via public-private partnership and is supporting construction of mega infrastructure in Nairobi and the surrounding area in different sectors – including water, transport, energy and waste. Infrastructure includes roads, dams, hydropower plants, sewerage disposal plants, airports and irrigation schemes.

Position held: **Environmental and Social Specialist**

Activities performed: Prepared the Environmental and Social Management Framework and Resettlement Policy Framework (RPF) for the project

Name of Assignment or project: Environmental and Social Management Framework of Land Husbandry, Water Harvesting and Hillside Irrigation Project (LWH)

Year: March 2009 – July 2009

Location: Rwanda

Client: World Bank and Ministry of Agriculture and Livestock, Rwanda

Main project features: The Government of Rwanda (GoR) designed and developed a Land Husbandry, Water Harvesting and Hillside Irrigation Program under Program I of its Strategic Plan for Agricultural Transformation (SPAT). The LWH Program, as conceived by the Government, is a two-phased program to implement improved land-husbandry and increased productivity in 101 pilot watersheds covering 30,250 ha of land. The first phase was to cover the development of 32 sites, permitting a learning process before the second phase, which would see the completion of the program through the remaining 69 sites. The project envisions some 12,000 ha of the 30,250 ha total to be irrigated. It is expected that a number of development partners will each finance a portion of the overall program, which therefore calls for strong programmatic guidance by the Government to ensure coherence, complementarities and adherence to a common approach.

Position held: Team Leader for Environmental/Social components of LWH

Activities performed: Preparation of ESMF, Environmental Impact Assessment (EIA) and Resettlement Policy Framework

Name of Assignment or project: ESMF for the Lake Victoria Environment Management Program II (LVEMP II)

Year: 2005

Location: Kenya

Client: World Bank; Ministry of Environment and Mineral Resources, Kenya; Lake Victoria Basin Commission

Main project features: The Lake Victoria Environmental Management Program II is a regional initiative covering Kenya, Uganda, Tanzania, Rwanda and Burundi that aims to protect Lake Victoria from further degradation. The project includes initiating projects, such as sewerage treatment plants, that minimize the pollution caused by direct release of untreated sewage in the Lake.

Position held: Team Leader for development of the ESMF

Activities performed: Preparation of an ESMF. Development of the ESMF also involved development of a regional ESMF for all the countries implementing LVEMP II, namely Kenya, Uganda, Tanzania, Rwanda and Burundi. Provided training to Government of Kenya staff, particularly those supporting implementation of the project, on environmental and social safeguards. Developed guidelines for contractors to ensure environmental safeguards, including monitoring.

Name of Assignment or project: Environmental and Social Management Framework for Water and Sanitation Service Improvement Project (WaSSIP)

Year: 2011 – 2012

Location: Kenya

Client: World Bank and Athi Water Services Board

Main project features: The WaSSIP will increase access to reliable, affordable and sustainable water supply and sanitation services and improve the water and wastewater services in areas served by the three Water Services Boards. At present, about 60 percent of Kenyans have access to safe drinking water while access to basic sanitation is at 80 percent. The project is expected to benefit about 9.3 million Kenyans in 27 districts with improved water and sanitation services, including residents of some of Kenya's largest urban informal settlements. Activities under the WaSSIP include: the rehabilitation of water production, transmission, storage and distribution facilities and wastewater collection, treatment and disposal facilities; the expansion of water supply and sewerage services; and the strengthening of the institutional structures for water and sanitation service provision, emphasizing increasing institutional accountability and transparency of Water Services Boards and Water Services Providers. The project will also assist in making the Water Services Regulatory Board and the Water Appeal Board fully operational.

Position held: **Environmental and Social Specialist**

Activities performed: Preparation of ESMF and RPF for this World Bank-funded project. Also conducted training for all of the water services boards in this project, and prepared ESMP and RAPs for the sub-projects.

Name of Assignment or project: Environmental and Climate Safeguards Specialist for Water and Sanitation Service Improvement Project

Year: 2011 – 2013

Location: Kenya

Client: Athi Water Services Board (AWSB); Lake Victoria South Water Services Board (LVSWSB); Coast Water Services Board (CWSB); World Bank

Main project features: The Water and Sanitation Service Improvement Project (WaSSIP) will increase access to reliable, affordable and sustainable water supply and sanitation services; and improve the water and wastewater services in the areas served by the three Water Services Boards. At present, about 60 percent of Kenyans have access to safe drinking water while access to basic sanitation is at 80 percent. The project is expected to benefit about 9.3 million Kenyans in 27 districts with improved water and sanitation services, including residents of some of Kenya's largest urban informal settlements. Activities under the WaSSIP include: the rehabilitation of water production, transmission, storage and distribution facilities and wastewater collection, treatment and disposal facilities; the expansion of water supply and sewerage services; and the strengthening of the institutional structures for water and sanitation service provision, emphasizing increasing institutional accountability and transparency of Water Services Boards and Water Services Providers. The project will also assist in making the Water Services Regulatory Board and the Water Appeal Board fully operational.

Position held: Environmental Safeguards Technical Advisor

Activities performed: Preparation of ESMF, Resettlement Policy Framework (RPF) and Indigenous People Planning Framework (IPPF). The World Bank's board, paving way for disbursement of funds, has approved all reports. Also prepared Environmental Management Plans (EMPs) and Resettlement Management Plans for various sub projects under implementation by AWSB.

Name of Assignment or project: Environmental Management Specialist for Multi-Sector Investment Opportunity Analysis (MSOIA)

Year: August 2011

Location: Rwanda, Burundi, Kenya, Uganda, Tanzania, Ethiopia, Egypt, DRC and South Sudan

Client: World Bank and Nile Basin Initiative (NBI)

Main project features: The MSOIA aims to develop a regional water investment strategy for the Nile Equatorial Lakes (NEL) region that broadly supports socio-economic development, poverty reduction, and the reversal of environmental degradation. The specific objectives of the assignment are: (i) to identify regional investment options, taking into account their economic, social and environmental implications as well as cumulative impacts; (ii) to investigate the alignment of potential regional investment options with national-level priorities and plans; (iii) to prioritize and sequence potential investments, also in light of existing and planned interventions (including those supported by development partners), up to 2035; and, (iv) to contribute to the regional knowledge base. The MSOIA will build on ongoing work in the NBI/NEL region, Lake Victoria Basin Commission (LVBC), national programs and plans.

Position held: **Environmental Management Specialist**

Activities performed: Reviewed the water and environmental policies in the eight NEL states; prepared background bio-physical status of environmental resources in the NEL states; conducted a stakeholder analysis and analysed the issues, threats, risks and hotspots in the NEL basins; prepared Strategic Social and Environmental Assessment (SSEA) that aimed to assess, at a strategic level, the environmental and social impacts of the investment options in the Nile Basin; determined the Social and Environmental Baseline; identified and mapped stakeholders; assessed major issues, hotspots, constraints/risks and opportunities; identified strategic environmental and social issues (relating to relevant policies, plans, programs and projects) and proposed opportunities to address them; used a structured stakeholder interaction in conjunction with analytical framework to examine investment options from a regional standpoint.

Name of Assignment or project: RAP for Regional Rusumo Fall Hydro Power Project-Including Electricity Transmission Component
Year: June 2011– March 2012
Location: Tanzania, Rwanda and Burundi
Client: SNC Lavallin, Canada; funded under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) which includes funding by the World Bank, African Development Bank, Global Environmental Facility and other donors
Main project features: The objective of the Regional Rusumo Falls Hydroelectric Project is to increase power supply of electricity to the national grids of Burundi, Rwanda, and Tanzania. There are five project components; the International Development Association supports four, and the Africa Development Bank supports one. The first component comprises civil works for the access to and construction of power facilities, offices, and housing. The second component comprises mechanical and electrical works for hydro-mechanical equipment, turbine-generator sets and auxiliaries, generation substations, and power complex control and communications equipment. The third component will finance the ESMP and RAP. The fourth component will finance owner's engineers to assist with overall project management and implementation of the ESMP and RAP. The fifth component consists of the construction of three transmission lines, which will connect the power station at Rusumo to the national grids of Rwanda and Burundi, and supply electricity to the western mining provinces of Tanzania.
Position held: **Project Manager and overall Team Leader** for preparation of RAP including electricity transmission line component.
Activities performed: Led team of more than 40 specialists in the coordination of the census survey, development of the Local Area Development Plan (LADP), creating an inventory of assets, development of the entitlement matrix, and review of national guidelines as relates to expropriation and final development of the RAP report, which is underdoing review by World Bank and the three riparian countries.

Name of Assignment or project: Strategic Environmental Assessment for the Mara River Basin
Year: 2005-2006
Location: Lake Jipe Ecosystem Kenya and Tanzania
Client: European Union, Community Development Trust Fund
Main project features: Mr. Kodiaga was the Team Leader who coordinated the team that prepared the Environmental and Social Impact Assessment for the Restoration of Lake Jipe project, an EU/BCP/CDTF project in Kenya and Tanzania. This project involved the detailed analysis of the development of mechanisms to mitigate the decimation of the Lake Jipe ecosystem that was shrinking at a frightening rate. The study developed as an outcome a catchment management plan for the Lake, which is now slowly recharging itself based on the proposed interventions.
Position held: Team Leader and Environmental Specialist
Activities performed: Coordinated team that prepared the Environmental and Social Impact Assessment.

Name of Assignment or project: ESMP for Rural Sector Support Program (RSSP)
Year: 2007 – 2008
Location: Rwanda
Client: Government of Rwanda's Ministry of Agriculture and Livestock, World Bank
Main project features: The objective of the RSSP is to increase agricultural production and marketing in marshland and hillside areas that are targeted for development under the project, and to do so in an environmentally sustainable manner. The project has three components (i) rehabilitation and development of marshlands and hillsides, involving expanding irrigated areas in cultivated marshlands and increasing the use of sustainable land management practices on associated hillsides to accelerate the pace of agricultural intensification; (ii) strengthening commodity chains, which supports the commercialization of smallholder agriculture in targeted marshland and hillside areas by intensifying production, promoting agricultural value addition, and expanding access to markets; (iii) project coordination and support, to ensure: (a) efficient execution of administrative, financial and procurement functions; (b) coordination of project activities among stakeholders; (iii) timely implementation and monitoring of environmental and land-use management frameworks mandated by World Bank policies; and (iv) establishment and operation of an effective monitoring and evaluation (M&E) system.
Positions held: **Team Leader**

Activities performed: Preparation of ESMP for both project phases, including six subproject-specific ESMPs and RAPs, which are part of the overall project. Provided training to stakeholders on environmental and social safeguard procedures for the World Bank and local host country ESIA regulations.

Name of Assignment or project: Rapid Baseline Social Analysis –Rusumo Falls Hydro Power Project
Year: 2005
Location: Rwanda, Burundi, Tanzania
Client: World Bank
Main project features: The Regional Rusumo Falls Hydropower and Multipurpose Project (RRFP) is the first major infrastructure project to be promoted by the NELSAP of the NBI within the overall Kagera Basin Integrated Development Framework. The project involves construction of a hydroelectric power plant at the Rusumo Falls at the border of Rwanda and Tanzania, as well as the construction of transmission lines linking the plant to the power grids of the tree participating countries. In addition to the hydropower production and regional transmission interconnection, the project will include multipurpose components to share benefits from the project. This will ensure that the interests of project-affected people are taken into account, and that the people whose lives are affected by the project also benefit.
Positions held: **Team Leader** and part of the joint consulting team (contracted by Golder Associates of South Africa) that undertook a Rapid Social Analysis
Activities performed: Rapid social analysis of project area; identified social outcomes, opportunities and risks associated with the project; provided groundwork for the formal feasibility/impact assessment studies.

Name of Assignment or project: Environmental and Social Assessment for Oil Exploration
Year: 2005
Location: Southern Sudan
Client: White Nile Limited Company
Main project features: Study is assessing the adverse impacts of oil exploration on the fragile Sudd wetlands and possible impacts on the social life and cultures of the traditional Dinka and Nuer populations in Southern Sudan. The study is referencing the Extractive Industry Transparency Initiative, the World Bank and Equator Principles.
Positions held: **Team Leader**
Activities performed: Led preparation of Environmental and Social Assessment Study related to oil drilling in Jonglei State, Bor County

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Name of Assignment or project: ESIA for Off Shore Oil Exploration
Year: 2010
Location: Kenya
Client: Apache Corporation, USA
Main project features: Team Leader for the Off Shore Oil Exploration ESIA for exploring oil in block L8 in the Indian Ocean in Kenya. The ESIA study involved the determination of the adverse impacts of oil exploration activities in Kilifi and Malindi in accordance with the legal framework of the country as well as international best practices in oil exploration.
Positions held: Team Leader and Environmental Specialist
Activities performed: Led preparation of Environmental and Social Assessment in line with IFC standards and specifically using EHS guidelines for oil and gas

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Name of Assignment or project: Oil Exploration
Year: 2008
Location: Kenya
Client: Central African Exploration and Mining Company (CAMEC)
Main project features: Contracted by CAMEC to conduct an ESIA for proposed oil exploration in Turkana District of Kenya.
Positions held: Team Leader, Environmental Specialist
Activities performed: Led preparation of Environmental and Social Assessment in line with IFC standards and specifically using EHS guidelines for oil and gas

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Name of Assignment or project: Urgent Electricity Rehabilitation Project
Year: 2005 – 2006
Location: Rwanda
Client: Rwanda's Energy Water and Sanitation Authority; World Bank

Main project features:
The objective of the Urgent Electricity Rehabilitation Project is to alleviate power shortages and enhance the capabilities of energy sector institutions in Rwanda. The project consists of three components: (i) power system reinforcement: generation and network investments for power system rehabilitation and expansion, including additional thermal generating units and rehabilitation of substations; (ii) technical assistance and capacity building: project implementation, technical assistance, and capacity building support to sector entities for energy sector policy, regulatory, and program development (institutional strengthening); (iii): domestic resource development and efficient utilization: studies, bidding documents, etc. for future domestic generation capacity, especially in the areas of hydroelectric power, biomass resources, and micro-hydro grids for rural electrification.
Positions held: Environmental and Social Safeguards advisor
Activities performed: Led in monitoring and supervision of the construction activities related to the construction of the 20 MW thermal power plant; related sub stations in the country and transmission lines. Also oversaw the implementation of the Resettlement Action Plans for the projects.
In this assignment, there was extensive use of the Pollution Prevention and Abatement handbook for World Bank as well as ensuring compliance to all the Bank's operational policies and procedures. The project involves preparation of resettlement actions plan and overseeing the resettlement process of over 2,500 Project Affected Persons (PAPs) including valuation of land, and property including compensations.

Name of Assignment or project: Environmental and Social Management Plan and Resettlement Action Plan-Turkwell-Kitale-Ortum Overhead Electricity Transmission Line
Year: 2012-2013
Location: Kenya
Client: World Bank and KETRACO
Main project features:

KETRACO will construct and operate approximately 135 Km of 220kV transmission line from Turkwel to Kitale substation in Kenya. The proposed transmission line is necessary for evacuation of power from the Turkwel Power Station in case the existing Turkwel – Lessos 220kV line is out of operation and also to supply the power to cater for the increased load at Ortum and Kitale.

The line originates from the existing Turkwel power station located in the Northern part of Kenya, in West Pokot County, in the Turkwel Gorge. The line then traverses through Dungudunguis market, Marich Pass to the proposed Ortum substation, which is on the northwestern side of Ortum Township. The line then continues from Ortum and by-passes Morpus Secondary and Primary Schools crossing the road to Kacheliba ad traversing through Kapenguria, Makutano townships into the proposed site of Kitale substation.

Position held: **Environmental and Social Specialist**
Activities performed: Preparation of Environmental and Social Impact Assessment including Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP) for the transmission line. The Environmental and Social Impact Assessment (ESIA) study includes a component on construction of a sub station. Tito has led a team of specialist in conducting and preparing the ESIA and RAP in line with the World Bank safeguards policies specifically EHS guidelines for transmission line construction

Name of Assignment or project: Environmental and Social Management Plan and Resettlement Action Plan-Wind Power Project E7
Year: -2005
Location: Kenya
Client: Hydro Quebec and E7
Main project features:

Team Leader and public participation specialist for the Environmental and Social Assessment for the Wind Power project in Lamu, Coastal province of Kenya implemented by Hydro-Quebec, Canada and funded by the E7 Group of energy utilities.
Position held: Environmental and Social Specialist

Activities performed: Preparation of Environmental and Social Impact Assessment including Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP) for the wind power project in Lamu, Kenya.

Name of Assignment or project: Environmental and Social Management Plan and Resettlement Action Plan-Lessos-Kabarnet-Nyahururu-Nanyuki Electricity Transmission Line
Year: 2010
Location: Kenya
Client: World Bank and KETRACO
Main project features:

Position held: **Environmental and Social Specialist**
Activities performed: Preparation of Environmental and Social Impact Assessment including Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP) for the transmission line. The Environmental and Social Impact Assessment (ESIA) study includes a component on construction of a sub station. Tito has led a team of specialist in conducting and preparing the ESIA and RAP in line with the World Bank safeguards policies specifically EHS guidelines for transmission line construction

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Name of Assignment or project: Environmental and Social Management Plan and Resettlement Action Plan-Kipevu and Eldoret Thermal Power Plants
Year: 2006
Location: Kenya
Client: World Bank/KENGEN
Main project features:

Team Leader of Environmental and Social Assessment for the Kenya Electricity Generation Company (KENGEN) proposed installation of Emergency Diesel Power Plants in Eldoret and Gas Turbine construction in Kipevu, coastal province of Kenya. The task involved guiding the team in undertaking the study and producing a report in compliance with the Environmental Management Act of Kenya and due regard to World Bank's environment and Social Safeguards policies and procedures. 2006

Position held: Environmental and Social Specialist
Activities performed: Preparation of Environmental and Social Impact Assessment including Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP) for the diesel thermal power plants in Eldoret and Mombasa in accordance with World Bank safeguards policies specifically EHS guidelines for transmission line construction

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Name of Assignment or project: Sudan Transitional Environment Program
Year: 2005-2006
Location: South Sudan
Client: USAID
Main project features:

Kodiaga consulted as an Environmental Planning and Organizational Development Specialist for USAID/Sudan under the Sudan Transitional Environment Programme (STEP) implemented by the International Resource Group (IRG) of the USA and Cadmus Group of USA. In this project he exposed staff of the Ministry of Environment Wildlife Conservation and Tourism in the Government of Southern Sudan (GOSS) to the environmental policies and impact monitoring regulations of different countries in Africa so that this can guide and inform their thinking in developing their own policy and procedures on environment. He led the team of ministers and directors of environment and water to countries including Kenya, Ghana, Namibia and South Africa to understand the legal environmental framework.

Position held: Environmental Planning and Organizational Development Specialist
Activities performed: In this project he exposed staff of the Ministry of Environment Wildlife

Conservation and Tourism in the Government of Southern Sudan (GOSS) to the environmental policies and impact monitoring regulations of different countries in Africa so that this can guide and inform their thinking in developing their own policy and procedures on environment. He led the team of ministers and directors of environment and water to countries including Kenya, Ghana, Namibia and South Africa to understand the legal environmental framework.

Name of Assignment or project: **Kalukundi Mining Project**
Year: 2005
Location: DR Congo
Client: AFRICO RESOURCES/IFC
Main project features:

Was the one of the Lead Public Participation Specialist for the proposed mining of copper and cobalt in Congo through the Kalukundi project to be funded by the **IFC**. EMC Consultants undertook the Social Impact Assessment of Copper and Cobalt Mining in Katanga region of Democratic Republic of Congo. The study aimed at determining social impacts of the proposed Kalukundi Copper and Cobalt Mining Project and proposes measures to mitigate prevent or reduce the impacts to manageable levels while maximizing the positive impacts.

Position held: Environmental Specialist
Activities performed: The study was undertaken in response to International Finance Corporation environment and social due diligence for the proposed equity investment by Africo Resources Ltd. The study was prepared to satisfy both Democratic Republic of Congo (DRC) Government regulations and International Finance Corporation (IFC) Performance Standards (PS) 2008.

Name of Assignment or project: Rwanda Rural Energy Access Scale Up Project
Year: 2009
Location: Rwanda
Client: World Bank/Ministry of Energy
Main project features:

Team Leader for the preparation of Environmental and Social Management Framework and Resettlement Policy Framework for National Electricity Roll Out Program (NERP) and Rural Energy Access Scale Up Project a **World Bank** funded Project implemented by EWSA, Rwanda.

Position held: Environmental and Social Specialist

Name of Assignment or project: **Resettlement Policy Framework and Environmental and Social Management Framework-Regional Pastoral Livelihoods Resilience Project**
Year: 2013
Location: Kenya
Client: World Bank
Main project features:

The Government of Kenya in 2013 received technical assistance from technical consortium of the development partners to finance the preparation of the proposed Regional Pastoral Livelihoods Resilience Project (RPLRP) that is to be implemented in Kenya, Uganda and Ethiopia. In Kenya, the project implementation will be under the overall responsibility of Ministry of Agriculture, Livestock and Fisheries (MALF. The Project Development Objective is to enhance livelihoods resilience of pastoral and agro-pastoral communities in drought prone areas through regional approaches. The project will be implemented in 14 Counties which are Lamu, Isiolo, Laikipia, Mandera, Marsabit, West Pokot, Turkana, Tana River, Garissa, Baringo, Samburu, Narok, Baringo and Wajir which have cross border activities and trans-boundary stock routes linking pastoral communities on either side of the borders.

Position held: **Environmental and Social Specialist**
Activities performed: Tito led a team of experts in preparing the Environmental and Social Management Framework and Resettlement Policy Framework for this World Bank funded project.

Name of Assignment or project: **Environmental and Social Management Framework-**

Private Sector Development (PSD) Re-engagement Program
Year: 2013
Location: Kenya
Client: World Bank
Main project features:

Mr. Kodiaga prepared **Environmental and Social Management Framework (ESMF)** for World Bank's Africa Finance and Private Sector Department is currently implementing Phase II of the Somalia Private Sector Development (PSD) Re-engagement Program ("the Program"). The objective of this multi-sectoral technical assistance (TA) program is to improve access to markets and generate new employment in key productive and service sectors. This four-year program, which commenced in February 2011 and is expected to close in June 2014, targets the region of Somaliland. The Program supports capacity building and knowledge creation, as well as sub-project implementation in the following sectors: (1) gums/resins (2) fisheries (3) solid waste management (4) financial sector (5) ports. Additionally the program aims more direct support to the private sector through Matching Grant and Innovation Fund mechanisms (the "Somaliland Business Fund" – SBF), aiming mainly at small-scale enterprises.

Position held: **Environmental and Social Specialist**
Activities performed: Tito led a team of experts in preparing the Environmental and Social Management Framework for this World Bank funded project.

Name of Assignment or project: Environmental and Social Impact Assessment and Management Framework-Lower Nzoia Irrigation Project (Phase 1 and 2)
Year: 2013-14
Location: Kenya
Client: World Bank
Main project features:

The Government of Kenya through National Irrigation Board (NIB) intends to develop the Lower Nzoia Irrigation Scheme Project that will bring 3500 hectares into irrigation. The Project will involve the construction of new water abstraction, conveyance, and distribution and drainage structures (main and secondary canals, and drains). It will also involve the construction of inspection and farm roads along the major infrastructure and farmers' fields as well as creation of the needed farmer's organizational structures.

Position held: **Environmental and Social Specialist**
Activities performed: Tito led a team of experts in reviewing the initial ESIA and RAP prepared for the Lower Nzoia Irrigation Programme (LNIP) Phase 1 and updated the report by preparing a ESIA and RAP for this World Bank funded project including preparing a new ESIA and RAP for Phase 2.

Name of Assignment or project: Review of ESMPs and RAPs for Kenya Transport Sector Support Project (KTSSP).
Year: 2013-Date
Location: Kenya
Client: World Bank, Kenya National Highways Authority (KeNHA),
Main project features: KTSSP became effective on August 22, 2011 US$ 300 million equivalent to the Republic of Kenya. The Project Development Objectives (PDOs) are to: (a) increase the efficiency of road transport along the Northern Corridor and the Tanzania-Kenya-Sudan road corridor; (b) enhance aviation safety and security to meet international standards; and (c) improve the institutional arrangements and capacity in the transport sector. Review and Update of ESIA and RAP for construction of four interchanges at Nakuru-Nyahururu turnoff; Nakuru-Njoro turnoff; Mau Summit-Kisumu turnoff and Ahero-Kisii Turnoff; Review and Update of ESIA and RAP for Rehabilitating the Maji ya Chumvi–Bachuma Gate road section (53 km), Kisumu-Kakamega Rehabilitation, Kakamega-Kitale Road Rehabilitation Project and Kitale-Webuye Road Rehabilitation Project.

Position held: **Environmental and Social Specialist**
Activities performed: Team Leader- Tito Kodiaga was contracted by the World Bank to undertake a detailed Review and update of the ESIA and RAP for the roads project under KTSSP including supervising the implementation of the ESMP and RAP for this project and advising KeNHA and World Bank on safeguards.

Name of Assignment or project: Review of ESMPs and RAPs for EATTFP, NCTIP, SSEATFP
Year: 2013-Date
Location: Kenya
Client: World Bank, Kenya National Highways Authority (KeNHA),
Main project features: East Africa Trade and Facilitation Program (EATTFP) has been conceived as a multi-sector program to facilitate further trade integration in the region by addressing institutional, legal, and infrastructure constraints. The Project Development Objectives (PDOs) are to: (i) enhance efficiency of the customs agencies clearance processes in the participating EAC Custom Unions to facilitate trade; (ii) improve efficiency and reliability of transport and logistics services along the key corridors; and (iii) enhance safety in identified areas and reduce governments transfers to railway by rationalizing the work force on the Kenya-Uganda Railway.

Position held: **Environmental and Social Specialist**
Activities performed: Team Leader- Review and Update of ESIA and RAP for ALL One Stop Border Post (OSBP) in Kenya, Uganda and Tanzania under East Africa Trade and Facilitation Program (EATTFP)

Name of Assignment or project: Review of ESMPs and RAPs for SSEATFP
Year: 2013-Date
Location: Kenya
Client: World Bank, Kenya National Highways Authority (KeNHA),
Main project features: The Republic of South Sudan and the Republic of Kenya have applied for financing to International Development Association (IDA) for the South Sudan – Eastern Africa Regional Transport and Trade Facilitation Program (SS-EARTTFP) in an amount of US$ 450 million, to support the 595 Kilometre Eldoret-Nadapal Road project that has been on the government's cards since the landlocked country gained autonomy from Sudan two years ago. The road aims to improve trade between the two countries and increase road travel between Kenya and South Sudan.

Position held: **Environmental and Social Specialist**
Activities performed: Team Leader- ESIAs/RAPs and ESMPs/ESMF and RPF For South Sudan – Eastern Africa Regional Transport and Trade Facilitation Program (SS-EARTTFP). Tito provided technical support to South Sudan – Eastern Africa Regional Transport and Trade Facilitation Program (SS-EARTTFP) from 2013-2014 by reviewing the ESMPs and RAPs including ESMF and RPF for this project and advising KeNHA and World Bank on adequate steps to mitigate adverse impacts.

Name of Assignment or project: Review of ESMPs and RAPs for NUTRIP
Year: 2013-Date
Location: Kenya
Client: World Bank, Kenya National Highways Authority (KeNHA), KuRRA
Main project features: NUTRIP was approved on July 9, 2012 for US$ 300 million equivalent to the Republic of Kenya. The Project Development Objectives (PDO) are to: (a) improve the efficiency of road transport along the northern corridor; (b) improve the institutional capacity and arrangements in the urban transport sub sector; and (c) promote the private sector participation in the operation, financing and management of transport systems. Component A (Support to KeNHA and KURA to Upgrade the Urban Road Transport Infrastructure) of this project has 3 project and includes the following activities:

1. Expanding and upgrading the Northern Corridor road section through Nairobi from JKIA turnoff to Rironi road, as well as associated service roads and access roads; all through

provision of goods, works and services.

2. Construction of the Kisumu Northern bypass road

Construction and rehabilitating non-motorised transport facilities, including foot paths, cycle tracks, pedestrian bridges and underpasses

Position held: **Environmental and Social Specialist**
Activities performed: Team Leader- provided technical support NUTRIP from 2013-2014 by reviewing the ESMPs and RAPs including ESMF and RPF for this project and advising KeNHA and KURA and World Bank on adequate steps to mitigate adverse impacts.

Name of Assignment or project: Environmental and Social Safeguards Specialist-Development of tools and guidelines for climate adaptation mainstreaming in water infrastructure projects-NELSAP
Year: 2012
Location: Nile Basin Countries
Client: NELSAP/World Bank/KfW
Main project features:

The objective of the consultancy services is to prepare guidelines for mainstreaming climate adaption into investment planning and study to pre-feasibility, one climate proofed regional water resources/infrastructure project that meets project preparation and social and environmental safeguard requirements of KfW for possible downstream financing and implementation. Tito Kodiaga was the Environmental and Climate Management Specialist in this **World Bank** funded study that covers all the NEL countries (Kenya, Uganda, Tanzania, Rwanda, Burundi, DR Congo, South Sudan) with focus on major basins including Mara River Basin, Sio, Malaba-Malakisi, Kagera, Lake Edward, and Albert, Lake Kyoga, among others.

Position held: Environmental Specialist
Activities performed: He assessed the impacts of climate change on water related infrastructure especially dams and designing tools and guidelines for climate change and adaptation and mainstreaming.

Name of Assignment or project: Greening ICT in Kenya, E-Waste Management Study
Year: 2013-2014
Location: Kenya
Client: World Bank
Main project features:

The objective of this study is to enhance knowledge on electronic waste associated with the expansion of information and communication technologies (ICT) in Africa and the promotion of sustainable E-waste management and life cycle approaches to ICT equipment. It is hoped that the work will eventually contribute to creating a platform for promoting Green ICT and reduce pollution risks and environment related health hazards.

Position held: Environmental Specialist
Activities performed: Mr. Kodiaga was contracted by the World Bank in November 2013-February 2014 to conduct an E-waste study for Kenya under the Greening ICT Programme. Qualitative and quantitative research approaches and techniques were employed in undertaking this study including literature review, in depth interviews and field site observations and are described in detail below. The study was conducted in Nairobi County and entailed collection of data from the existing E-waste recycling institutions (both formal and informal), relevant government institutions engaged in E-waste management in Kenya, Non Governmental Organizations, industry officials and private sector agencies engaged in ICT.

13. References:

To be provided upon request

14. Certification:

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged. I further declare that I am able and willing to work:

1. For the period(s) foreseen in the specific Terms of Reference for the position for which my CV has been included and
2. Within the implementation period of the specific contract.

{day/month/year}

Tito Kodiaga 11th May 2014

Name of Expert Signature

{day/month/year}

Name of authorized Signature Date

Representative of the Consultant

(the same who signs the Proposal)

Education

M.Sc. Sustainable Management of the Water Environment, University of Newcastle-upon-Tyne, UK, 2002

BSc Mathematics, Honours, UMIST, UK, 1996

Certifications

CIWEM Chartered Scientist, 2007

Languages

English – Mother Tongue

Spanish – Fluent

French – Basic

Golder Associates (UK) Limited – Bourne End

ESIA Practitioner/Associate

Andrew Morsley is a Senior ESIA Practitioner with a BSc in Mathematics and MSc in Sustainable Management of the Water Environment. Andrew is the ESIA Lead for Golder in the UK and has been with Golder for 10 years, working in the 3 UK offices and in Santiago Chile for two years. He has over 15 years of engineering experience with over ten years focused on technical input and project management of ESIAs. Andrew has also been involved in IFC 3rd party reviews of ESIAs, Hydrological Assessments, Water Balances, Dam Breach Analyses, Flood Risk Assessments, Hydraulic and Hydrological modelling, Hydrogeological Assessments, glacial studies and alluvial risk assessments. Andrew has extensive cross sector experience and has worked on ESIA studies in the UK, Chile, Argentina, Central African Republic, Mali, Guinea, Romania, Slovakia, Canada, Indonesia and Ireland. Andrew's mother tongue is English, but he speaks and writes fluent Spanish and speaks basic French.

Employment History

Golder Associates (UK)Ltd – Bourne End, UK
Senior Hydrologist/Project manager (2010 to Present)

Golder Associates S. A. – Santiago, Chile
Senior Hydrologist (2008 to 2010)

Golder Associates (UK) Ltd. – Chelmsford, UK
Senior Hydrologist (2004 to 2008)

Symonds-Group Ltd. – East Grinstead, UK
Hydrologist/Hydraulic Modeller (2003 to 2004)

Carl Bro – Leeds, UK
Leakage Zonal Manager (2002 to 2003)

Water Management Consultants – Carlisle, UK
Water/Drainage Engineer (2001 to 2001)

Manesmann Rexroth – Royston, UK
Support Engineer (2001 to 2001)

GEC Marconi Radar and Defence (BAe) – Stanmore, UK
System Integration Engineer (1997 to 1999)

KEY PROJECT EXPERIENCE

Weda Bay Nickel Mine
Indonesia
Third party review of Physical Sciences elements of the ESIA and review of compliance to IFC Performance Standards 2006 and 2012 for a Nickel Mine.

SMFG/BHP/Billiton, Nimba Mining ESIA
Guinea
Physical Sciences lead for the ESIA baseline and ESIA and task leader for surface water for the Nimba Iron Ore Mine.

Euromax, Ilovitza ESIA
Macedonia
Project Manager for ESIA baseline for a proposed copper gold mine in the Bosilovo municipality of Macedonia

Falea
Mali
Project management of initial baseline survey work for the Falea ESIA.

Kremnica Gold Mining ESIA
Slovakia
Project management of the physical aspects of the ESIA baseline study, including air quality, hydrogeology, hydrology and ARD. Technical lead for hydrological, hydraulic and hydrometric support to an ESIA project for a proposed Gold Mine in Slovakia.

Aurafrique Mining ESIA
Central African Republic
Project management of the ESIA for a proposed Gold Mine in the Bambari region of the Central African Republic. The role also involved coordination of all physical aspects of the baseline and ESIA (hydrology dust, air quality, hydrogeology and ARD) and input into water supply, waste and sanitation issues associated to the social impacts and Environmental Management Systems.

Jahodna Mining ESIA
Slovakia
Project management of the physical aspects of the scoping study and initial ESIA baseline and hydrological, hydraulic and hydrometric support to an ESIA project for a proposed Uranium Mine in Slovakia.

Carpathian Gold Mining ESIA
Romania
Project management of the physical aspects of the ESIA baseline, including hydrological and hydrometric support to setting up a baseline for an Environmental and Social Impact Assessment for a proposed Gold Mine in the Rovina region of Romania.

Colbun Hydroelectric Plant
Chile
Senior review of hydrological and meteorlogical baseline studies for a hydroelectric plant in Patagonian Chile.

El Teniente
Chile
An evaluation of hydrological and aluvial risk from three catchments located just upstream of significant mine infrastructure, in the light of significant aluvial events in the preceding years.

Pascua Lama
Chile
Project management and technical input into studies of glaciers in the vicinity of the proposed Pascua Lama mine development.

Pascua Lama
Chile/Argentina
Hydrological and aluvial risk analysis for a road runnig across the Andes from Chile to Argentina.

Plumpton Rocks
UK
Lead hydrologist on a restoration scheme of a heritage monument in Yorkshire. Coordinating with the panel engineer to redesign the spillway and discharge mechanism and evaluate the Dam Category according to the Reservoirs Act

Tara mines
Ireland
Lead hydrologist on conceptual design of passive treatment of minewater using wetlands

Tara Mines Dam Break Out Study
Tara, Ireland
Project Management and technical supervision of hydrological support and hydrodynamic modelling for a breakout study of a tailings facility at Tara Mines. Site visit and exploration of over 20 risk assessment scenarios.

Certej Dam Break Out Study Romania	Project Management and technical supervision of hydrological support and hydrodynamic modelling for a breakout study of a tailings facility.
Antamina Dam Break Out Study Peru	Project Management and technical supervision of hydrological and hydraulic modelling for a breakout study of a large tailings facility.
Simandou Guinea	Tuflow model reviewer for port flood studies
Gosford Race Club NSW, Australia	Review of Tuflow/Estry model, Senior modeller for modelling of mitigation options
Gosford City Council NSW, Australia	Review of Tuflow/Estry model of entire Catchment, Senior modeller for modelling of various mitigation options
Taldybulak Project Kyrgyzstan	Project management of initial ESIA baseline studies, Senior review and project management of hydrological and hydrogeological installations for initial ESIA baseline surveys.
Flood Consequences Assessment for Waste Facility EIA Pontypool, UK	Responsible for flood risk assessment in accordance with TAN15 including hydrological modelling using FEH, WinFAP, HEC HMS, Tuflow models to characterise the catchment and the hydrology and 2d hydrodynamic modelling (TUFLOW) of the flooding mechanism which led to mitigation definition.
AWE Aldermaston, Flood Risk Assessment for EIA UK	Project managed, provided technical input and strategic advice to the Flood Risk Assessment for a proposed nuclear facility.
British Sugar Flood Risk Assessment UK	Technical lead responsible for a Flood Risk Assessment of an expansion of the British Sugar facility adjacent to the River Wissey. The flood risk assessment formed part of the wider EIA, also carried out by Golder UK.
Rockwood Pigments, Kidsgrove, Hydrological Assessment UK	Project manager and lead hydrodynamic and hydrological modeller. Used GIS techniques HEC HMS hydrologic and Tuflow 2d hydrodynamic modelling to characterise a complex pluvial flooding/ rainfall runoff model.
Numerous FRAs for Golder and Symonds	Project managed, Technical lead, modeller and strategic advice to the Flood Risk Assessment, Tuflow and ISIS modelling and hydrological input to EIAs for over 40 proposed land developments, transport infrastructure, waste facilities and Aggregate developments in England, Wales, Northern Ireland, Ireland and Scotland.
Andacollo Argentina	Hydrological assessment of the impacts of a fly ash deposit associated to a coal burning energy plant.
Colbun Chile	Hydrological assessment of the impacts of a fly ash deposit associated to a coal burning energy plant.
Lobo Marte Chile	Project management and technical input to hydrological studies to water supply options in an endorreic catchment in the Chilean Altiplano.
Jerooy Mining ESIA Kyrgyzstan	Provided strategy advice and planning for the hydrological aspects of the baseline and EIA.

BTC Landfill EIA Georgia	Lead Hydrologist managing site water balance and flood risk elements of conceptual design, acceptance criteria, risk assessment and conceptual mitigation.
Aquifer Characterisation through Pump Test and Analyses	Site work and analysis of data from pump testing to ascertain the aquifer resource potential, the vertical and lateral extent and the likely pathway from source to receptor at a landfill site in Evesham.
Landfill Hydrogeological Design	Hydrogeologist responsible for design of de-watering system. Hydrogeological de-water modelling and hydrogeological risk assessment modelling with LandSim and hardware definition.
Monolithic Leachate Waste Test Analyses	Hydrogeologist responsible for analysis of monolithic leachate test analyses in accordance with Waste Acceptance Criteria. Leaching testing was carried out on mining paste backfill.

PROFESSIONAL AFFILIATIONS

Associate member of the Institute of Environmental Management and Assessment (IEMA)

Member of the Chartered Institute of Water and Environmental Management (CIWEM)

Chartered Scientist

Paul G Lawrence

61 Exmouth Market, Flat 1
London, EC1R 4QL
United Kingdom
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paul@lawrence-webb.com

Summary

Paul is a social impact assessment and stakeholder engagement consultant with 17 years' experience of working on civil society and social development issues. For the last eight years he has specialised in natural resources and infrastructure development. Paul has designed and implemented work plans for Social Impact Assessment (SIA) studies and stakeholder engagement to comply with international best practice, developing bespoke training programmes on these topics for client staff. He has also developed a framework for auditing the socio-economic and public consultation components of industrial sites to ensure they are compliant with the Equator Principles and Performance Standards of the International Finance Corporation (IFC) and Performance Requirements of the European Bank for Reconstruction and Development (EBRD). Paul has used this framework on 'greenfield' impact assessments in Russia and Kazakhstan and on existing industrial facilities in Armenia, Georgia and Uzbekistan. He has completed the three-day IFC Labour Academy to understand the application of Performance Standard 2 on Labour and Working Conditions and conducted labour assessments in Belarus and Russia as part of due diligence in project finance.

Prior to consultancy work, he managed a civic diplomacy project for a UK-based conflict resolution organization that aimed to increase public involvement in the peace process between Armenians and Azerbaijanis over Nagorny-Karabakh, conducting an extensive needs assessment with business, government and non-governmental leaders to find incentives for peace and increase cross-conflict cooperation. Paul has also worked as a researcher and written on environmental, human rights and sustainability issues in the former Soviet Union. A fluent Russian speaker, he has lived in Russia and the South Caucasus for over four years. He holds an MA in public policy and international affairs with an emphasis on development studies.

Experience

2010 – present **Shelburne Consulting Limited** **London, UK**

Director

Independent consultant delivering and managing services related to:

- SIA, including baseline studies and social management plans
- Stakeholder engagement and public consultation
- Social and labour auditing
- Social investment and community development programmes
- Training on stakeholder engagement, social performance and management

2006 – 2010 **Golder Associates (UK) Limited** **London, UK**

Socio-economist and Stakeholder Engagement Practitioner, Corporate Services

Developed and managed projects in relation to international SIA, stakeholder engagement and sustainable development. Major projects included a full impact assessment for a gold mine in the Central African Republic, socio-economic baseline studies in Armenia, Mongolia and Uzbekistan and design of a five-country training programme on stakeholder engagement for a steel manufacturing company in Eastern Europe and former Soviet Union.

2004-2005 **International Alert** **London, UK**
Civil Society Strand Manager
Managed civil society strand of conflict resolution project between Armenians and Azerbaijanis, which included conference organization and facilitation, small projects and coalition-building among peacebuilding organizations. Oversaw all programmatic financial accounting and reporting for £200,000 annual budget.

2002 **Mercy Corps** **Asmara, Eritrea**
Academic Intern
10-week graduate programme academic internship. Main projects included developing an integrated community development proposal to aid Eritrean refugees returning from Sudan and research on micro-finance in Eritrea and East Africa.

2000-2001 **Project Harmony** **Armenia, Azerbaijan and Georgia**
Director, Programme for Internet Community Development
Developed three-country project to increase use of information communication technology (ICT) by small businesses and organisations aiding refugees. Project was set up as pilot by the US State Department to utilise ICT for social development. Oversaw all programmatic and financial accounting and reporting for $165,000 budget. Established organisational presences in Azerbaijan and assisted in fundraising.

1998-2000 **ISAR** **Baku, Azerbaijan and Washington, DC, USA**
Consultant, Summer 2000 (Based in Baku, Azerbaijan)
Researched local nongovernmental organisations, interviewed leaders and stakeholders in effort to better understand the impact of civil society organisations, including opportunities and challenges for sector development in Azerbaijan.

Publications Programme Manager, 1998-2000 (Based in Washington, DC, USA)
Facilitated production process for quarterly publication, *Give & Take: A Journal on Civil Society in Eurasia*. Included soliciting themes and commissioning articles related to the development of nascent nongovernmental organisations throughout the former Soviet Union.

1996-1998 **US Peace Corps, Western Russia** **Astrakhan, Russia**
English Teacher
Planned and taught daily conversational English language and American culture classes to university students at *Astrakhan State Pedagogical University* and secondary school students at *School of Gifted Children*.

1994-1995 **Massachusetts Department of Youth Services** **Brewster, MA, USA**
Trailstaff Chief Instructor, "Homeward Bound" Programme
Counselled groups of nine adjudicated youth on month-long, outdoor experiential education programme, designed as alternative sentencing to traditional juvenile detention facilities.

Education MA in Public and International Affairs – International Development, Woodrow Wilson School, Princeton University, Princeton, NJ, USA, 2003

BA English Literature major and Mass Communication minor, Principia College, Elsah, IL, USA, 1993

Languages Fluent Russian

PROJECT RELATED EXPERIENCE – SOCIAL IMPACT ASSESSMENT AND SOCIO-ECONOMIC AUDITING

Oil and Gas Processing Plant **Azerbaijan**

Socio-economic lead for major oil and gas ESIA in an industrial region of Azerbaijan. Design and management of baseline data collection, impact analysis and social management plans. The project is being implemented to meet IFC Performance Standards.

Gas Pipeline **Turkey**

Technical and senior review during the scoping phase for a gas pipeline, including support in the development of work plans for the data collection of the socio-economic baseline.

Gold Mine **Azerbaijan**

Design and implementation of socio-economic analysis for an operating and expanding gold mine. The project included a gap analysis of existing plans and policies for compliance with the EBRD Performance Requirements. Base on the gap analysis, work includes development of management plans to mitigation negative social impact.

Coal Mine **Russia**

Design and implementation of SIA on proposed coal mine in rural area of the Chukotka Autonomous District in the Russian Far East. The project includes assessment and engagement components related to potential impacts on indigenous peoples.

Gas Pipeline **Albania, Greece and Italy**

Team member on a Human Rights Impact Assessment for a natural gas pipeline starting in Greece, through Albania, across the Adriatic and linking with Italy. Oversaw stakeholder engagement elements and conducted stakeholder consultation in Albania.

Shale Gas Exploration **Romania**

Oversaw socio-economic research, impact studies and stakeholder engagement for gas exploration in Eastern Romania. Exploration activities have the potential to develop new shale gas production in Romania. Included preliminary engagement with external stakeholders and the development of a formal Stakeholder Engagement Plan.

Manufacturing Belarus

Conducted labour assessment for a group of companies producing roller shutter systems in Belarus. Determined the extent to which the group's management systems and operations in Belarus complied with IFC Performance Standard 2 on Labour and Working Conditions and developed an action plan to address any deficiencies.

Oil Production Turkmenistan

Reviewed social and stakeholder engagement elements related to an oil facility in Western Turkmenistan, including a review of existing impact assessments for an extension of the operating facility and new export options. Included interviews with the client's environmental and social managers and external stakeholders. The main deliverable consisted of a Stakeholder Engagement Plan and gap analysis to inform the operator of deficiencies in comparison with internal impact assessment and sustainability standards.

Gas to Liquid Plant **Uzbekistan**

Designed and managed socio-economic and stakeholder engagement components of a greenfield Gas to Liquid (GTL) plant in Uzbekistan. Included all social elements of the project from scoping to impact assessment and development of relevant management plans. Final impact assessment will comply with the IFC Performance Standards.

Gold Mine **Russia**
Assessed socio-economic and stakeholder engagement components of a greenfield gold mine in the Russian Far East. Included a corporate audit of the company's management systems, as well as a gap analysis of the Russian-language ESIA for its compliance with the EBRD Performance Requirements. All deficiencies were incorporated in an Environmental and Social Action Plan.

Gas Exploration and Production **Russia**
Reviewed social elements related to gas exploration and the refurbishment of gas processing facilities in the Polar Arctic region of Yamal-Nenets. Included interviews with the client's environmental and social managers and external stakeholders. The main deliverable consisted of a gap analysis to inform the operator of deficiencies in comparison with the IFC Performance Standards.

Retail Supermarket Chain **Belarus**
Conducted labour assessment for an existing retail supermarket chain as part of an expansion project to increase the number of stores from 63 to 128. Determined the extent to which the client's management systems and operations in Belarus complied with IFC Performance Standard 2 on Labour and Working Conditions and developed an action plan to address any deficiencies.

Gold Mine **Kyrgyzstan**
Audited social and public consultation components of national Environmental Impact Assessment for proposed gold mine in the Talas Region of Kyrgyzstan. Included a gap analysis report that identified additional actions needed to make the national EIA compliant with Equator Principles and relevant IFC Performance Standards.

Gold Mine **Central African Republic**
Design and implementation of SIA on proposed gold mine development that will have national, regional and local impacts. The project represented the largest single investment into the Central African Republic to date and has potential to support considerable socio-economic development.

Off-shore Oil Development **Kazakhstan**
Audited social and public consultation components of Environmental and Social Impact Assessment for proposed off-shore oil platform in Caspian Sea. The audit aims to provide independent review for Category A project and assess ESIA documents for Equator Principle compliance.

Uranium Mine Mongolia
Supervised archaeological and socio-economic baseline data collection for the proposed re-commissioning of a former Soviet-managed uranium mine. Wrote socio-economic baseline to ensure the project complied with IFC Performance Standards.

Gold Mine **Armenia**
Audited socio-economic components of existing gold mine complex to comply with Equator Principles and IFC Performance Standards. Assessed corporate responsibility efforts and developed community engagement strategies. Conducted scoping phase of Social Impact Assessment for planned expansion, including stakeholder consultation at local, regional and national levels.

Steel Plant and Coal Mine **Kazakhstan**
Audited socio-economic components of existing steel plant and coal mines to comply with EBRD Environmental Policy and international good practice. Assessed social investment programme and stakeholder engagement strategies through site visit interviews with government representatives and NGOs.

Copper Mine **Georgia**
Audited socio-economic components of existing copper mine complex to comply with Equator Principles and IFC Performance Standards. Assessed corporate responsibility efforts and developed community engagement strategies.

PROJECT RELATED EXPERIENCE – STAKEHOLDER ENGAGEMENT AND PUBLIC CONSULTATION

Stakeholder Engagement **Kazakhstan**
Technical support to public affairs team in relation to its stakeholder engagement strategy within an ESIA. Reviewed corporate policies, management documents and stakeholder engagement database. Provide recommendations for overall strategy.

Stakeholder Engagement **Bosnia, Kazakhstan, Ukraine**
Overall design and implementation of a stakeholder engagement training programme in Bosnia, Kazakhstan, Macedonia, Romania and Ukraine. Programme aimed to operationalise the company's Community Engagement Standard through the development of a face-to-face training programme that built on the existing community engagement materials in the company. Worked as the lead facilitator in Bosnia, Kazakhstan and Ukraine.

Stakeholder Engagement **Kyrgyzstan**
Advised client on best practice related to stakeholder engagement in relation to the development of a gold mine in a sensitive mountainous environment in rural Kyrgyzstan. Supported client's staff to develop a Stakeholder Engagement Plan to complement the environmental permitting process.

Stakeholder Engagement **Central African Republic**
Mentored client's Community Liaison Officer in stakeholder engagement. Ensured project conformed to IFC Performance Standards and Best Practice, including implementation of grievance mechanism and community steering committee that shared responsibility for social investment strategy around the proposed site.

Conflict Mediation **Armenia and Azerbaijan**
Facilitated community confidence-building initiatives, including face-to-face seminars and conferences, between Armenians and Azerbaijanis, including residents of the disputed territory of Nagorny-Karabakh. Utilised Open-Space Technology and other participatory methods for strategic planning.

Regional Collaboration **Armenia, Azerbaijan and Georgia**
Conducted community needs assessments with parallel groups of Armenian, Azerbaijani and Georgian NGOs and small enterprises. Initiated online communication and collaboration strategies throughout the region and mentored organisations in strengthening ties with like-minded initiatives in the Caucasus and other countries of the former Soviet Union.

PROJECT RELATED EXPERIENCE – INTERNATIONAL AND SOCIAL DEVELOPMENT

Conflict Resolution **London, UK**

Development of a peacebuilding strategy in partnership with national NGOs in Armenia, Azerbaijan and Nagorny-Karabakh. Conducted stakeholder analysis and incorporated in-programme strategy, including assessment trips and meetings with national government and international actors. Liaised with peacebuilding initiatives in Georgia, Abkhazia, South Ossetia and North Caucasus as part of regional strategy.

Education, Humanitarian Relief **Asmara, Eritrea**

Developed integrated community sustainable development proposal to aid Eritrean refugees returning from Sudan. Researched the micro-finance environment in Eritrea and East Africa for potential programme expansion. Drafted and compiled staff orientation and training manual to standardise office procedures.

Community Development **Armenia, Azerbaijan and Georgia**

Facilitated planning for all logistical needs and programmatic phases of project – including development of training curriculum – with local staff, partners and US colleagues. Managed multi-cultural staff of four people based in three different countries. Designed online interactive events, training environments and workspaces. Oversaw all programmatic financial accounting and reporting for budget. Established organisational presence in Azerbaijan and assisted in fundraising.

Education

BA (Hons) (II:i) Ancient History and Archaeology , University of Manchester, Manchester, 1993

Languages

Spanish – Fluent

English – Fluent

French – Fluent

Golder Associates (UK) Limited – Leeds

Paul Wheelhouse is a Senior Archaeologist with over nineteen years, post-graduation, experience in archaeological and cultural heritage fieldwork, consultancy and research. He holds a Bachelor of Arts (Honours) degree in Ancient History and Archaeology from the University of Manchester. Following graduation, Paul worked for a short period in Oman and subsequently for a number of archaeological contractors in the UK, and gained over twelve years' experience in archaeological excavation, post-excavation analysis, project management and publication. Before joining Golder in 2005, Paul was Senior Manager for Archaeological Services WYAS, the largest archaeological contractor in the north of England, where he directed and managed a wide and diverse range of archaeological projects of all periods. He was Site Supervisor during archaeological work in advance of the construction of the M1-A1 Link Road and co-author of the publication report New Link to the Past: The Archaeology of the M1-A1 Link Road. Paul was also co-director and co-author of the monograph report of excavation work at Ferrybridge, Ferrybridge Henge: the Ritual Landscape.

Paul is a Member of the Institute of Field Archaeologists and is responsible for the coordination and project management of archaeological work for Golder's clients, principally in the United Kingdom and Europe. This regularly involves work on a diverse range of developments, including transportation, mining and mineral extraction, oil and gas, power, land development, manufacturing and waste management. Paul designs and formulates cost and time-effective archaeological solutions, creates management strategies, and oversees the implementation of archaeological research and mitigating field investigations including geophysical surveys, trial and detailed excavations, in a coordinating and monitoring role. Paul regularly undertakes desk-based assessments for Environmental Impact Assessments submitted in support of planning applications with respect to archaeology and cultural heritage, and has developed a good working relationship with local authority archaeologists and representatives from national organisations, such as English Heritage and the National Trust.

Paul coordinates cultural heritage ESIA chapters, managing reconnaissance surveys and the evaluation of archaeological sites for international projects, including mine sites in Africa: Central African Republic, Guinea, Liberia, Malawi, Sierra Leone, and Togo; preparing work instructions and recording systems for local sub-contracted archaeologists to use, and working closely with the mine operators to ensure protection of sites identified in the field. He has also inputted to a feasibility study for a proposed oil and gas facility in the Mediterranean Sea, investigating the potential for encountering marine cultural heritage within a large block of sea, which included WW1 and WW2 shipwreck sites and the wrecks of Roman trading vessels.

Employment History

Golder Associates (UK) Ltd – UK
Senior Archaeologist (2005 to Present)

Responsible for cultural heritage and archaeological input for ESIA/EIAs for Golder's clients in Europe and Africa. Manages and co-ordinates major infrastructure EIAs in the UK.

Archaeological Services WYAS – UK
Senior Manager (1994 to 2005)

Responsible for the management and co-ordination of archaeological investigations throughout the United Kingdom for a large commercial archaeological contractor, specialising in major linear and infrastructure projects.

Tempus Reparatum – UK
Archaeological Technician (1994 to 1994)

Archaeological excavator undertaking fieldwork prior to the development of a large aggregate extraction site in the Thames Valley, England.

Canterbury Archaeological Trust – UK
Archaeological Excavator (1994 to 1994)

Archaeological excavator on a large Anglo-Saxon cemetery in Kent, England in advance of a residential development.

Archaeological Services WYAS – UK
Archaeological Site Assistant (1993 to 1994)

Archaeological excavator on numerous sites in northern England in advance of a development.

South-West Missouri State University – Oman
Archaeological Excavator/Surveyor (1993 to 1993)

Archaeological supervisor at a citadel site in southern Oman, providing practical fieldwork teaching to US archaeology students.

PROJECT EXPERIENCE – HIGHWAY / TRANSPORT SCHEMES

A590 High and Low Newton Bypass, ECI Project Cumbria, UK	Senior Archaeologist responsible for the production of the archaeological specification and tender documentation, liaison with the Lake District National Park Authority archaeologist, and the coordination and monitoring of the archaeological works (trial trenching, building recording, earthwork surveys, palaeoenvironmental investigations and watching brief) in advance of, and during, road construction (to DMRB Stage 3).
A1 Adderstone to Belford Bypass Northumberland, UK	Senior Archaeologist responsible for the implementation of geophysical surveys along the scheme route and watching briefs during geotechnical investigations, and the preparation of associated documentation in liaison with the Local Authority's archaeological advisors (to DMRB Stage 3).
A165 Reighton Bypass North Yorkshire, UK	Senior Archaeologist with responsibilities for the design and implementation of photographic building recording, trial trenching and detailed open area archaeological excavations in advance of road construction, and watching briefs during, working in close liaison with the County Archaeologist (to DMRB Stage 3).
A64 Musley Bank & A64 Golden Hill Improvements Malton, North Yorkshire, UK	Responsible for the research and production of a Cultural Heritage Assessment report as part of an EIA in advance of proposals for road junction upgrades, including the implementation and monitoring of geophysical surveys (to DMRB Stage 2).
Finningley and Rossington Regeneration Route Scheme Doncaster, South Yorkshire, UK	Responsible for the production of mitigation designs and tender documentation for geophysical surveys and trial trenching in advance of a road scheme to link the M18 with Robin Hood Airport, Finningley (to DMRB Stage 2).
A165 Scarborough Integrated Transport Scheme (SITS) North Yorkshire, UK	Senior Archaeologist with responsibilities for the design and implementation of geophysical surveys, trial trenching and detailed open area archaeological excavations in advance of road construction, and watching briefs during, working in close liaison with the County Archaeologist (to DMRB Stage 3).
A66 Dualling North Yorkshire and County Durham, UK	Client's Agent role to the Highways Agency's designers, overseeing and monitoring the implementation of archaeological mitigation associated with an ECI contract. Works involved the investigation of a Scheduled Monument, and liaison with English Heritage and County Archaeologists, reviewing completion certificates and signing off works as they were completed.
A453 Dualling (M1 J24 to A52 Nottingham) Leicestershire and Nottinghamshire, UK	Client's Agent role to the Highways Agency's designers, reviewing an archaeological desk-based assessment and written scheme of investigation for geophysical surveys and trial trenching.
A160-A180 Improvements Immingham, North Lincolnshire, UK	Environmental coordinator overseeing the environmental review for a pre-TPI entry scheme. Work involved liaison with HA's SSR team, and the production of a review report and recommendations for further work to enable the scheme to progress on to the TPI.

Kosovo Highway Project
Republic of Kosovo

Archaeological and cultural heritage consultant responsible for the co-ordination and implementation of in-country research, consultation, site walkover reconnaissance surveys and production of a Cultural Heritage Assessment report as part of an ESIA for a large highway project in Kosovo. Presently the Project Manager responsible for delivery of the translated ESIA documents to the client and government authorities.

PROJECT EXPERIENCE – WASTE

Former HTI Site
New Inn, Pontypool, South Wales

Senior Archaeologist responsible for the archaeological research and production of a Cultural Heritage Appraisal report as part of an EIA in advance of proposals for a new incinerator, consulting with CADW, NMRW, RCAHMW and GGAT.

Rock Common Landfill
Washington, West Sussex, UK

Responsible for the archaeological research and production of a Cultural Heritage Assessment report as part of an EIA in advance of proposals for a landfill site, visiting and consulting with the County Sites and Monuments Record and Archive Record Office. Preparation of appropriate mitigation proposals for the scheme in advance of development works.

Downpatrick
Northern Ireland

Responsible for the archaeological research and production of a Cultural Heritage Assessment report as part of an EIA to accompany detailed planning application for materials recycling, anaerobic digestion and electricity generation facility (waste to energy).

PROJECT EXPERIENCE – MINING, MINERALS AND RECLAMATION

Bantycock Quarry
Nottinghamshire, UK

Archaeological consultant retained to oversee the implementation of extensive fieldwork investigations in advance of a proposed 266 hectare extension to an existing gypsum mine. Produced a detailed specification, coordinated the tender process, including site visits, and reviewed tender submissions, advising the client via a report on a preferred sub-contractor.

Forcett Quarry, Richmondshire
North Yorkshire, UK

Archaeological advisor for a proposed 20 hectare extension to a limestone quarry. Review of previous archaeological information, liaison with County Archaeologist, management and coordination of fieldwork (geophysical survey) in advance of submission of the Environmental Statement.

Passendro Gold Mine
Central African Republic

Archaeological consultant for an Environmental and Social Impact Assessment (ESIA) for a proposed gold mine in CAR. Work has involved the coordination of a local archaeological team to undertake baseline surveys to feed into the ESIA, supplying them with equipment to complete the work and devising appropriate scopes of work and site recording pro forma sheets.

Bakouma Uranium Mine
Central African Republic

Archaeological consultant for an Environmental and Social Impact Assessment (ESIA) for a proposed uranium mine in CAR. Work to date has involved the on-site coordination of a local archaeological team to complete initial baseline reconnaissance surveys, surveying sites in the proposed mine extraction areas.

Tonkolili Iron Ore Mine Sierra Leone	Archaeological and cultural heritage consultant for an Environmental, Social and Health Impact Assessment (ESHIA) for a proposed iron ore mine in Sierra Leone. Work to date has involved the on-site coordination of a local archaeological team to complete initial baseline reconnaissance surveys, surveying sites in the proposed mine extraction areas.
Scantogo Limestone Mine and Clinker Facility Togo	Archaeological consultant for an Environmental and Social Impact Assessment (ESIA) for a proposed limestone mine in Togo. Work has involved the on-site coordination of a local archaeological team to complete initial baseline reconnaissance surveys, including recording sites within the proposed mine extraction areas and conducting interviews with the potentially affected communities with respect to their cultural heritage.
Nimba Iron Ore Project Guinea	Archaeological consultant and technical task lead for cultural heritage for an Environmental and Social Impact Assessment (ESIA) for a proposed iron ore mine in Guinea. Work to date has involved the preparation of plan of study for the initial baseline surveys, including associated rail links, and conducting the baseline surveys and community interviews.
Chambe Basin REE Project Malawi	Archaeological consultant responsible for cultural heritage and archaeology baseline studies associated with an ESIA for a proposed rare earth elements mine in the Chambe Basin, Mulanje, Malawi. Working alongside a local archaeologist, the survey successfully recorded the locations of prehistoric occupation sites within surrounding caves and rock shelters, and documented evidence for early human land use and burial. The intangible cultural heritage comprised water features considered to be possessed by spirits.
New Liberty Gold Mine Project Liberia	Responsible for the cultural heritage components of an ESIA for a proposed gold mine in Liberia, conducting the following tasks: - An archaeology field survey of the development footprint; - Community interviews with village elders and chiefs within proximity of the mine; - Recording of identified cultural heritage sites; and - Preparation of a baseline report and impact assessment, including mitigation proposals. The sites identified included: cemeteries, initiation sites, shrines and watercourses considered sacred to the community.

PROJECT EXPERIENCE – OIL & GAS

Gas to Liquid (GTL) Pipeline Uzbekistan	Responsible for the production of a Cultural Heritage Assessment report as part of an ESIA for a proposed GTL pipeline in Uzbekistan, working with local heritage specialists.
Rhone Maritime Block Mediterranean Sea	Preparation of the Cultural Heritage component of a feasibility study in the Rhone Maritime Block in the western Mediterranean, investigating the potential for shipwrecks and other sites of antiquity relating to a proposed offshore oil and gas facility and associated onshore infrastructure near Marseille, France.

PROJECT EXPERIENCE – LAND DEVELOPMENT

Miles Platting
Manchester, UK

Responsible for the archaeological research and production of a Cultural Heritage Assessment report as part of an EIA to accompany detailed planning application for the redevelopment of a run-down part of north central Manchester, including devising suitable and appropriate mitigation (building recording and watching briefs).

Former British Sugar site
Kidderminster, Worcestershire, UK

Archaeological research undertaken to inform a client considering purchasing the site for future redevelopment. Work included assessing the likelihood of development impacts on surrounding cultural heritage receptors, such as Listed Buildings and Conservation Areas.

TRAINING

Golder Project Management Course (24 hours)

Golder Risk Assessment Course (12 hours)

Golder 101 Introduction to Consulting (5 hours)

Passport to Safety (2 day health and safety training to ECITB standard plus one day refresher) - Construction Skills Certification Scheme

Professional Report Writing (16 hours)

Environmental Impact Assessment Co-ordination Course (16 hours)

Emergency First Aid and Outdoor Survival Management (16 hours)

International Association for Public Participation (IAP2) Course (32 hours)

PROFESSIONAL AFFILIATIONS

Member of Institute of Field Archaeologists (MIFA)

Associate of Institute of Environmental Management and Assessment (AIEMA)

Member of the International Association for Impact Assessment (IAIA)

PUBLICATIONS

Journal Articles

P., Wheelhouse. *'M1-A1 Link Road, Becca Bank, Aberford, Leeds', Yorkshire Archaeological Society Roman Antiq. Sec. Bull. 14,21-2.* (1997)

P., Wheelhouse. *Bullerthorpe Lane' in Roberts, I, Burgess, A, and Berg, D, A new Link to the Past: The Archaeological Landscape of the M1-A1 Link Road, 37-47.* (2001)

P., Wheelhouse and Burgess A.. *'The Linear Earthworks' in Roberts, I., Burgess, A., and Berg, D., A New Link to the Past: The archaeological landscape of the M1-A1 Link Road, 123-148, (reporting the results of three out of four equally-sized excavations, Burgess reporting on one), Yorkshire Archaeology 7.* (2001)

P., Wheelhouse. *'The Anglian Cemetery' in Moloney, C., Holbrey, R., Wheelhouse, P. and Roberts, I, Catterick Racecourse, North Yorkshire: The re-use and adaptation of a monument from prehistoric to Anglian times, Archaeological Services WYAS Publ. 4.* (2003)

P., Wheelhouse. *The Ritual Monuments' in Roberts, I (ed), Ferrybridge Henge: The Ritual Landscape, Yorkshire Archaeology 10* (2005)

Other

UNPUBLISHED ARCHIVE REPORTS (SELECTION)

Wheelhouse, P, 1994, Humberside International Airport, Kirmington: Archaeological Watching Brief.

Wheelhouse, P, 1995, Wynyard Road, Thorpe Thewles, Cleveland: Archaeological Watching Brief.

Wheelhouse, P, 1995, St Mary's Close, Elloughton, North Humberside: Archaeological Watching Brief.

Wheelhouse, P, 1996, M1-A1 Link Road Site 29: Archaeological Evaluation.

Wheelhouse, P, 1996, M1-A1 Link Road Site 23: Archaeological Evaluation.

Wheelhouse, P, 1996, M1-A1 Link Road Site 24: Archaeological Evaluation.

Wheelhouse, P, 1996, M1-A1 Link Road Site 4: Archaeological Evaluation.

Wheelhouse, P, 1996, Scout Moor, Rossendale, Lancashire: Desk-top Assessment.

Wheelhouse, P, 1996, Scotter Road, Messingham, South Humberside: Archaeological Evaluation.

Wheelhouse, P, 1996, Dale Lane Industrial Estate, South Elmsall, West Yorkshire: Archaeological Evaluation.

Fletcher, M, Keith, K and Wheelhouse, P, 1997, Foxcliffe Quarry, Byram-cum-Sutton, Brotherton, North Yorkshire: Desk-based Assessment.

Redhouse, D and Wheelhouse, P, 1997, M1-A1 Link Road Lofthouse to Bramham Area 7: Assessment.

Redhouse, D and Wheelhouse, P, 1997, M1-A1 Link Road Lofthouse to Bramham Area 3: Assessment.

Redhouse, D and Wheelhouse, P, 1997, M1-A1 Link Road Lofthouse to Bramham Area 22: Assessment.

Wheelhouse, P, 1997, Cooper Gallery, Church Street, Barnsley, South Yorkshire: Desk-based Assessment.

Wheelhouse, P, 1997, Outlane Golf Club, Outlane, Huddersfield, West Yorkshire: Archaeological Watching Brief.

Wheelhouse, P, 1997, Humberside International Airport, Kirmington, South Humberside: Archaeological Watching Brief.

Keith, K and Wheelhouse, P, 1998, Development between 99/107 Northgate, Wakefield, West Yorkshire: Desk-based Assessment.

Wheelhouse, P, 1998, Land at Cross Lane, Drighlington, West Yorkshire: Archaeological Assessment.

Fletcher, M and Wheelhouse, P, 1999, Rockingstones Quarry, Wholestone Moor, Outlane, Huddersfield: Archaeological Assessment.

Moloney, C, Holbrey, R, Wheelhouse, P et al, 1999, Catterick Racecourse, North Yorkshire.

Wheelhouse, P, 1999, Land at Cross Lane, Drighlington, West Yorkshire: Archaeological Test Pitting.

Wheelhouse, P, Whittingham, M and O'Neill, R, 2000, Grim's Ditch at Colton Mill, Colton, West Yorkshire: Topographic Survey.

Wheelhouse, P, 2001, Proposed Woodhead Opencast, Wombwell, South Yorkshire: Archaeological Test Pitting.

Roberts, I and Wheelhouse, P, 2002, Yorkshire Electricity Ferrybridge to Hook Moor A1 / M62 132kV, 66kV, and 33kV Diversions: Desk-based Assessment.

Wheelhouse, P, 2002, Land north of Cropton Road, Royston, South Yorkshire: Desk-based Assessment.

Plus the management and coordination of over 200 archaeological and cultural heritage projects.

Golder Associates Pty Ltd – Brisbane

Principal Biodiversity Consultant

Mervyn is a principal biodiversity consultant based in Golder's Brisbane office. He has over 20 years' experience in Australia and overseas, covering a broad range of ecological and biodiversity disciplines. Specific areas of practice include biodiversity impact assessment and management, socio-ecological systems and ecosystem services, ecological assessments, ecological risk assessment, wetland and riparian ecology, landscape ecology, ecological restoration, declining frog populations, biological indicators and statutory requirements. Mervyn also has extensive experience in environmental management (including: environmental impact assessment; management systems, plans and auditing; permitting and approvals).

Education

Dip Natural Resources, Spencer Institute of TAFE, 2002

Dip. Environmental Management, Spencer Institute of TAFE, 2002

M.Sc. Ecology , University of Port Elizabeth, 1997

B.Sc. Ecology (Honours), University of the Witwatersrand, 1994

B.Sc. (Ecology), University of the Witwatersrand, 1992

Certifications

RABQSA Environmental Auditor certificate number 13076, 2003

Certified Practitioner International Association of Public Participation, 2011

Certified Environmental Practitioner Cert0526, 2013

Certified Environmental Practitioner (Ecology Specialist) E20005, 2013

Languages

English – Fluent

Afrikaans – Fluent

Employment History

Golder Associates Pty Ltd – Brisbane, Australia

Principal Ecologist (2003 to Present)

Biodiversity Management - general biodiversity and ecological management, impact assessment, surveys and advice.
Environmental Management - EIAs, EMPs, EMSs, permitting and approvals, auditing.

Spencer Institute of TAFE – Port Lincoln, Australia

Lecturer Environmental and Natural Resource Management (2002 to 2003)

Teach environmental management and natural resource management, including Environmental Law. Offer professional assistance and advice with ecological surveys, revegetation plans.

Northern Territory University and Northern Territory Parks and Wildlife Commission – Darwin, Australia

Volunteer Field Biologist (1999 to 2000)

Assist and advise on research projects.

University of the Witwatersrand – Johannesburg, South Africa

Research Ecologist (1996 to 1999)

Conduct my own and departmental ecological research initiatives. Offer specialist advice on EIAs and management plans. Teach and supervise undergraduate and postgraduate students.

Mervyn Mason – South Africa

Ecological Consultant (part-time) (1994 to 1999)

Design, consult and offer professional advice on numerous EIAs and EMPs to the mining industry, and other private and government industries. Environmental awareness and education projects to the general public.

South African National Defence Force – Pretoria, South Africa

Environmental Officer (1993 to 1993)

Design and implement EMPs to minimise impacts of military training exercises.

PROJECT EXPERIENCE – BIODIVERSITY IMPACT ASSESSMENT AND MANAGEMENT

Confidential KwaZulu-Natal, South Africa	Technical lead. I am the technical lead for a biodiversity impact assessment for a proposed sand mining lease. The basis of the assessment is a cost-benefit analysis of the value of keeping the ecosystem for its biodiversity values, or mining it.
Confidential Uganda, Uganda	Technical lead. I and the co-ordinator and reviewer for all the biodiversity (terrestrial and aquatic) for an ESIA for a proposed oil development. This project is to IFC standards.
SMM Solomon - Solomon Islands Nickel Project Santa Isabel, Solomon Islands	Technical lead and reviewer. I was the co-ordinator and technical reviewer for all the biodiversity (terrestrial, aquatic and marine ecology) and soils and geology sections for the ESIA for a proposed nickel laterite mine. This project was to IFC standards.
OLTIN YO'L GTL - Gas to Liquids Project Uzbekistan , Uzbekistan	Technical lead and reviewer. I provided advice and technical review for the ecosystem services component update of the ESHIA for this project. Specifically, the ESHIA was updated to include an assessment of ecosystem services in line with the IFC's 2012 performance standards.
Archer Exploration - Campoona Hill South Australia, Australia	Technical lead. I led a team to undertake summer ecological surveys for a proposed graphite mine on the Eyre Peninsula. These studies were then used to undertake an ecological impact assessment for the overall impact assessment for the project's development.
Confidential Guinea, Guinea	Technical advisor. I undertook the impact assessment for the ecosystem services component of the ESIA for the Nimba Iron Project in Guinea. This involved providing direction to, and liaising with sub-consultants to gain sufficient baseline data to develop the impact assessment.
Confidential Gabon, Gabon	Technical lead. I undertook the assessment for the ecosystem services component of the baseline studies for Eramet's niobium and rare earth project in Gabon.
Confidential Malawi, Malawi	Technical lead and reviewer. I was the technical lead and provided technical review of biodiversity baseline studies for a proposed metaliferous mine in Malawi.
Local Government Infrastructure Services - Cook Shire Landfill Expansion Queensland, Australia	Technical lead. I undertook the biodiversity impact assessment for a proposed inert landfill for the Cook Shire on Cape York. This formed part of the overall development application for the project.
Public Transport Authority - Proposed Burswood Stadium Western Australia, Australia	Technical reviewer. I undertook the technical review of the flora and wetland surveys and impact assessment for the proposed Burswood Stadium in Perth.

Centrex Metals Limited - Sheep Hill Port
South Australia, Australia

Technical lead. I undertook the terrestrial biodiversity impact assessment for a proposed port site for Centrex Metals located on Eyre Peninsula. This formed part of the overall EIA for the project. The port site required stockpile areas and ship loading facilities for iron ore.

Covey Associates Pty Ltd - Yandina Hard Rock Quarry
Queensland, Australia

Project manager and technical lead. We undertook a targeted ecological impact assessment for a proposed hard rock quarry. The site potentially supports species listed under the federal Environment Protection and Biodiversity Act. Targeted surveys were conducted for these species as per federal government guidelines, following which a comprehensive impact assessment was completed.

Mount Compass Sand and Loam - Mount Compass
South Australia, Australia

Technical reviewer. I undertook the technical review of the flora and fauna survey, and accompanying ecological impact assessment for a proposed expansion of the sand mining operations at Mount Compass.

Yarrabah Aboriginal Shire Council - Yarrabah Landfill
Queensland, Australia

Technical reviewer. I provided the technical review of all the ecological survey and impact assessment studies for the proposed extension to the Yarrabah landfill in far north Queensland.

Exxaro Resources Limited - Belfast Coal Project
Mpumalanga, South Africa

Technical reviewer. I provided a technical review of the implementation guide for the identified wetland offset scenarios for the proposed Exxaro NBC Belfast Coal Project, Mpumalanga.

Department of Defence - Londonderry and Bringelly
New South Wales, Australia

Technical advisor. Fauna and flora assessment for a due diligence of Department of Defence properties.

Orica Australia Pty Ltd - Effluent release, Gladstone
Queensland, Australia

Technical lead. We undertook an ecotoxicological and condition assessment of a watercourse that was the site of a treated effluent release from a ruptured pipeline. The assessment involved assessment of soil and vegetation contaminant levels at various distances from the release site. These levels were assessed against vegetation health to form a baseline for ongoing monitoring of the site.

Maroochy Palm Holding Pty Ltd - Maroochy Palms
Queensland, Australia

Technical lead. We undertook and ecological impact assessment for a site that lies adjacent to a significant wetland. The site itself supports populations of threatened frogs.

Moreton Bay Regional Council - Moreton Bay
Queensland, Australia

Project manager and team lead. Developed a list of priority species in the Moreton Bay region. These included flora and fauna that were significant because of their threatened status or for other reasons. We developed a guidebook about the species, with a profile of each that presented useful information to guide residents, council employees and the like in regards to their conservation.

Sunshine Coast Regional Council - Roys Road Forestry Station Queensland, Australia	Technical lead. Conducted specialist surveys at the site, which supports potential habitat for 26 threatened species (state and federally-listed). This site also supports an arboretum containing 6 species of threatened New Caledonian Araucaria species. The surveys were used to inform the development intent of the site.
Sunshine Coast Regional Council - Caloundra Landfill Expansion Project Queensland, Australia	Project manager and technical lead. Conducted specialist frog surveys for the threatened Wallum Froglet (Crinia tinnula) in areas proposed for landfill expansion. Those surveys were used to inform the development of a species management programme for the site and an offset site.
Hunter Development Corporation - Kooragang Island Waste Emplacement Facility Rehabilitation New South Wales, Australia	Technical advisor for the development of a management plan for the endangered Green and Golden Bell Frog (Litoria aurea) population inhabiting this waste facility. Part of the management plan included the development of an action plan for a section of the site, which had high levels of contamination. The aim of the action plan was to determine at what point the site should be remediated if levels of contamination became detrimental to the community, and thus remediation would over-ride the saving of the frog population.
Department of Public Works - Kindergartens and Public Housing Queensland, Australia	Project manager and technical lead. Undertook assessment of various sites around south-east Queensland. For each site, I assessed its potential to support Koalas (Phascolarctus cinereus). From that assessment advice was provided and a management plan was developed to minimise impacts to Koalas during construction.
Department of Public Works - Badu Island Police Station Development Queensland, Australia	Project manager and technical advisor. Undertook a detailed survey to determine the population size and dynamics of the threatened grass Germainia capitata on the site of a proposed Police Station on Badu Island, Torres Strait. Those studies were used to develop a translocation management and monitoring plan for the grass.
Origin Energy - Kogan Gas Field Expansion Queensland, Australia	Project manager and technical lead. My team and I undertook a comprehensive ecological assessment of a proposed gas field expansion area.
Arrow Energy - Styx River coal seam gas exploration Queensland , Australia	Project manager and technical advisor. Undertook vegetation surveys of proposed exploration well pads and access tracks for regulatory compliance with the Queensland Nature Conservation Act and the federal
Arrow Energy - Moranbah Gas Project Queensland, Australia	Project manager and technical advisor. Undertook vegetation surveys of proposed exploration well pads and access tracks for regulatory compliance with the Queensland Nature Conservation Act and the federal
Department of Public Works - Redland Bay Hospital expansion Queensland, Australia	Project manager and technical lead. Undertook assessment of an area proposed for the expansion of the Redland Bay Hospital. The site formed part of a larger habitat corridor that supported a population of Koalas (Phascolarctus cinereus). From that assessment advice was provided and a management plan was developed to minimise impacts to Koalas during construction.

Department of Public Works - Sleeman Sports Complex Queensland, Australia	Project manager and technical lead. Undertook assessment of an area proposed for the expansion of the Sleeman Sports Complex. The site formed part of a larger habitat corridor that supported a population of Koalas (Phascolarctus cinereus). From that assessment advice was provided and a management plan was developed to minimise impacts to Koalas during construction. A comprehensive inventory of flora and fauna supported on the site was also completed.
Sunshine Coast Regional Council - Caloundra Landfill Queensland, Australia	Project manager and technical lead. Conducted detailed flora and fauna assessment for those areas proposed for landfill expansion. Completed a detailed biodiversity impact assessment required under the federal Environment Protection and Biodiversity Conservation Act 1999 to ascertain the magnitude of potential impacts on matters of national environmental significance.
Department of Public Works - Badu Island Police Station Queensland, Australia	Project manager and technical lead. Undertook a detailed flora and fauna survey on the site of a proposed Police Station on Badu Island, Torres Strait. These studies were completed to aid in a development application for the site.
Sunshine Coast Regional Council - Nambour Landfill Queensland, Australia	Project manager and technical lead. Undertook detailed flora and fauna surveys for a proposed landfill expansion. Those studies fed into a biodiversity impact assessment for the site. The site supported a population of the threatened Tusked Frog (Adelotus brevis). I developed a management plan for this population to minimise impacts from construction and operation of the landfill.
Arrow Energy - Dalby Queensland, Australia	Project manager and technical advisor. We assessed the potential impacts of irrigation on vegetation and soil using reverse osmosis-treated, coal seam gas water.
Namosi Joint Venture - Namosi Copper Project Viti Levu, Fiji	Technical advisor. I supervised and supported ecological baseline studies for the Namosi Joint Venture's Copper Project in Fiji to international standards.
University of the Witwatersrand - Blyde River Canyon Mpumalanga, South Africa	Project manager and principle researcher. I undertook research on the social behaviour of wild Hippopotamus (Hippopotamus amphibius) in the Blyde River Canyon. This isolated population was the study group used to attempt to understand Hippo behaviour for the purposes of managing Hippo and human interactions. Specifically, how to keep Hippos out of human crops.
Gonfaron Tortoise Research Facility Provence-Alpes-Côte d'Azur , France	Technical Assistant. I provided technical assistance in research projects for Greek Tortoises (Testudo graeca) and various freshwater tortoises inhabiting the French Riviera region of southern France.
SunWater - Cloncurry Pipeline Queensland, Australia	Project manager and technical lead. Undertook comprehensive, specialist fauna and flora surveys for the proposed Cloncurry pipeline route. These studies fed into an impact assessment and development application developed by my team. My team obtained all the required approvals and permits for the pipeline.
University of the Witwatersrand - Mtunzini KwaZulu-Natal, South Africa	Project manager and principle researcher. I undertook research over three seasons in an attempt to understand what variables, primarily climatic water chemistry, influence chorus attendance (inferred breeding success) by various frog species at an artificial pond. The aim of the research attempted to understand how climate change and pollutants could influence amphibian declines.

Penrice Quarry and Minerals - Angaston Quarry South Australia, Australia	Technical advisor. Undertook a detailed ecological assessment of proposed site for a waste rock dump at the quarry. This information was used to inform the development application.
Boral Construction Materials - Lobathol Quarry South Australia, Australia	Technical advisor. Undertook a detailed ecological assessment of proposed site for quarry expansion.
Australian Solomons Gold - Gold Ridge Mine Guadalcanal, Solomon Islands	Technical lead. I lead and undertook baseline ecological studies and the ecological impact assessment for a proposed hydropower scheme to supplement power at Gold Ridge mine.
Intex Resources - Mindoro Nickel Project Mindoro, Philippines	Technical advisor and field lead. I supervised and supported ecological baseline studies for the Mindoro Nickel Project in the Philippines to International standards.
Vale Inco Limited - Kalgoorlie Nickel Project Western Australia, Australia	Technical lead and field supervisor. Lead and conducted detailed Level 2 (a Western Australian standard), spring vertebrate fauna surveys for a proposed lateritic nickel deposit.
Continental Minerals - Xiongcun Copper Project Tibet, China	Technical advisor. Developed the biodiversity impact assessment to International Finance Corporation standards for proposed a copper mine in Tibet. The mine is on the Tibetan Plateau, an area of unique biodiversity.
Union Resource - Mehdiabad Zinc Project Mehdiabad, Iran	Technical lead. Provided expert assessment and review for an ESIA for the proposed Mehdiabad zinc mine. The mine is located in a protective area within Iran that supports populations of Cheetah (Acinonyx jubatus), Gazelle (Gazella spp.), Wild Sheep (Ovis orientalis), and Persian Ibex (Capra aegagrus). Impact minimisation strategies were designed to minimise potential impacts to wildlife as a result of the mine. The assessment included the impacts of dust on wildlife and impacts to water sources.
Mega Uranium - Ben Lomond uranium deposit Queensland, Australia	Technical lead and field supervisor. Lead and undertook detailed dry season fauna surveys of proposed uranium mine site.
Lagoon Creek Resources - Westmoreland uranium deposit Queensland / Northern Territory, Australia	Project manager and technical lead. Undertook a flora and fauna baseline study for the development of a proposed uranium deposit.
Origin Energy - Spring Gully Gas Field Queensland , Australia	Technical lead. I developed the Biodiversity Management Plan for the Spring Gully Gas Field. The management plan was a condition placed on origin by the regulator for the development of the gas field.

Auzex Resources - Kingsgate molybdenum deposit NSW, Australia	Project manager and technical lead. Conducted detailed baseline flora and fauna surveys for proposed molybdenum mine. These studies fed into the impact assessment for the project, which included the NSW legislative seven-part test.
OSD - Kogan power station gas pipeline Queensland, Australian	Project manager and technical lead. Lead and undertook comprehensive flora and fauna assessment for a proposed 70 km gas pipeline.
Covey and Associates - Maroochydore Caravan Park Queensland, Australia	Technical lead. Undertook an assessment of the values of habitat for frogs occurring on a proposed subdivision site. Advise on measures to preserve vegetation and habitat values.
Australand Development - Logan Queensland, Australia	Project manager and technical advisor. Undertook due diligence ecological assessment of potential residential subdivision.
SunWater - Monto Minerals water supply pipeline Queensland, Australia	Technical advisor and field lead. Undertook an assessment of the Regional Ecosystems and vegetation along the length of a proposed pipeline to supply the Monto Industrial Mineral Project.
Sunshine Coast Regional Council - Sunshine Coast Airport Queensland, Australia	Project manager and technical lead. Undertook detailed ecological assessment of a proposed extension to the Sunshine Coast Airport. These studies fed into an impact assessment and a referral to the federal government under the Environment Protection and Biodiversity Conservation Act 1999.
Incoll Management - Rainbow Beach Shores Stage 2 Queensland, Australia	Project manager and technical lead. Undertook detailed ecological assessments of a proposed extension to an existing holiday development. These assessments fed into an impact assessment and referral under the federal Environment Protection and Biodiversity Conservation Act 1999.
Maunsell Aecom - Collinsville rail regrade project Queensland, Australia	Project manager and technical lead. Provided expert faunal assessment of the route of a proposed regrading of a section of rail line between Collinsville and Bowen in Central Queensland.
Maunsell Aecom - Missing Link Rail Project Queensland, Australia	Project manager and technical lead. Provided expert faunal assessment of route of proposed Missing Link rail line between Newlands Mine and North Goonyella Mine. These studies fed into an impact assessment.
SunWater - Burdekin Pipeline Project Queensland, Australia	Technical advisor. Undertook vegetation and ecological assessments of a proposed water pipeline from the Gorge Weir on the Burdekin River to Moranbah 230 km to the south. The project involved ground truthing Regional Ecosystems and providing ecological advice to the planning of the route, Part of this project involved completing a referral under the federal Environment Protection and Biodiversity Conservation Act 1999.

Plan Consult Pty Ltd - Nambour and Maroochy River Queensland, Australia	Technical advisor. I developed vegetation management plans for new and existing developments. I also undertook surveys and mapped terrestrial and aquatic vegetation communities with the aim of developing long-term management plans and meeting legal requirements.
Noosa Shire Council - Ringtail Creek Quarry Queensland, Australia	Technical advisor. Undertook investigations to identify and minimise impacts to vegetation from a proposed extension to Ringtail Creek Quarry. These studies fed into a vegetation management plan for the site.
Department of Public Works - Rockhampton Riverfront Redevelopment Project Queensland, Australia	Project manager and technical lead. Undertook vegetation and ecological assessment of proposed new riverfront development along the Fitzroy River, Rockhampton.
Department of Public Works - Mary River Promenade Project Queensland, Australia	Project manager and technical lead. Undertook an assessment of the ecological values of the Mary River Promenade in relation to proposed new wharfs and public amenities. This was presented as an impact assessment.
Johannesburg Zoo - Artificial Wetland Project Johannesburg, South Africa, Australia	Technical advisor. I provided advice to the Johannesburg Zoo on the construction of an artificial wetland for the treatment and reuse of wastewater at the Johannesburg Zoo in South Africa.
Department of Public Works - Nambour Queensland, Australia	Project manager and technical lead. Undertook an assessment of the ecological values of vegetation occurring on a proposed construction site. I provided advice on measures to preserve vegetation and habitat values.
Xstrata - Koniambo Nickel Project Koniambo, New Caledonia	Technical advisor. I assisted in the development, design and costing for progressive mine revegetation and rehabilitation for the closure plan for the Koniambo Nickel Project.
Plan Consult - Maroochy River Queensland, Australia	Project manager and technical lead. I assessed an area of proposed development for threatened flora and fauna species and provide ecological advice. I mapped vegetation communities occurring on the site and provided advice in relation to relevant State and Federal Acts and Regulations governing fauna and flora issues.
Department of Public Works - Brisbane Queensland, Australia	Project manager and technical lead. I undertook an assessment of habitats for rare, threatened and vulnerable species and offered advice for management and any required mitigation measures for potential adverse affects on populations due to human activities. I assessed the ecological values of vegetation occurring on the proposed construction site.
Plan Consult Pty Ltd - Sunrise Road development Queensland, Australia	Technical lead. I undertook a comprehensive flora and fauna assessment of an area proposed for development. This also involved mapping of the vegetation communities occurring on the site, providing advice in relation to relevant State and Federal Acts and Regulations governing fauna and flora issues.

South Australian Parks and Wildlife Service - Lincoln National Park
South Australia, Australia

Technical advisor. I provided professional assistance and expertise for faunal surveys of Lincoln National Park and Coffin Bay National Park on the Lower Eyre Peninsula through the Department of Environment and Heritage, South Australia.

Charles Darwin University - Arnhem Land and Groote Eylandt
Northern Territory , Australia

Technical advisor. I assisted with investigating the impacts of harvests of nesting adult Green Turtles (Chelonia mydas) and their eggs by Aboriginal peoples in Arnhem Land and Groote Eylandt. Movement patterns of the turtles were also studied through placement of satellite transmitters on nesting females.

Northern Territory Parks and Wildlife Service - Crocodile surveys
Northern Territory, Australia

Technical assistant. I assisted in population surveys of Saltwater Crocodiles (Crocodylus porosus) in the Top End of Australia

Arthur Albertson Consulting - X!ung Bushmen Traditional Lands Mapping Project
Botswana

Technical advisor. I provided advice on the mapping of traditional territory boundaries for the different bushmen tribes in Botswana.

Gauteng Nature Conservation - Suikerbosrand Nature Reserve ecological survey
Gauteng, South Africa

Technical lead. I conducted an ecological survey of the Suikerbosrand Nature Reserve in South Africa. This project also involved teaching Nature Conservation staff biological survey techniques, particularly frogs.

University of Port Elizabeth - Blesbokspruit Wetland and Mine Leachate Project
Nigel, South Africa

Technical advisor. I assisted with preparing and conducting an ecological impact assessment of mine leachate on the fish and frog populations of this natural wetland in the highveld coalfields.

Endangered Wildlife Trust - Makuleke Tribal Land
Northern Province, South Africa

Technical advisor. I investigated and reported on different sustainable land-use alternatives for the Makuleke tribe of the northern Kruger National Park. These traditional owners of the far northern Kruger National Park had their lands returned to them after being forcibly removed in 1961. The project also involved developing and delivering environmental education materials to the tribe.

University of Cape Town Avian Demography Unit - South African Frog Atlas Project
South Africa

Technical advisor and lead. I was involved in the development, planning and running of the South African Frog Atlas Project. This project aimed to map the distribution of all frog species in the country using quarter-degree grid squares. The results of this project are important in the development and use of frogs as indicators of ecosystem health.

South African National Parks Board - Richtersveld National Park faunal survey Northern Cape, South Africa	Technical advisor and assistant. I assisted with conducting a detailed herpetological survey of the Richtersveld National Park in South Africa. This survey formed part of a larger priject lead by Villanova University in the USA.
University of Port Elizabeth - Mount Marlow Farm Eastern Cape Province, South Africa	Technical advisor. I formed part of an advisory team for assessing the opportunities for corporate development and environmental education on the farm Mount Marlow in the Cookhouse region of the Little Karroo.
Port Elizabeth Museum - St Georges Strand Casino Eastern Cape Province, South Africa	Technical assistant. I contributed to the EIA for a proposed casino development at St Georges Strand, Port Elizabeth.
Pretoria Portland Cement - Grassridge Limestone Quarry Eastern Cape Province, South Africa	Technical assistant and advisor. I contributed to the initial EIA for a proposed limestone mine at Grassridge in the Addo district of South Africa. Assisted in the design and development of a remediation strategy for areas already stripped of their limestone as well as future remediation work.
GENCOR - Coega Zinc Smelter Eastern Cape Province, South Africa	Technical assistant. I contributed to the EIA for GENCOR's proposed zinc-smelting plant at Coega and Driftsands, Port Elizabeth, South Africa
University of the Witwatersrand - Goodehoop Private Reserve Mpumalanga , South Africa	Technical assistant. I assisted in conducting an ecological survey of the Goodehoop Private Nature Reserve in South Africa.

PROJECT EXPERIENCE – ENVIRONMENTAL MANAGEMENT AND IMPACT ASSESSMENT

Confidential Port Moresby, Papua New Guinea	Technical advisor. I was part of a due dilligence team that assessed the potential for a port relocation project.
Papua New Guinea Sustainable Development Program - Oriomo Industrial Park Western Province, Papua New Guinea	Technical lead. I was the technical co-ordinator for environmental baseline studies within an area proposed for an industrial park development. The baseline studies included water quality and hydrology, ecology, soils and and marine ecology. The role involved the management and support of in-country sub-consultants,

SMM Solomon - Solomon Islands Nickel Project Santa Isabel, Solomon Islands	Technical lead. I am the co-ordinator and technical reviewer for all the biological (terrestrial, aquatic and marine ecology) and soils and geology sections for the ESIA for a proposed nickel laterite mine.
PNG SDP - Oriomo Industrial Park Development Western Province, Papua New Guinea	Technical lead. I performed the role of technical lead for the environmental components of the baseline studies for this project. This involved the supervision of subconsultants for the collection of ecological, soil and water baseline data.
Rio Tinto Coal - Riversdale Coal Project Tete, Mozambique	Technical Advisor. I was the primary client liason in Australia for RTC's Riversdale project ESIA. I also wrote the project description.
Gladstone Regional Council - Calliope Waste Water Treatment Plant Queensland, Australia	Technical reviewer. I undertook the technical review of the site-based management plan for the Calliope Waste Water Treatment Plant.
Department of Transport and Main Roads - Wallaman Falls Road Queensland, Australia	Technical reviewer. I undertook the technical review of the construction environmental management plan for the upgrade works on the Wallaman Falls Road in far north Queensland. The road is located within the Wet Tropics World Heritage Area. As such, particular management measures were required to no impact upon the world heritage values.
Brisbane City Council - Larapinta Sand Quarry Queensland, Australia	Project manager and technical advisor. My team and I undertook an environmental and geotechnical due diligence assessment of the Larapinta Sand Quarry site. BCC intended to purchase the site.
Caltex Australia Petroleum Pty Ltd - Aviation Refuelling Facilities Queensland, Australia	Technical advisor and reviewer. I provide ongoing technical advice and review of environmental management plans for Caltex's refuelling facilities located at various airports around the state.
Department of Public Works\QBuild - Carseldine Office Park Redevelopment Queensland, Australia	Project Manager. My team provided on-site, third-part environmental management oversight for the redevelopment of the Carseldine Office Precinct. This included developing, implementing and auditing the construction environmental management plan.
Department of Main Roads and Transport - Maranoa Bridge Replacement Queensland, Australia	Project Manager and Technical lead. My team and I undertook a comprehensive review of environmental factors for the proposed replacement of the Maranoa River bridge, located at Mitchell, central Queensland. The REF conformed to the DTMR's stringent requirements, and formed the basis of all permitting documentation.
Namosi Joint Venture - Namosi Copper Project Viti Levu, Fiji	Technical lead. I developed the terms of reference and project description for the Namosi Copper Project. These terms of reference and the project description formed the basis for the ESIA for the project to Fijian standards.

Redland City Council - Judy Holt Park remediation
Queensland, Australia

Technical lead. I developed a construction environmental management (CEMP) for the proposed remediation works for the Judy Holt Park. This site was a former landfill that was rehabilitated and developed into community sports facilities.

Morobe Mining Joint Venture - Hidden Valley Gold Mine
Papua New Guinea

Technical lead. We developed an options assessment for three preferred sites for tailings storage facilities for the mine's expansion. The assessment was undertaken using Golder's in-house multicriteria assessment tool, GoldSET.

Parker Drilling Inc. - Papua New Guinea
Papua New Guinea

Technical advisor - I advised on the site-specific environmental management requirements for the operation of drill rigs for Parker Drilling's operations in the oil and gas industry in Papua New Guinea.

Queensland Co-ordinator General/Brisbane City Council - Legacy Way Tunnel
Queensland, Australia

Lead Auditor. Undertook six-monthly audit of the construction of the Legacy Way tunnel. The audit was against the condition imposed on the project's construction, and operation, by the Co-ordinator General.

Lagoon Creek Resources - Westmoreland uranium deposit
Queensland, Australia

Project manager and technical lead. I undertook a regulatory review for a proposed uranium mine at Lagoon Creek, straddled the Queensland and Northern Territory border. The review included identification of all legislative requirements in both states.

CBH Sulphur Springs - Panaroma Copper-Zinc Project
Western Australia, Australia

Technical advisor. I assisted in the development and compilation of an EIA (public environmental report) for a proposed copper mine in the Pilbara region.

Union Resources - Mehdiabad Zinc Project
Mehdiabad, Iran

Technical advisor. I provided expert assessment and review for an ESIA for the proposed zinc mine.

Rio Tinto Comalco - South of the Embley Project
Queensland , Australia

Project manager and technical advisor. I managed the water management section for the EIA for the proposed expansion of bauxite mining. This integrated mine water requirements, ecological requirements and environmental flows.

Namosi Joint Venture - Namosi Copper Project
Viti Levu, Fiji

Technical advisor - Conceptual environmental managment plan and mine closure plan for the Namosi Joint Venture Project.

Hutchinson Builders - various sites
Queensland, Australia

Project manager and technical lead. We developed EMPs to comply with the Green Star rating system of the Green Building Council of Australia for various building projects around south east Queensland. We also developed an environmental management system for the company.

Continental Minerals - Xiongcun Copper Project
Tibet, China

Technical Lead. I developed a conceptual construction EMP and social management plan, as part of the ESIA for the proposed copper/gold mine in Tibet.

Australian Solomons Gold - Gold Ridge Gold Mine Guadalcanal, Solomon Islands	Technical lead and advisor. I was the senior review of the EMP for the recommissioning of the Gold Ridge Gold Mine. I also developed the EIA for the proposed run-of-river hydro-electric scheme designed to supplement the mine's power supply.
SunWater - Burdekin Pipeline Project Queensland, Australia	Technical advisor. I developed a construction EMP for the proposed new water pipeline from the Gorge Weir on the Burdekin River to Moranbah, 230 km to the south. Special consideration was made for endangered ecosystems traversed by the pipeline.
Ok Tedi Mining - Ok Tedi Ok Tedi, Papua New Guinea	Technical advisor. I was part of a team that reviewed and revised the Mine Closure Plan for the Ok Tedi mine, Western Province, Papua New Guinea. Specifically, we revised the Mine Area Rehabilitation Plan and advised on revegetation and rehabilitation measures.
SunWater - Gattonvale Off-stream Storage Queensland, Australia	Technical lead. I developed and wrote construction and operational EMPs for the Gattonvale Off-stream Storage adjacent to the Bowen Weir near Collinsville.
Xstrata - Koniambo Nickel Project Koniambo, New Caledonia	Technical assistant. I assisted in the development, design and costing for progressive mine revegetation and rehabilitation for the closure plan for the Koniambo Nickel Project.
South African National Defence Force - various South Africa	Technical lead. I developed EMPs for the South African National Defence Force at Louis Trichardt Airforce Base, Limpopo Valley, Pietersburg Bombing Range, Rooikop Radar Installation, Sishen Army Battle School and Vaalbank Engineers Training Terrain.

PROJECT EXPERIENCE – ENVIRONMENTAL MANAGEMENT AND ASSESSMENT

Powerlink - Collinsville substations Queensland, Australia	Project manager and technical advisor. I identified and assessed the environmental factors as per Step 1 of Powerlink's Environmental Assessment and Public Consultation Procedures for Designating Land for Community Infrastructure Manual, for the purposes of constructing two substations.
Ergon Energy - Collinsville Pumpstations Queensland, Australia	Project manager and technical lead. I undertook a review of existing environmental factors, relevant statutory approvals and impact assessment for the proposed 132 kV powerlines to supply the four pump stations for the Burdekin Pipeline. This project included stakeholder consultation and noise assessment.
Department of Environment and Resource Management - Wild Rivers of Cape York Queensland, Australia	Project manager and technical lead. I lead a team that reviewed of the status of Wild Rivers on the Cape York Peninsula in light of the Department of Environment and Resource Management's guidelines and Queensland's Wild Rivers legislation.

Mega Uranium - Ben Lomond uranium deposit Queensland, Australia	Technical advisor. I undertook a desktop review of all legislative requirements for a proposed uranium mine in northern Queensland.
Confidential New South Wales, Australia	Project manager and technical advisor. I was part of a due diligence assessment of a potential mine acquisition by a large bank.
SunWater - Moranbah Pipelines Queensland, Australia	Technical advisor. I undertook a review of existing environmental factors and relevant statutory approvals for the Eungella Pipeline eastern and southern extension, Moranbah. This project included ground truthing all mapped Regional Ecosystems occurring along the length of the proposed pipeline routes.
SunWater - Theodore New Start Project Queensland, Australia	Technical advisor. I undertook a review of existing environmental factors and relevant statutory approvals for the Theodore New Start Project. This project involved the re-alignment of irrigation canals. Work included ground truthing all mapped Regional Ecosystems occurring along the length of the proposed canal re-alignments and ring tanks.
BMI Group - Murarrie Landfill Queensland, Australia	Technical assistant. I undertook six monthly groundwater and surface water monitoring and analysis for contaminant movement at Murarrie Landfill. Monthly dust sampling and reporting. Report the finings of all monitoring in an Annual Review provided to the EPA for the landfill’s licence agreement. This has been an ongoing project since 2002.
SunWater - Gattonvale Off-stream Storage Facility Queensland, Australia	Technical advisor. I undertook a review of existing environmental factors and relevant statutory approvals for the Bowen Weir off stream storage facility. This project included ground truthing all mapped Regional Ecosystems occurring within the area of the proposed ring tank and pump station.
Department of Public Works - Mt Gravatt TAFE Campus Queensland, Australia	Technical advisor. I undertook a preliminary environmental assessment of the Mt Gravatt campus of the Moreton Institute of TAFE, Brisbane. This project included mapping and an assessment of the ecological values of the large tract of native vegetation occurring on the site.
Department of Public Works - Moreton Institute of TAFE Brisbane, Queensland, Australia	Technical advisor. I completed an environmental compliance audit of the Mt Gravatt campus of the Moreton Institute of TAFE, Brisbane in relation to all relevant environmental legislation.

PROJECT EXPERIENCE – APPROVALS AND PERMITTING

Gelita Australia Pty Ltd - Water supply dam, Beaudesert` Queensland, Australia	Project manager and technical lead. We undertook a review of environmental factors and impact assessment required for the permitting of a water storage for Gelita's gelatine factory. The REF had to satisfy local government requirements, as well as state and federal requirements.

QGC - Chinchilla Evaporation Ponds Queensland, Australia	Technical lead. My team developed the environmental sections for the regulatory submissions for the permitting of various evaporation ponds for QGC's coal seam gas fields.
SunWater - Cloncurry Pipeline Queensland, Australia	Project manager and technical lead. We identified, made applications for and obtained the necessary environmental approvals and permits for 40 km water pipeline
Sunshine Coast Regional Council - Sunshine Coast Aiport Maroochydore, Queensland, Australia	Project manager and technical lead. We prepared and submitted a referral, under the Environment Protection and Biodiversity Conservation Act 1999, for a proposed extension to the Singapore Flying School at Sunshine Coast Airport, Maroochydore.
SunWater - Monto Industrial Minerals water supply pipeline Queensland, Australia	Technical lead. We prepared and submitted a referral under the Environment Protection and Biodiversity Conservation Act for a proposed water pipeline to supply the Monto Industrial Mineral Project.
Sunwater - Burdekin Pipeline Project Queensland, Australia	Technical advisor. We identified, made applications for and obtained the necessary environmental approvals and permits for 230 km of water pipeline from Gorge Weir (Burdekin River) to Moranbah. Permits and approvals included: Environment Protection and Biodiversity Conservation Act 1999 referral; Vegetation Clearance; Development Applications for weir modifications; Other Development Applications; Sand Quarrying / extraction; Riverine Protection.
SunWater - Moranbah Pipeline Eastern Extensions Queensland, Australia	Technical advisor. I identified, made applications for and obtained the necessary environmental approvals and permits for 47 km of water pipeline from Moranbah to a point east near Coppabella Mine. Permits and approvals included: Vegetation Clearance; Sand Extraction; Riverine Protection.
Sunwater - Moranbah Pipeline Southern Extension Queensland, Australia	Technical advisor. I identified and undertake preliminary approval applications for 70 km of water pipeline from Moranbah to a point south near Vermont Coal Mine. Permits and approvals included: Environment Protection and Biodiversity Conservation Act 1999 referral; Riverine Protection.
Incoll Management - Rainbow Shores Stage 2 Queensland, Australia	Project manager and technical lead. Developed, presented and submitted a referral under the Environment Protection and Biodiversity Conservation Act 1999 for a development at Rainbow Beach.
Lagoon Creek Resources - Westmoreland Uranium Project Queensland, Australia	Project manager and technical lead. I identified and began the process of acquisition of all environmental permits and permissions required to start up a uranium mine at Lagoon Creek, northern Queensland.

PROFESSIONAL AFFILIATIONS

Member International Society of Ecological Economics

Member Ecosystem Services Partnership

Member International Association of Impact Assessment

Member Environmental Institute of Australia and New Zealand

Member Society for Conservation Biology

Member Ecological Society of Australia

PUBLICATIONS

Refereed Journal Articles

Conradie, W, WR Branch, H Braack and MC Mason. Notes on the diet of recently metamorphosed Giant African Bullfrogs (Anura: Pyxicephalidae: Pyxicephalus adspersus) and growth increase during the first nine months in a semi-natural habitat. *Herpetology Notes*, 3 (2010)

Mason, MC, GIH Kerley, CA Weatherby and WR Branch. Leopard and Angulate Tortoises in the Thicket Biome, Eastern Cape, South Africa: Populations and Biomass Estimates. *African Journal of Ecology*, 38 (2000)

Mason, MC, GIH Kerley, CA Weatherby and WR Branch. Leopard Tortoises (Geochelone Pardalis) in Valley Bushveld, Eastern Cape, South Africa: Specialist or Generalist Herbivores?. *Chelonian Conservation and Biology* , 3(3) (2000)

Mason, MC and NI Passmore. Hyperolius Tuberilinguis (Tinker Reed Frog): Oviposition. *Herpetological Review*, 29(4) (1999), 231-232.

Mason, MC and GJ Alexander. Oviposition Site Selection in Tetradactylus Africanus Africanus. *African Journal of Herpetology*, 45(1) (1996)

Mason, MC and GJ Alexander. Tetradactylus Africanus Africanus: Reproduction. *Journal of the Herpetological Association of Africa*, 42 (1992)

Books

St Clair-Hill, M, MC Mason and VC Carruthers. 1999. *Frogs of Gauteng and North-West Province: an interactive CD-ROM*. Johannesburg, Wildlife and Environment Society.

Harrison, JA, M (eds) Burger and MC Mason. 1998. *Tree Frogs and Reed Frogs. In: Frogs and Frog Atlasing in Southern Africa*. South Africa, University of Cape Town.

Mason, MC and VC Carruthers. 1998. *A Beginners Guide to the Frogs of Gauteng and North-West Province.* . South Africa, Wildlife and Environment Society of South Africa.

Conference Proceedings

Mason, MC, B Hart, M Mander and R Mitchell. 2013. *Many tools make light work*. IAIA 2013, May. Calgary , Canada.

Mason, MC, M Drury, R Mitchell and B Bourque. 2012. *Using a multi-criteria analysis approach to biodiversity and ecosystem services offset design and selection*. 5th Annual Ecosystem Services Partnership. Portland, Oregon, United States of America.

Kerley, GIH, MC Mason, CA Weatherby and WR Branch. 1999. *The Role of Tortoises in the Ticket Biome, South Africa: Important Mesoherbivores in a Mega-Herbivore Dominated Ecosystem*. The 1997-1998 Symposia, Desert Tortoise Council.

Mason, MC, PJ Bishop and NI Passmore. 1998. *Aspects of Chorus Attendance by Frogs at an Artificial Pond*. Herpetological Association of Africa Symposium. Stellenbosch, South Africa.

Mason, MC, GIH Kerley, CA Wetherby and WR Branch. 1998. *Tortoise Populations in Thicket Biome Dynamics: Overlooked Mesoherbivores?*. Herpetological Association of Africa Symposium. Stellenbosch, South Africa.

Wing, JET, N Pillay and MC Mason. 1998. *The Structure of Distress Calls of two Populations of the Striped Field Mouse, Rhabdomys Pumilio*. Southern African Zoological Society Conference. Durban, South Africa.

Kasl, B, MC Mason and NI Passmore. 1998. *The Effect of Male Size and Sociality on Waving Frequency in the Fiddler Crab, Uca Annulipes* . Southern African Zoological Society Conference. Durban, South Africa.

Kerley, GIH, MC Mason and CA Weatherby. 1998. *The Role of Tortoises in the Thicket Biome, South Africa: Ranging Behaviour, Diet and Seed Dispersal* . Desert Tortoise Council 23rd Annual Symposium. Tuscon, Arizona.

Giacoma, C, E Balleto, PJ Bishop, MC Mason and NI Passmore. 1996. *Demographics of a Population of Red Toads (Schismaderma Carens) at a Pond in South Africa*. Third African Amphibian Working Group. Bristol, United Kingdom.

Mason, MC, CA Weatherby and GIH Kerley. 1995. *Tortoises in a Sustainable Valley Bushveld System*. Grassland Society of southern Africa. Valley Bushveld Symposium. Grahamstown, South Africa.

Mason, MC, CA Weatherby and WR Branch. 1995. *Home Range in the Common Padloper (Homopus Areolatus)*. Herpetological Association of Africa Symposium . St Lucia, South Africa .

Weatherby, CA, MC Mason and WR Branch. 1995. *Geochelone Pardalis in South African Valley Bushveld: Home Range, Movement Patterns and Site Fidelity*. Herpetological Association of Africa Symposium. St Lucia, South Africa.

Mason, MC and GJ Alexander. 1995. *Oviposition Site Selection in Tetradactylus Africanus Africanus (Sauria, Gerrhosauridae)*. Herpetological Association of Africa Symposium. St Lucia, South Africa.

Weatherby, CA, MC Mason, WR Branch and GIH Kerley. 1995. *Home Range and Movements of Geochelone Pardalis in the Eastern Cape, South Africa*. International Conference on Chelonian Conservation. Gonfaron, France.

Mason, MC, CA Weatherby and WR Branch. 1995. *Does Dietary Selection Influence Habitat Utilisation in the Leopard Tortoise? Implications for Conservation*. International Conference on Chelonian Conservation. Gonfaron, France.

Mason, MC, CA Weatherby and GIH Kerley. 1995. *Dietary Selection in the Leopard Tortoise (Geochelone Pardalis) and Effects on Habitat Utilisation*. Southern African Zoological Society Conference. Grahamstown, South Africa.

Mason, MC. 1993. *The Role of the South African Defence Force in Reptile and Amphibian Conservation*. Herpetological Association of Africa Symposium. Pretoria, South Africa.

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NEMA/TOR/5/2/......15,154............................ *Date*....15/3/2016........................

....TULLOW KENYA B.V................................

....P.O BOX 63298 – 00619........................

....NAIROBI...

....

RE: ACKNOWLEDGEMENT AND APPROVAL OF TERMS OF REFERENCE (TOR) FOR THE ENVIRONMENTAL IMPACT ASSESSMENT

We acknowledge the receipt of the TOR for the above subject.

Pursuant to the Environmental Management and Coordination Act, 1999 the second schedule and the Environmental (Impact Assessment and Audit) Regulations 31 and 35, your terms of reference for the Environmental Impact Assessment (EIA) for the proposed....SOUTH LOKICHAR UPSTREAM DEVELOPMENT PROJECT... SOUTH LOKICHAR, NORTH EAST TURKANA COUNTY.. have been approved.

You shall submit five (5) copies and one electronic copy of your report prepared by a registered expert to the Authority. EIA licence fee 0.1% of the total project cost) shall be paid to **NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY REVENUE ACCOUNT – AC NO: 1102298158, KCB KICC BRANCH** on submission of the report.

FRANCIS CHWANYA
EIA SECTION HEAD

ANNEX I

Project Standards

B

REPORT

Foundation Stage of the South Lokichar Development for Upstream Oil Production in South Lokichar Environmental and Social Impact Assessment (ESIA)

Project Standards

Submitted to:

Tullow Kenya B.V.

Submitted by:

Golder Associates (UK) Ltd

Cavendish House, Bourne End Business Park, Cores End Road,
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May 2020

Distribution List

Tullow Kenya B.V. - 1 copy pdf

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Table of Contents

TABLES

1.0 INTRODUCTION

This section of the ESIA presents the proposed Project Standards. These are used for the preparation of the baseline reports and are included as part of the impact assessment criteria of the ESIA.

The ESIA project standards were selected by reviewing international and national guideline values. The international standards make reference to the institutions and guidelines produces by the lead international agencies and worldwide institutions such as IFC, WHO, USEPA, and UK Environment Agency (EA) guidelines.

A list of national and international guidelines that are relevant to the ESIA have been provided as part of the Legal and Institutional Framework section, this subsection make reference to the values provided in those guidelines. Where National standards are absent or are not appropriate, Golder's approach has been to refer to other internationally recognised guidelines for reference.

2.0 AIR QUALITY

2.1 Ambient Air Quality

Ambient air quality should meet national or local standards. Where these are absent or international guidelines are more stringent, alternative indicative guideline values are considered appropriate.

Table 1: Ambient Air Quality

Parameter	Average	Applicable International Standard a)	Kenyan Standard b		Project Standard
			At boundary	Off-Site (rural)	
Sulphur Dioxide (SO_2)	Annual mean	-	50 μg/m^3 (c)	50 μg/m^3 (c)	50 μg/m^3 (c)
	24-hour mean	20 μg/m^3	125 μg/m^3 (c)	80 μg/m^3 (c)	20 μg/m^3
	10-minute mean	500 μg/m^3	-		500 μg/m^3
Nitrogen Dioxide (NO_2)	Annual mean	40 μg/m^3	-	0.05 ppm (94 μg/m^3)	40 μg/m^3
	24-hour mean	-	-	0.1 ppm (188 μg/m^3)	0.1 ppm (188 μg/m^3)
	1-hour mean	200 μg/m^3	-	0.2 ppm (376 μg/m^3)	200 μg/m^3
Nitrogen Oxides (NO_x)	Annual mean	-	80 μg/m^3	60 μg/m^3	60 μg/m^3
	24-hour mean	-	150 μg/m^3	80 μg/m^3	80 μg/m^3
Total Particulate Matter (TPM)	Annual mean	-	-	140 μg/m^3	140 μg/m^3
	24-hour mean	-	-	200 μg/m^3	200 μg/m^3
Particulate Matter (PM_{10})	Annual mean	20 μg/m^3 (guideline) 70 μg/m^3 Interim Target 1(d) 50 μg/m^3 Interim Target 2(d) 30 μg/m^3 Interim	50 μg/m^3	50 μg/m^3	20 μg/m^3

Parameter	Average	Applicable International Standard a)	Kenyan Standard b		Project Standard
			At boundary	Off-Site (rural)	
		Target 3(d)			
	24-hour mean	50 µg/m³ (guideline) 150 µg/m³ Interim Target 1(d) 100 µg/m³ Interim Target 2(d) 75 µg/m³ Interim Target 3(d)	70 µg/m³	100 µg/m³	50 µg/m³
Particulate Matter ($PM_{2.5}$)	Annual mean	10 µg/m³ (guideline) 35 µg/m³ Interim Target 1(d) 25 µg/m³ Interim Target 2(d) 15 µg/m³ Interim Target 3(d)	35 µg/m³		10 µg/m³
	24-hour mean	25 µg/m³ (guideline) 75 µg/m³ Interim Target 1(d) 50 µg/m³ Interim Target 2(d) 37.5 µg/m³ Interim Target 3(d)	75 µg/m³		25 µg/m³
Ozone (O_3)	8-hour mean	100 µg/m³	120 µg/m³	1.25 ppm (2,450 µg/m³, instant peak)	100 µg/m³
	1-hour mean	-	200 µg/m³	0.12 ppm (235 µg/m³)	0.12 ppm (235 µg/m³)
Carbon monoxide (CO)/Carbon Dioxide (CO_2)	8-hour mean	-	5 mg/m³	2.0 mg/m³	2.0 mg/m³
	1-hour mean	-	10 mg/m³	4.0 mg/m³	4.0 mg/m³
Lead (Pb)	Annual mean	-	0.5- 2.0 µg/m³	0.75 µg/m³	0.75 µg/m³
	24-hour mean	-	0.5- 2.0 µg/m³	1.00 µg/m³	1.00 µg/m3

(a) WBG IFC (2007). EHS Guideline: Air Emissions and Ambient Air Quality / WHO, 2005. Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines.

(b) Kenyan Government, 2014. The Environmental Management and Co-ordination (Air Quality) Regulations, 2014.

(c) Standards for Sulphur Oxides (SOx) but will be considered as SO2.

(d) IFC Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

2.2 Emissions to Air

Ambient air quality should meet national or local standards. Where these are absent or international guidelines are more stringent, alternative indicative guideline values are considered appropriate.

Table 2: Emissions to Air from Small Combustion Facilities (Engine 3 to 50 MWth with Liquid Fuels)

Parameter	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Particulate Matter (PM10)	50 mg/Nm^3 or up to 100 if justified by environmental assessment	50 mg/Nm^3	50 mg/Nm^3
Sulphur Dioxide (SO2)	1.5% to 3% Sulphur if justified by project specific considerations	1.5% - 3% Sulphur fuel	1.5% Sulphur
Nitrogen Oxides (NOx)	Bore size diameter (mm) <400: 1,460 mg/Nm^3 (or up to 1,600 if justified to maintain high energy efficiency) Bore size diameter (mm) >400: 1,850 mg/Nm^3	Bore size diameter (mm) <400: 1,460 mg/Nm^3 (or up to 1,600 if justified to maintain high energy efficiency) Bore size diameter (mm) >400: 1,850 mg/Nm^3	1,600 mg/Nm^3
Dry Gas, Excess O2 Content (%)	15%	-	15%

(a) WBG IFC (2007). EHS Guideline: Air Emissions and Ambient Air Quality / WHO, 2005. Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines.

(b) Kenyan Government (2014). The Environmental Management and Co-ordination (Air Quality) Regulations, 2014.

Table 3: Emissions to Air from Small Combustion Facilities (Turbine 15 to 50 MWth with Natural Gas)

Parameter	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Particulate Matter (PM10)	N/A	N/A	N/A
Sulphur Dioxide (SO2)	N/A	N/A	N/A
Nitrogen Oxides (NOx)	25 ppm	25 ppm	25 ppm
Dry Gas, Excess O2 Content (%)	15%		15%

(a) WBG IFC (2007). EHS Guideline: Air Emissions and Ambient Air Quality / WHO, 2005. Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines.

(b) Kenyan Government (2014). The Environmental Management and Co-ordination (Air Quality) Regulations, 2014.

(c) Emissions Guidelines for a Non- Degraded Airshed

Table 4: Emissions Guidelines for Combustion Turbines (Natural Gas >50MWth)

Parameter	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Particulate Matter (PM10)	N/A	N/A	50 mg/Nm^3
Sulphur Dioxide (SO2)	N/A	N/A	1.5% Sulphur
Nitrogen Oxides (NOx)	51 ppm[(c)]	51 ppm[(c)]	1,600 mg/Nm^3
Dry Gas, Excess O2 Content (%)	15%	15%	15%

(a) WBG IFC (2007). EHS Guideline: Thermal Power Plants.
(b) Kenyan Government (2014). The Environmental Management and Co-ordination (Air Quality) Regulations, 2014; and
(c) Emissions Guidelines for a Non- Degraded Airshed

Table 5: Emissions Guidelines for Incinerators (Municipal Solid Waste)

Parameter	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Particulate Matter (PM10)	-	100 mg/Nm^3	100 mg/Nm^3
Sulphur Dioxide (SO2)	N/A	N/A	NA
Nitrogen Oxides (NOx)	N/A	300 mg/Nm^3	300 mg/Nm^3
Dry Gas, Excess O2 Content (%)	N/A	15%	15%

Table 6: Emissions Guidelines for Incinerators (Medical Waste)

Parameter	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Particulate Matter (PM2.5)	N/A	20 mg/Nm^3	20 mg/Nm^3
Sulphur Dioxide (SO2)	N/A	500 mg/Nm^3	500 mg/Nm^3
Nitrogen Oxides (NOx)	N/A	300 mg/Nm^3	300 mg/Nm^3
Dry Gas, Excess O2 Content (%)	15%	15%	15%

a) IFC, 2007. EHS Guideline: Air Emissions and Ambient Air Quality.
b) Kenyan Government, 2014. The Environmental Management and Co-ordination (Air Quality) Regulations, 2014.

2.3 References

- Kenyan Government, 2014. The Environmental Management and Co-ordination (Air Quality) Regulations, 2014.
- World Bank Group General EHS Guidelines. 2007. Environmental, Health and Safety (EHS) Guidelines - Air Emissions and Ambient Air Quality
- WHO (World Health Organization). 2005. Air Quality Guidelines – Global Update 2005.

3.0 NOISE AND VIBRATION

3.1 Noise

Golder carried out a review of the IFC Noise Guideline and Kenya Noise Regulations, recommending the use of the IFC Noise Guideline for Project operation (Golder tech memo 1654017.511). This was subsequently confirmed with NEMA in a minuted meeting that the IFC Noise Guideline could be used as Project standards for the Upstream EOPS Phase II ESIA and has been adopted for the ESIA also. The IFC Noise Guideline does not provide construction noise level limits and therefore the approach is to use construction limits provided in the Kenya Noise Regulations.

Table 7: Noise Standards Relevant to the ESIA

Receptor Classification	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Residential, Institutionaland Educational Receptors	■ Daytime (7:00 to 22:00): ▪ 55 dBA $L_{eq,1hr}$ ■ Night-time (22:00 to 7:00): ▪ 45 dBA $L_{eq,1hr}$ Noise impacts should not exceed the levels presented above or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.	■ Residential (indoor): ▪ Daytime (06:00 to 20:00): – 45 dBA L_{eq},14hr ▪ Nighttime (20:00 to 06:00): – 35 dBA L_{eq},10hr ■ Residential (outdoor): ▪ Daytime (06:00 to 20:00): – 50 dBA L_{eq},14hr ▪ Nighttime (20:00 to 06:00): – 35 dBA L_{eq},10hr	■ Residential (outdoor): ▪ Daytime (07:00 to 22:00): – 55 dBA L_{eq},1hr ■ Residential (outdoor): ▪ Nighttime (22:00 to 07:00): – 45 dBA L_{eq},1hr ▪ Nighttime (20:00 to 06:00): – 35 dBA L_{eq},10hr ■ OR exceed 3 dB increase over background levels at nearest receptor location off-site

Receptor Classification	Applicable International Standard [a]	Kenyan Standard [b]	Project Standard
Construction Sites – Residential	-	■ Daytime (06:00 to 18:00): ▪ 60 dBA L_{eq},12hr ■ Nighttime (18:00 to 06:00): ▪ 35 dBA L_{eq},12hr	■ Daytime (06:00 to 18:00): ▪ 60 dBA $L_{eq,}$ 12hr ■ Nighttime (18:00 to 06:00): ▪ 35 dBA L_{eq},12hr
Construction Sites – Other	-	■ Daytime (06:00 to 18:00): ▪ 75 dBA L_{eq},12hr ■ Nighttime (18:00 to 06:00): ▪ 65 dBA L_{eq},12hr	■ Daytime (06:00 to 18:00): ▪ 75 dBA L_{eq},12hr ■ Nighttime (18:00 to 06:00): ▪ 65 dBA L_{eq},12hr

(a) IFC, 2007. EHS Guidelines: Environmental – Noise.
(b) Kenyan Government, 2009. The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Regulations.

3.2 Vibrations

In the absence of detailed Kenyan standards for vibration an alternative international equivalent has been chosen and presented in Table 6.

Table 8: Vibration Standards

<table>
<tr><th>Receptor Classification</th><th colspan="4">Applicable International Standard [a] [b]</th><th>Kenyan Standard [c]</th><th colspan="2">Project Standard</th></tr>
<tr><td>Unreinforced or light- framed structures</td><td colspan="4">British Standard BS5228-2:2009
PPV in frequency range of predominant pulse – transient vibration guide values for cosmetic damage.</td><td rowspan="2">5 mm/s beyond any source property boundary</td><td colspan="2">PPV in frequency range of predominant pulse.</td></tr>
<tr><td>Residential or light commercial buildings</td><td colspan="2">4 Hz to 15 Hz
15 mm/s at 4 Hz and above, increasing to 20 mm/s at 15 Hz.</td><td colspan="2">15 Hz and above
20 mm/s at 15 Hz, increasing to 50 mm/s at 40 Hz and above.</td><td>4 Hz to 15 Hz
15 mm/s at 4 Hz and above, increasing to 20 mm/s at 15 Hz.</td><td>15 Hz and above 20 mm/s at 15 Hz
increasing to 50 mm/s at 40 Hz and above.</td></tr>
<tr><td rowspan="4">Continuous ground-borne vibration; people in residential buildings</td><td colspan="4">BS.6472:2008 Evaluation of human exposure to vibration in buildings [1 Hz to 80 Hz].
Vibration dose values [$m/s^{1.75}$] above which various degrees of adverse comment may be expected in residential buildings.</td><td rowspan="4">-</td><td colspan="2" rowspan="2">Daytime (06:00 – 22:00) 0.6 $m/s^{1.75}$</td></tr>
<tr><td>Period</td><td>Low probability of adverse comment</td><td>Adverse comment possible</td><td>Adverse comment probable</td></tr>
<tr><td>Daytime, 16hr</td><td>0.2 – 0.4</td><td>0.4 – 0.8</td><td>0.8 – 1.6</td><td colspan="2" rowspan="2">Night-time (22:00 – 06:00) 0.3 $m/s^{1.75}$</td></tr>
<tr><td>Night-time, 8hr</td><td>0.1 – 0.2</td><td>0.2 – 0.4</td><td>0.4 – 0.8</td></tr>
</table>

(a) British Standards Institution, 2008. BS 5228-2:2009+A1:2014 - Code of practice for noise and vibration control on construction and open sites. Vibration Noise. 2014 revision. London, United Kingdom
(b) British Standards Institution, 2008. BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting London, United Kingdom
(c) NEMA Noise and Excessive Vibration Pollution (2009).

3.3 References

- British Standards Institution, 1993. BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration London, United Kingdom.
- British Standards Institution, 2008. BS 5228-2:2009+A1:2014 - Code of practice for noise and vibration control on construction and open sites. Vibration Noise. 2014 revision. London, United Kingdom.
- British Standards Institution, 2008. BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting London, United Kingdom.
- Health and Safety Executive, 2005. Control of Vibration at Work Regulations 2005 United Kingdom. IFC, 2007. EHS Guidelines: Environmental – Noise.
- Kenyan Government, 2009. The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Regulations.
- World Bank Group General EHS Guidelines. 2007. Environmental, Health and Safety (EHS) Guidelines Occupational Health and Safety.

4.0 DISCHARGES/ABSTRACTIONS FROM WATER

4.1 Effluent Discharge Standards to Surface Water

Sewage from an industrial facility should only be discharged to surface water is it meets national or local standards for sanitary wastewater discharges. Where national or local standards are absent or are not appropriate, alternative indicative guideline values provided in Table 7 are considered applicable to sanitary wastewater discharges.

Table 9: Effluent Discharge Standards to the Environment

Parameter	Applicable International Standard [a b]	Kenyan Standard [b]	Project Standard
1,1,1-trichloroethane	-	3 mg/l	3 mg/l
1,1,2-trichloethane	-	0.06 mg/l	0.06 mg/l
1,1-dichloroethylene	-	0.2 mg/l	0.2 mg/l
1,2-dichloroethane	-	0.04 mg/l	0.04 mg/l
1,3-dichloropropene	-	0.02 mg/l	0.02 mg/l
Alkyl Mercury compounds	-	Not Detectible	Not Detectible
Ammonia, ammonium compounds, NO_3 compounds and NO_2 compounds (Sum total of ammonia-N times 4 plus nitrate-N & Nitrite-N)	-	100 mg/l	100 mg/l
Arsenic	-	0.02 mg/l	0.02 mg/l
Arsenic and its compounds	-	0.1 mg/l	0.1 mg/l
Benzene	-	0.1 mg/l	0.1 mg/l
Biochemical Oxygen Demand (BOD_5)	25 mg/l [c]	30 mg/l	25 mg/l
Boron	-	1.0 mg/l	1.0 mg/l
Boron and its compounds – non marine	-	10 mg/l	10 mg/l
Boron and its compounds – marine	-	30 mg/l	30 mg/l
Cadmium	-	0.01 mg/l	0.01 mg/l
Cadmium and its compounds	-	0.1 mg/l	0.1 mg/l
Carbon tetrachloride	-	0.02 mg/l	0.02 mg/l

Parameter	Applicable International Standard [a] [b]	Kenyan Standard [b]	Project Standard
Chemical Oxygen Demand (COD)	125 mg/l [a]	50 mg/l	50 mg/l
Chromium VI	-	0.05 mg/l	0.05 mg/l
Chloride	-	250 mg/l	250 mg/l
Chlorine free residue	-	0.10 mg/l	0.10 mg/l
Chromium total	-	2 mg/l	2 mg/l
Cis-1,2- dichloroethylene	-	0.4 mg/l	0.4 mg/l
Copper	-	1.0 mg/l	1.0 mg/l
Dichloromethane	-	0.2 mg/l	0.2 mg/l
Dissolved iron	-	10 mg/l	10 mg/l
Dissolved Manganese	-	10 mg/l	10 mg/l
E.coli	-	Nil Counts / 100 ml	Nil Counts / 100 ml
Fluoride	-	1.5 mg/l	1.5 mg/l
Fluoride and its compounds (marine and non-marine)	-	8 mg/l	8 mg/l
Lead	-	0.01 mg/l	0.01 mg/l
Lead and its compounds	-	0.1 mg/l	0.1 mg/l
n-Hexane extracts (animal and vegetable fats)	-	30 mg/l	30 mg/l
n-Hexane extracts (mineral oil)	-	5 mg/l	5 mg/l
Oil and grease	10 mg/l [a]	Nil	Nil

Parameter	Applicable International Standard [a] [b]	Kenyan Standard [b]	Project Standard
Organo-Phosphorus compounds (parathion, methyl parathion, methyl demeton and Ethyl parantrophenyl phenylphosphorothroate, EPN only)	-	1.0 mg/l	1.0 mg/l
Polychlorinated biphenyls, PCBs	-	0.003 mg/l	0.003 mg/l
pH (Hydrogen ion activity----marine)	6 – 9 (general) [a]	5.0-9.0	5.0-9.0
pH (Hydrogen ion activity--non marine)	6 – 9 (general) [a]	6.5-8.5	6.5-8.5
Phenols	-	0.001 mg/l	0.001 mg/l
Selenium	-	0.01 mg/l	0.01 mg/l
Selenium and its compounds	-	0.1 mg/l	0.1 mg/l
Hexavalent Chromium VI compounds	-	0.5 mg/l	0.5 mg/l
Sulphide	-	0.1 mg/l	0.1 mg/l
Simazine	-	0.03 mg/l	0.03 mg/l
Total Suspended Solids	35 mg/l [c]	30 mg/l	30 mg/l
Tetrachloroethylene	-	0.1 mg/l	0.1 mg/l
Thiobencarb	-	0.1 mg/l	0.1 mg/l
Temperature (in degrees Celsius) based on ambient temperature	-	± 3 degrees Celsius	± 3 degrees Celsius
Thiram	-	0.06 mg/l	0.06 mg/l
Total coliforms	400 (MPN per 100 ml) [a]	30 counts /100 ml	30 counts /100 ml
Total Cyanogen	-	ND	ND

Parameter	Applicable International Standard a b	Kenyan Standard b	Project Standard
Total Nickel	-	0.3 mg/l	0.3 mg/l
Total Dissolved solids	-	1200 mg/l	1200 mg/l
Colour in Hazen Units	-	15 HU	15 HU
Detergents	-	Nil	Nil
Total mercury	-	0.005 mg/l	0.005 mg/l
Trichloroethylene	-	0.3 mg/l	0.3 mg/l
Zinc	-	0.5 mg/l	0.5 mg/l
Total Phosphorus	2 mg/l a	2 mg/l (Guideline value)	2 mg/l
Total Nitrogen	10 mg/l a	2 mg/l (Guideline value)	2 mg/l

(a) International Finance Corporation. EHS Guidelines: Environmental 2007.
(b) Kenyan Government, 2006. The EMCA (Water Quality) Regulations (2006) Schedule 3: Standards for Effluent Discharge into the Environment.
(c) IFC EHS Guidelines for Onshore Oil and Gas Developments 2017.

4.2 Drinking Water Quality

Drinking or potable water should meet national or local standards. Where these are absent or are not appropriate, alternative indicative guideline values provided in Table 8 are considered applicable.

Table 10: Drinking Water Quality Standards

Parameter	Applicable International Standard [a b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Units (unless otherwise stated)	**µg/l**	**mg/l**	**mg/l**	
Acrylamide	0.5	-	-	0.5 µg/l
Alachlor	20	-	-	20 µg/l
Aldicarb	10	-	-	10 µg/l
Aldrin and dieldrin	0.03	-	0.00003	0.00003 mg/l
Aluminium	-	-	0.2	0.2 mg/l
Antimony	20	-	-	20 µg/l
Arsenic	10 (A,T)	0.01	0.01	0.01 mg/l
Atrazine and its chloro- striazine metabolites	100	-	-	100 µg/l
Barium	700	-	0.7	0.7 mg/l
Benzene	10	-	0.01	0.01 mg/l
Benzo[a]pyrene	0.7	-	-	0.7 µg/l
Boron	2400	-	2.4	2.4400 mg/l
Bromate	10 (A,T)	-	0.01	0.01 mg/l
Bromodichloromethane	60	-	-	60 µg/l
Bromoform	100	-	-	100 µg/l
Cadmium	3	0.01	0.003	0.003 mg/l
Carbofuran	7	-	-	7 µg/l
Carbon tetrachloride	4	-	0.002	0.002 mg/l
Chlorate	700 (D)	-	-	700 µg/l (D)
Chlordane	0.2	-	0.0003	0.0003 mg/l
Chlorine	5000 (C)	-	-	5000 µg/l (C)
Residual Chlorine	-	-	Absent	Absent

Parameter	Applicable International Standard [a b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Chlorite	700 (D)	-	-	700 µg/l (D)
Chloroform	300	-	0.03	0.03 mg/l
Chlorotoluron	30	-	-	30 µg/l
Chlorpyrifos	30	-	-	30 µg/l
Chromium (total)	50 (P)	-	0.05	0.05 mg/l
Copper	2000	0.05	1	0.05 mg/l
Cyanazine	0.6	-	-	0.6 µg/l
Cyanide	-	-	0.01	0.01 mg/l
2,4-D	30	-	-	30 µg/l
2,4-DB	90	-	-	90 µg/l
DDT and metabolites	1	-	0.001	0.001 mg/l
Dibromoacetonitrile	70	-	-	70 µg/l
Dibromochloromethane	100	-	-	100 µg/l
1,2-Dibromo-3- chloropropane	1	-	-	1 µg/l
1,2-Dibromoethane	0.4 (P)	-	-	0.4 µg/l (P)
Dichloroacetate	50 (D)	-	-	50 µg/l (D)
Dichloroacetonitrile	20 (P)	-	-	20 µg/l (P)
1,2-Dichlorobenzene	1000 (C)	-	-	1000 µg/l (C)
1,4-Dichlorobenzene	300 (C)	-	-	300 µg/l (C)
1,2-Dichloroethane	30	-	0.03	0.033 mg/l
1,1-Dichloroethene	-	-	0.03	0.03 mg/l
1,2-Dichloroethene	50	-	-	50 µg/l
1,1-Dichloroethylene	-	-	0.0003	0.0003 mg/l
Dichloromethane	20	-	-	20 µg/l
2,4-Dichlorophenoxyacetic acid	-	-	0.03	0.03 mg/l
1,2-Dichloropropane	40 (P)	-	-	40 µg/l (P)

Parameter	Applicable International Standard [a b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
1,3-Dichloropropene	20	-	-	20 µg/l
Dichlorprop	100	-	-	100 µg/l
Di(2-ethylhexyl) phthalate	8	-	-	8 µg/l
Dimethoate	6	-	-	6 µg/l
1,4-Dioxane	50	-	-	50 µg/l
Edetic acid	600	-	-	600 µg/l
Endrin	0.6	-	-	0.6 µg/l
Epichlorohydrin	0.4 (P)	-	-	0.4 µg/l (P)
Ethylbenzene	300 (C)	-	-	300 µg/l (C)
Fenoprop	9	-	-	9 µg/l
Fluoride	1500	1.5	1.5	1.5 mg/l
Heptachlor and Heptachlor Epoxide	-	-	0.00003	0.00003 mg/l
Hexachlorobenzene	-	-	0.001	0.001 mg/l
Hexachlorobutadiene	0.6	-	-	0.6 µg/l
Hydroxyatrazine	200	-	-	200 µg/l
Isoproturon	9	-	-	9 µg/l
Lead	10 (A,T)	0.05	0.01	0.01 mg/l
Lindane	2	-	0.002	0.002 mg/l
MCPA	2	-	-	2 µg/l
Mecoprop	10	-	-	10 µg/l
Mercury (total)	6	-	0.001	0.001 mg/l
Methoxychlor	20	-	0.02	0.02 mg/l
Metolachlor	10	-	-	10 µg/l
Microcystin-LR	1 (P)	-	-	1 µg/l (P)
Molinate	6	-	-	6 µg/l
Molybdenum	-	-	0.07	0.07 mg/l

Parameter	Applicable International Standard [a b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Monochloramine	3000	-	-	3000 µg/l
Monochloroacetate	20	-	-	20 µg/l
Nickel	70	-	0.02	0.02 mg/l
Nitrate as NO_3	50000	10	45	10 mg/l
Nitrilotriacetic acid	200	-	-	200 µg/l
Nitrite	3000	3	0.9	0.9 mg/l
N-Nitrosodimethylamine	0.1	-	-	0.1 µg/l
Pendimethalin	20	-	-	20 µg/l
Pentachlorophenol	9 (P)	-	-	9 µg/l (P)
Phenols	-	-	0.002	0.002 mg/l
Phosphates (as PO_4)	-	-	2.2	2.2 mg/l
Selenium	40 (P)	0.01	0.01	0.01 mg/l
Simazine	2	-	-	2 µg/l
Sodium	-	-	200	200 mg/l
Sodium dichloroisocyanurate	50000	-	-	50000µg/l
Styrene	20 (C)	-	-	20 µg/l(C)
2,4,5-T	9	-	-	9 µg/l
Terbuthylazine	7	-	-	7 µg/l
Tetrachloroethene	40	-	0.04	0.04 mg/l
Toluene	700 (C)	-	0.7	0.7 mg/l
Trichloroacetate	200	-	-	200 µg/l
Trichloroethene	20 (P)	-	-	20 µg/l (P)
2,4,6-Trichlorophenol	200 (C)	-	0.2	0.2 mg/l
Trifluralin	20	-	-	20 µg/l

Parameter	Applicable International Standard a b	Kenyan Standard c	Kenya Standard for potable water - natural d	Project Standard
Trihalomethanes	The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1	-	-	The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1
Uranium	30 (P)	-	0.03	0.03 mg/l
Vinyl chloride	0.3	-	-	0.3 µg/l
Xylenes	500 (C)	-	0.5	0.5 mg/l
Polynuclear Aromatic Hydrocarbons	-	-	0.0007	0.0007 mg/l
Turbidity	-	-	25 NTU	25 NTU
Taste	-	-	Not objectionable	Not objectionable
Odour	-	-	Not objectionable	Not objectionable
Colour	-	-	50 true colour units max.	50 true colour units max.
pH	-	6.5-8.5	5.5-9.5	6.5-8.5
Electrical Conductivity	-	-	2500 µS/cm	2500 µS/cm
Total filterable residue	-	-	-	-
Total hardness as $CaCO_3$	-	-	600	600 mg/l
Calcium	-	-	150	150 mg/l
Magnesium	-	-	100	100 mg/l
Magnesium and Sodium	-	-	-	-
Potassium			50	50 mg/l
Sulphate (SO_4)	-	-	400	400 mg/l
Chloride	-	-	250	250 mg/l
Iron (total)	-	-	0.3	0.3 mg/l
Manganese	-	-	0.1	0.1 mg/l

Parameter	Applicable International Standard [a b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Zinc	-	1.5	5	1.5 mg/l
BOD_5	-	-	-	-
Absorbed Oxygen (as $KMnO_4$)	-	-	-	-
Ammonia NH_3	-	0.5	0.5	0.5 mg/l
Total Nitrogen (excluding NO_3)	-	-	-	
Surfactants (Alkyl Benzyl Sulphonates)	-	-	-	-
Surfactants (reacting with methylene blue)	-	-	0.2	0.2 mg/l
Total viable counts at 37°C per ml	-	-	50 counts	50 counts at 37°C per ml
Total viable counts at 22°C per ml			100 counts	100 counts at 22°C per ml
Total Coliforms (CFU/100 ml)	-	-	Nil	Nil
E.coli (CFU/100 ml)	-	Nil/100	Nil	Nil/100
Pseudomonas aeruginosa fluorescence (CFU/100 ml)	-	-	Nil	Nil
Salmonella (per 100 ml)	-	-	Nil	Nil
Shigella (per 100 ml)	-	-	Nil	Nil
Giardia (per 100 ml)			Nil	Nil
Cryptosporidium (per 100 ml)			Nil	Nil
Staphylococcus aureus (CFU/100 ml)	-	-	Nil	Nil
Streptococcus faecalis (CFU/100 ml)	-	-	Nil	Nil
Sulphate reducing anaerobes (CFU/100 ml)	-	-	Nil	Nil
Phenolic substances (as Phenol)	-	Nil	-	Nil
Gross alpha activity	-	-	0.5	0.5 Bq/L
Gross beta activity	-	-	1	1 Bq/L

Parameter	Applicable International Standard [a b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Suspended Solids	-	30	Nil	Nil
Total dissolved solids	-	1200	1500	1500 mg/l
Organic matter	-	-	0.003	0.003 mg/l
Alkyl benzyl sulphonates	-	0.5	-	0.5 mg/l
Permangenate (PV)	-	1	-	1 mg/l

(a) World Health Organization (WHO), 2011. Drinking Water Quality Guidelines – 4th edition.

(b) P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited. T = provisional guideline value because calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, etc. A = provisional guideline value because calculated guideline value is below the achievable quantification level. D = provisional guideline value because disinfection is likely to result in the guideline value being exceeded. C = concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.

(c) Kenyan Government, 2006. Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water.

(d) Kenya Bureau of Standards (KEBS), 2018. Kenya Standard KS EAS 12:2018 (ISC 13.060.20). Potable Water – Specification. Second Edition. The standard for natural potable water has been included for the purposes of screening natural baseline groundwater and surface water quality.

(e) Kenya standard for boric acid (H3BO3). WHO standard for boron selected for comparison to water quality results for boron.

(f) Under conditions of epidemic diseases, it may be necessary to increase the residual chlorine temporarily.

4.3 References

- Kenya Bureau of Standards (KEBS), 2018. Kenya Standard KS EAS 12:2018 (ISC 13.060.20). Drinking Potable Water – Specification. Third Second Edition
- Kenyan Government, 2006. Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water.
- Kenyan Government, 2006. The EMCA (Water Quality) Regulations (2006) Schedule 3: Standards for Effluent Discharge into the Environment.
- World Health Organization (WHO), 2017. Drinking Water Quality Guidelines – 4th edition.

5.0 SOILS

There are no specific guidelines that are expected to be followed to conduct these evaluations of the soil and terrain properties; therefore, Golder best practice, based on pedologic principles and research literature, will be adopted.

To classify the soils for the ESIA project, the FAO of the UN soil classification system will be used, which is a common classification system for describing natural soils in Africa (FAO, 2006; FAO, 2007; FAO, 2014) and the United States Department of Agriculture Soil Taxonomy Classification System (USDA, 1993; USDA, 1999). The soil field survey will follow the Guidelines for Soil Survey and Land Evaluation in Ecological Research (Breimer et al, 1986).

5.1 References

- Breimer, R.F., A.J. van Kekem and H van Reuler, 1986. Guidelines for Soil Survey and land Evaluation in Ecological Research, MAB Technical Note 17, Prepared in Co-operation with the International Soil Reference and Information Centre (ISRIC), Published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), ISBN 92-3-3102366-7.
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- FAO, 2014. World Reference Base for Soil Resources. IUSS Working Group WRB. World Soil Resources Reports No. 106. FAO, Rome, Italy. (Update 2015).
- USDA, 1993. Soil survey manual. U.S. Department of Agriculture Handbook 18.
- USDA, 1999. Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys.
- U.S. Department of Agriculture Handbook 436.

6.0 BIODIVERSITY AND ECOSYSTEM SERVICES

Table 11: Biodiversity Requirements

Aspect	Applicable International Standard	Kenyan Standard	Project Standard
Protected Areas	IFC PS6 – delineation of critical habitats	Prohibition of disturbance or harming flora and fauna in National Park[(a).]	Project should aim to avoid any direct impacts on protected areas.
Wildlife and ecosystems	IFC PS6 – delineation of critical habitats	Wildlife Conservation and Management Act (2013) - strong emphasis on protection of wildlife both within and outside protected areas.	Wildlife Conservation and Management Act (2013) - strong emphasis on protection of wildlife both within and outside protected areas.
Conflicts between people and wildlife		Wildlife Conservation and Management Act (2013) Part IX deals with human-wildlife conflict, including problem animals and unlawful wounding of animals.	Project must endeavour to ensure that no animals are unlawfully wounded or killed as a result of construction and operation activities.
Ecosystem Services	Standards include: Landsberg et al (2013); IPIECA (2005; 2007; 2010); IPIECA (2016); and Secretariat of the Convention on Biological Diversity (2012). IFC PS6 – sustainable management of living natural resources	Kenya NBSAP (produced as an obligation to commitments under the CBD) key objectives include provisions for sustainable utilisation of biodiversity resources. The County Wildlife Conservation and Compensation committees instituted by the Kenya Wildlife Conservation and Management Act (2013) ensure that benefits derived from the use of wildlife resources are distributed in accordance with the provisions of the Act.	No residual significant impacts on land cover types/vegetation communities that provide priority Ecosystem services to local beneficiaries should be sustained as a result of Project impact. Management of biodiversity and ecosystem services (BES) impacts, dependencies, risks and identification of opportunities in the oil and gas sector.
Wetlands	Convention on Wetlands of International Importance (the Ramsar Convention 1971). CSBI (2015). Secretariat of the Convention on Biological Diversity (2006).	According to The EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management Plan) Regulations (2009) in non-specifically protected wetlands, Environmental impact assessment and environmental audits as required under the Act shall be mandatory for all activities likely to have an	Any potential effects on wetlands must be covered by the environmental impact assessment.

Aspect	Applicable International Standard	Kenyan Standard	Project Standard
		adverse impact on the wetland. The Wetlands Policy (2013) seeks to regulate, protect, manage and conserve all wetlands including those within public, private and community land in line with the Constitution.	

(a) *(a) The Republic of Kenya, 2013. The Wildlife Conservation and Management Act.*

6.1 References

- Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA), 1992. Convention on Biological Diversity.
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- Kenyan Government, 2000. The Kenya National Biodiversity Strategy and Action Plan (NBSAP). Landsberg, et al, 2013. Weaving Ecosystem Services into Impact Assessment, World Resources Institute. Ramsar, 1971. Convention on Wetlands of International Importance especially as Waterfowl Habitat.
- Secretariat of the Convention on Biological Diversity, Netherlands Commission for Environmental Assessment, 2006. Biodiversity in Impact Assessment, Background Document to CBD Decision VIII/28: Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment, Montreal, Canada.
- Secretariat of the Convention on Biological Diversity and the United Nations Environment Programme-World Conservation Monitoring Centre, 2012. Best policy guidance for the integration of biodiversity and ecosystem services in standards. Montreal, Technical Series No. 73, 52 pages.

- The Republic of Kenya, 2009. The Environmental Management and Co-ordination Act (Wetlands, River Banks, Lake Shore and Sea Shore Management) Regulations.
- The Republic of Kenya, 2013. The Wildlife Conservation and Management Act. The Republic of Kenya, 2013. The Wetland Policy.
- The Energy and Biodiversity Initiative, 2007. Good practice in the prevention and mitigation of Primary and Secondary Biodiversity Impacts.
- The Energy and Biodiversity Initiative, 2006. Biodiversity indicators for monitoring impacts and conservation actions.

7.0 CULTURAL HERITAGE

For Cultural heritage, the National Museums and Heritage Act (2006) represents the national standard. The Protection of Traditional Knowledge and Cultural Expressions Act (2016) is also relevant and has been given due consideration.

The Cultural Heritage assessment also complies with IFC PS 8: Cultural Heritage (2012a) (including accompanying guidance – Guidance Note 8: Cultural Heritage (2012b)).

7.1 References

- IFC (International Finance Corporation). 2012e. Performance Standard 8: Cultural Heritage. Washington, D.C. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps8 .
- The Republic of Kenya, 2006.The National Museums and Heritage. Act.
- The Republic of Kenya, 2016. The Protection of Traditional Knowledge and Cultural Expressions Act.

Signature Page

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ANNEX I

Baseline Supporting Information

C

Weather and Climate

C1

Table 1: Kapese

Month	Average Temperature (°C)	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Average Total Precipitation (mm)	Minimum Total Precipitation (mm)	Maximum Total Precipitation (mm)	Average Wind Speed (m/s)	Minimum Wind Speed (m/s)	Maximum Wind Speed (m/s)
January	29.5	20.2	37.0	33.7	84.5	12.9	5.3	0.8	9.8	2.5	0.5	8.4
February	31.0	22.0	38.5	30.5	84.5	9.6	0.9	0.0	1.8	3.1	0.5	7.7
March	29.3	19.9	39.2	48.9	98.7	12.8	50.9	2.2	99.6	2.8	0.5	8.5
April	28.1	20.4	37.0	58.8	98.1	21.7	50.2	26.0	74.4	2.5	0.5	8.7
May	27.5	20.2	34.7	59.9	98.5	23.0	90.4	62.2	118.6	2.0	0.5	6.1
June	27.5	19.7	35.2	52.5	99.4	21.8	50.3	1.4	99.2	2.1	0.5	6.8
July	27.9	21.0	34.3	44.2	86.2	25.6	2.1	0.2	4.0	2.3	0.5	7.4
August	28.4	20.0	35.8	43.0	95.1	21.8	11.7	0.8	32.8	2.5	0.5	7.9
September	28.9	20.4	36.1	40.8	97.7	20.3	18.7	0.0	56.0	2.5	0.5	6.7
October	29.4	20.6	36.7	42.4	95.3	14.9	26.7	4.2	54.0	2.8	0.5	7.4
November	28.8	20.0	36.0	44.7	98.2	16.4	29.1	1.4	56.6	2.9	0.5	7.8
December	29.0	19.7	36.1	40.0	94.0	13.0	2.5	0.0	6.6	2.7	0.5	7.3

Table 2: Ngamia

Month	Average Temperature (°C)	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Average Total Precipitation (mm)	Minimum Total Precipitation (mm)	Maximum Total Precipitation (mm)	Average Wind Speed (m/s)	Minimum Wind Speed (m/s)	Maximum Wind Speed (m/s)
January	29.6	19.7	37.6	29.1	81.7	9.5	5.9	0.2	11.6	2.6	0.5	6.5
February	31.0	21.4	38.8	33.1	88.0	10.3	13.8	0.2	20.6	2.9	0.5	6.7
March	30.8	20.4	40.1	40.9	96.2	11.2	28.9	0.2	83.6	2.7	0.5	7.4
April	28.8	15.7	37.7	57.5	97.5	23.2	106.0	70.0	142.0	2.3	0.5	6.6
May	28.1	21.2	35.7	59.8	98.4	23.9	110.6	n/a	n/a	1.8	0.5	5.8
June	28.2	20.3	35.9	48.9	96.9	22.8	47.2	n/a	n/a	2.0	0.5	4.9
July	28.3	19.9	34.8	46.2	91.2	25.0	8.0	n/a	n/a	2.0	0.5	6.5
August	28.2	20.5	36.1	44.5	97.3	21.5	14.0	n/a	n/a	2.2	0.5	7.0
September	29.3	20.7	36.5	38.0	83.4	21.6	4.0	n/a	n/a	2.5	0.5	5.9
October	30.1	21.1	37.0	41.5	95.5	17.3	21.7	0.6	40.8	2.8	0.5	6.5
November	29.3	19.8	36.3	45.1	98.8	16.0	36.0	2.4	92.8	2.8	0.5	6.3
December	29.8	20.5	36.5	35.3	96.3	14.2	18.7	2.0	49.0	2.9	0.5	6.9

Table 3: Lodwar

Month	Average Temperature (°C)	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Average Total Precipitation (mm)	Minimum Total Precipitation (mm)	Maximum Total Precipitation (mm)	Average Wind Speed (m/s)	Minimum Wind Speed (m/s)	Maximum Wind Speed (m/s)
January	n/a	16.5	38.8	n/a	n/a	n/a	9.2	0.0	124.0	4.9	1.0	13.0
February	n/a	16.9	39.9	n/a	n/a	n/a	5.8	0.0	30.2	5.2	2.0	13.0
March	n/a	17.9	39.5	n/a	n/a	n/a	21.5	0.0	96.4	5.3	2.0	12.0
April	n/a	20.2	38.9	n/a	n/a	n/a	43.1	0.0	164.4	5.6	1.0	12.0
May	n/a	20.1	38.5	n/a	n/a	n/a	20.2	0.0	87.8	5.8	1.0	15.0
June	n/a	21.3	37.4	n/a	n/a	n/a	14.9	0.0	182.9	5.9	2.0	15.0
July	n/a	20.6	36.6	n/a	n/a	n/a	10.7	0.0	67.0	6.3	3.0	11.0
August	n/a	20.2	36.6	n/a	n/a	n/a	18.9	0.0	120.2	6.8	2.0	14.0
September	n/a	22.6	38.0	n/a	n/a	n/a	11.0	0.0	134.9	6.2	2.0	14.0
October	n/a	19.0	38.3	n/a	n/a	n/a	8.8	0.0	50.6	6.7	2.0	13.0
November	n/a	18.8	37.5	n/a	n/a	n/a	26.2	0.0	172.4	5.5	1.0	13.0
December	n/a	17.3	37.4	n/a	n/a	n/a	12.3	0.0	106.1	4.5	2.0	10.0

Noise and Vibration

C2

The following figures show the time series of either in one-minute, 10-minute, or one-hour L_{Aeq} and L_{A90}, depending on the monitoring frequency of each measurement. The International Finance Corporation (IFC) noise limits are shown for comparison.

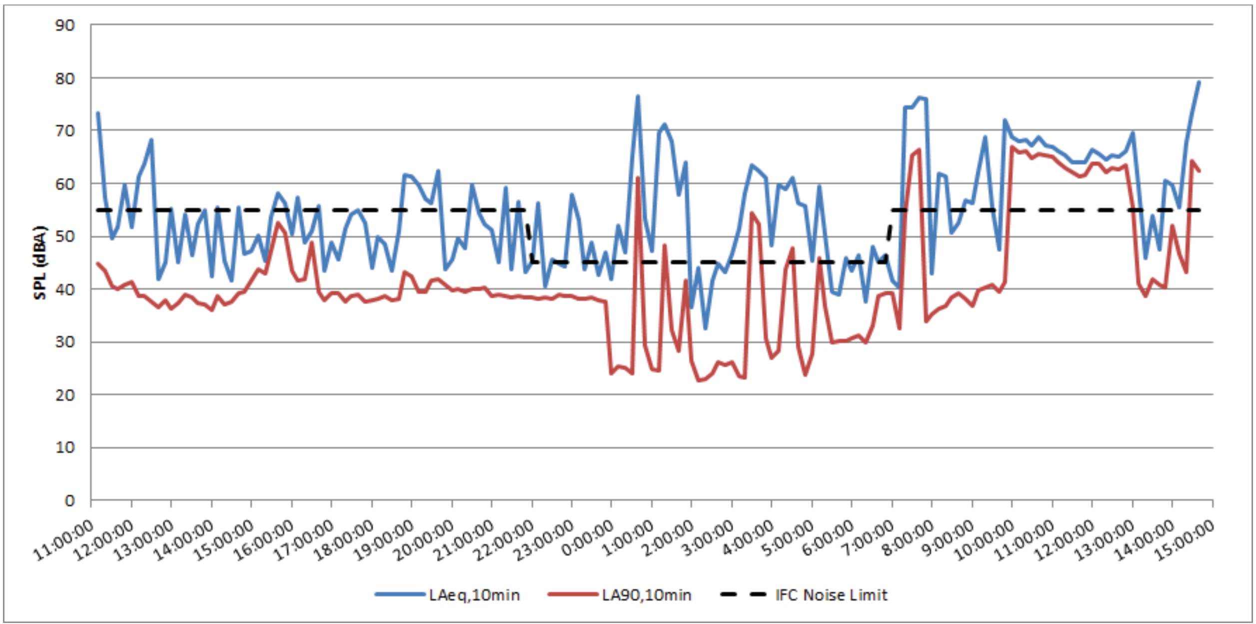


Figure 1: Time history graph of measured baseline noise levels at Lokichar (October 22 to 23, 2015)

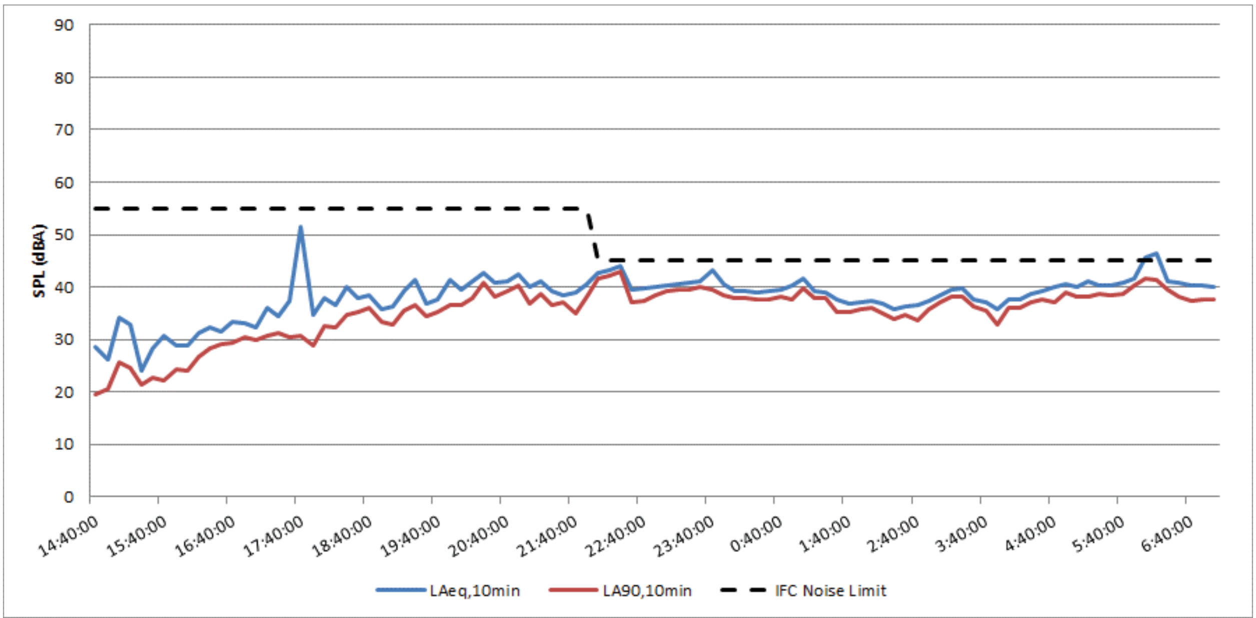


Figure 2: Time history graph of measured baseline noise levels at Twiga-1 (October 29 to 30, 2015)

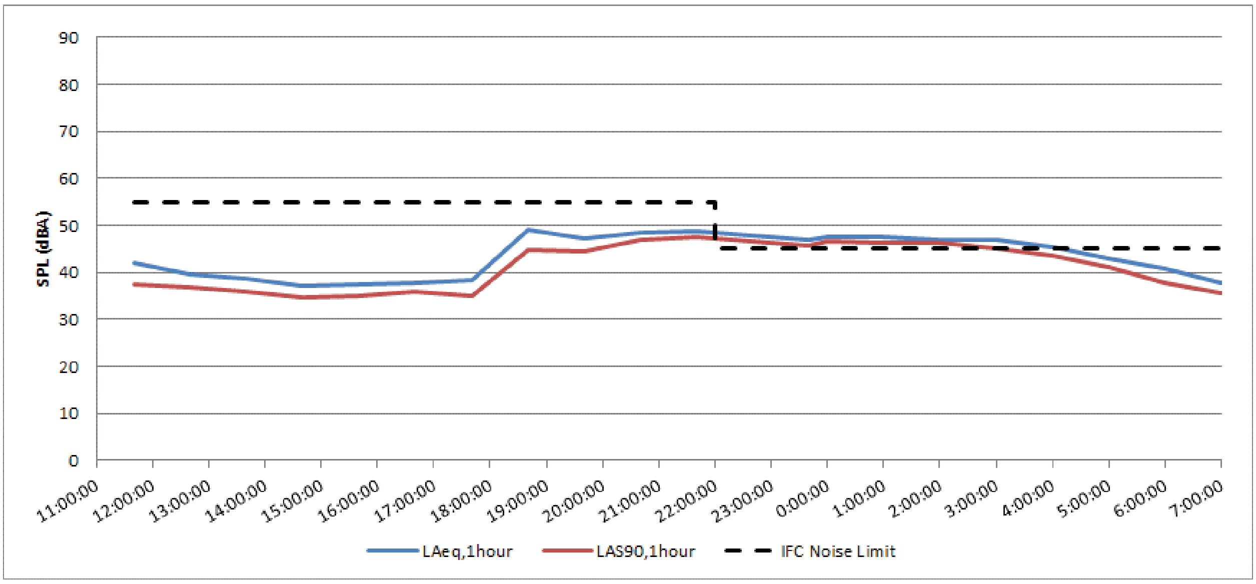


Figure 3: Time history graph of measured baseline noise levels at Twiga-1 (January 10 to 11, 2016)

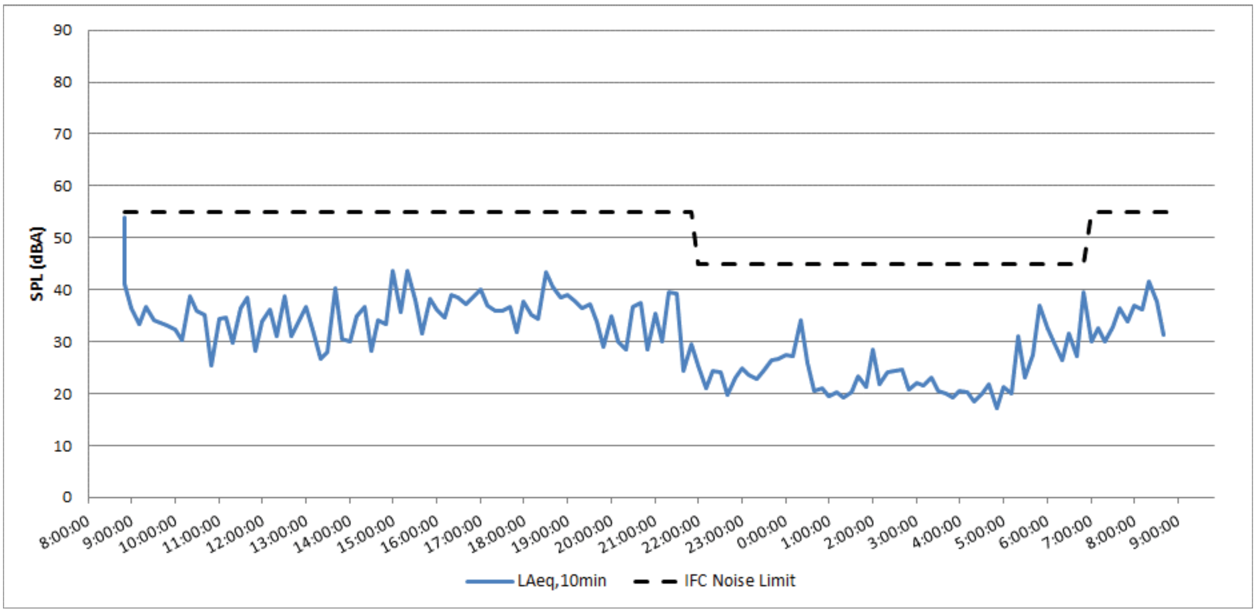


Figure 4: Time history graph of measured baseline noise levels at Twiga-1 (December 6 to 7, 2018)

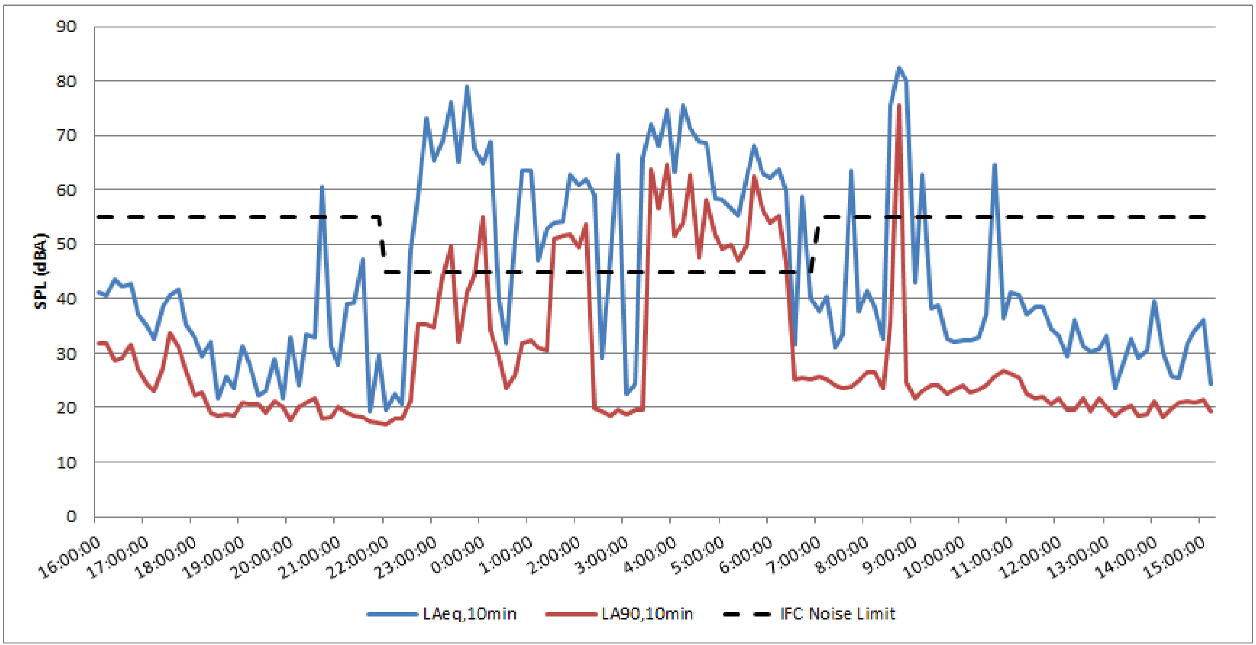


Figure 5: Time history graph of measured baseline noise levels at Amosing-5 (October 25 to 26, 2015)

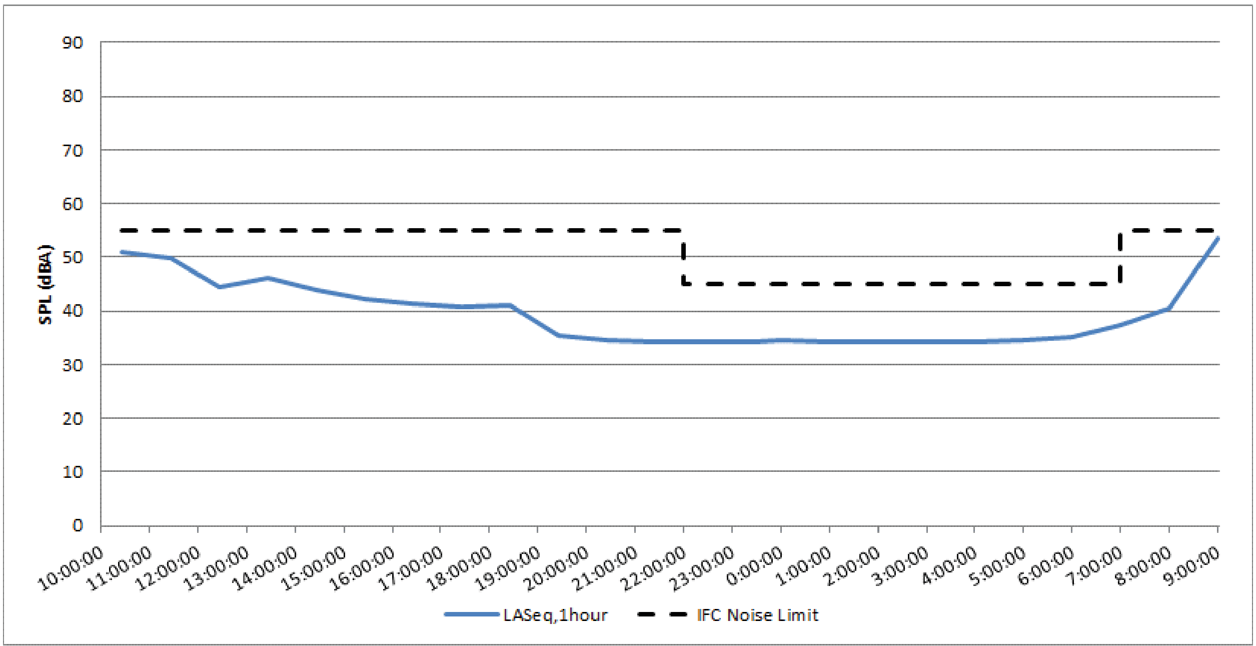


Figure 6: Time history graph of measured baseline noise levels at Amosing-5 (January 12 to 13, 2016)

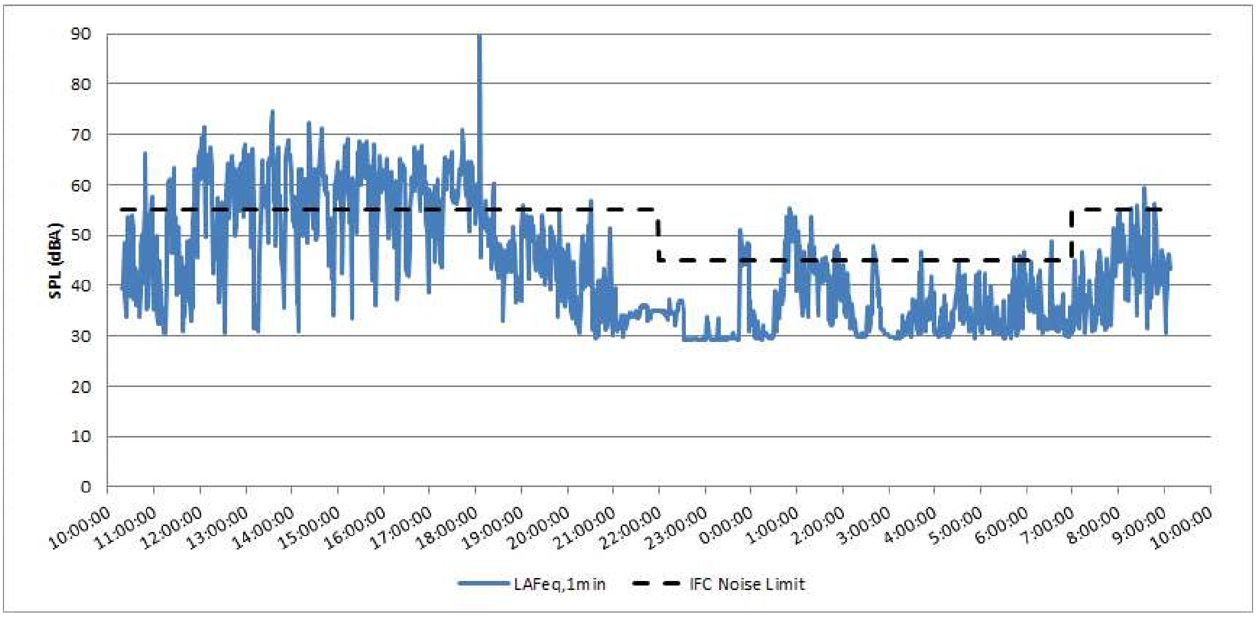


Figure 7: Time history graph of measured baseline noise levels at Amosing-5 (October 3 to 4, 2016)

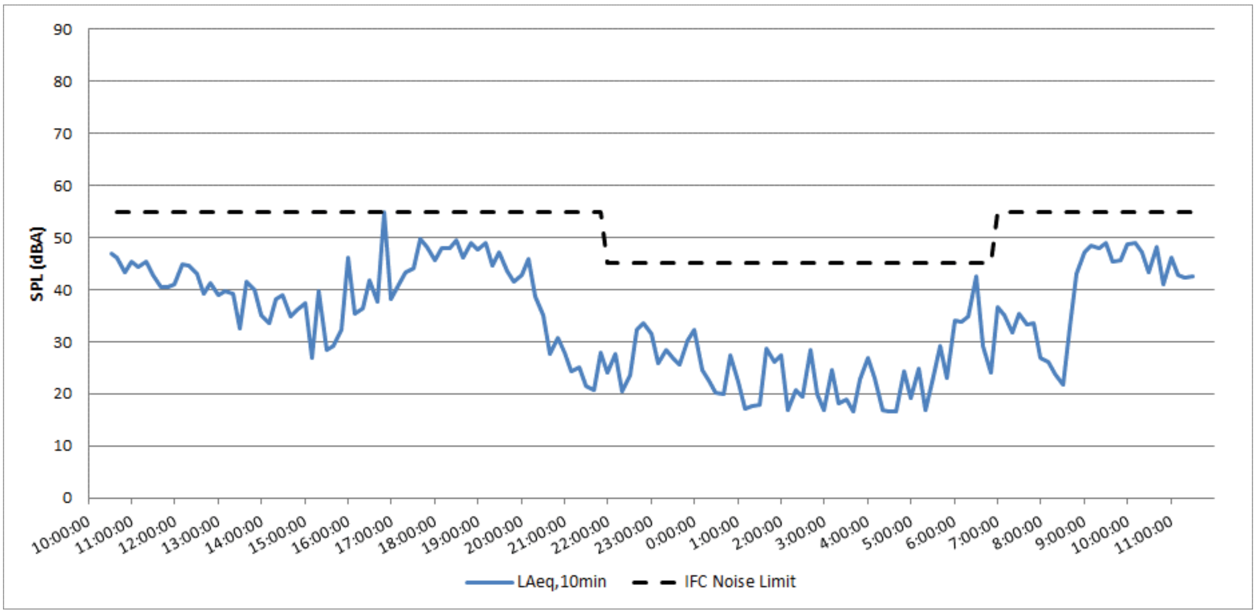


Figure 8: Time history graph of measured baseline noise levels at Amosing-5 (March 12 to 13, 2019)

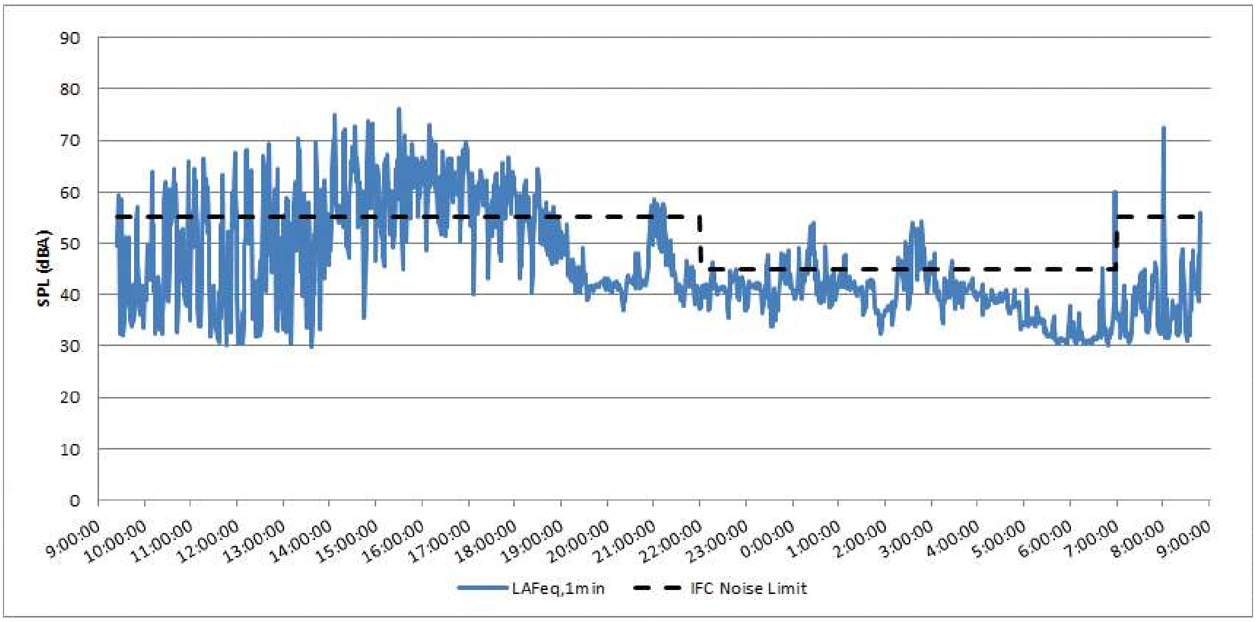


Figure 9: Time history graph of measured baseline noise levels at Ngamia-5/6 (October 2 to 3, 2016)

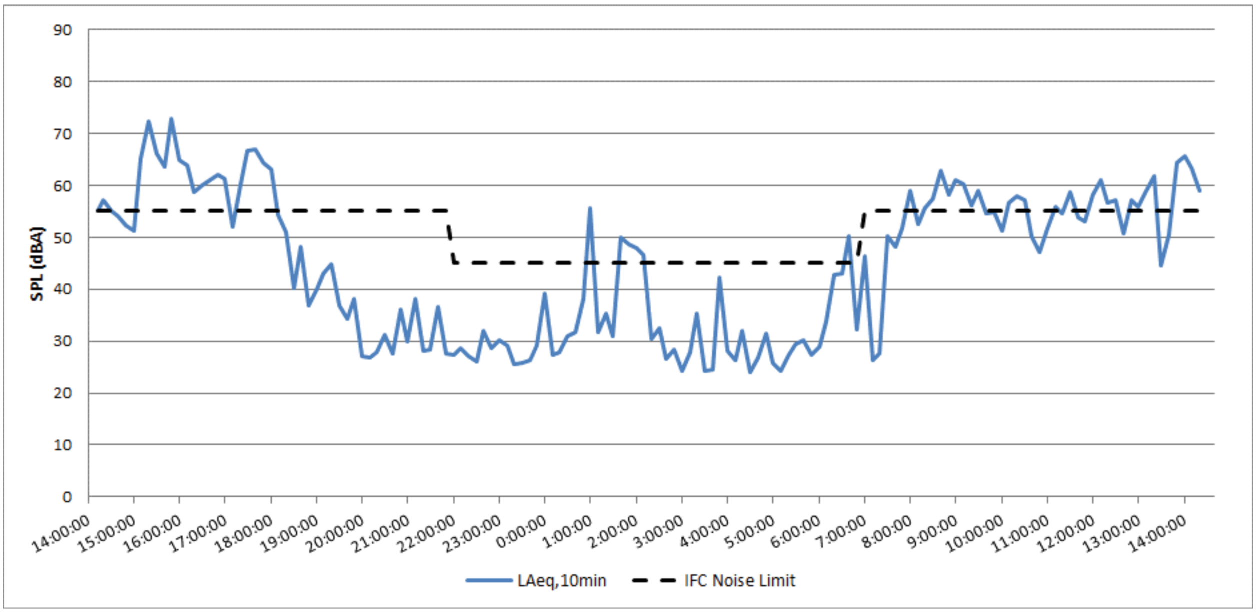


Figure 10: Time history graph of measured baseline noise levels at Ngamia-5/6 (December 3 to 4, 2018)

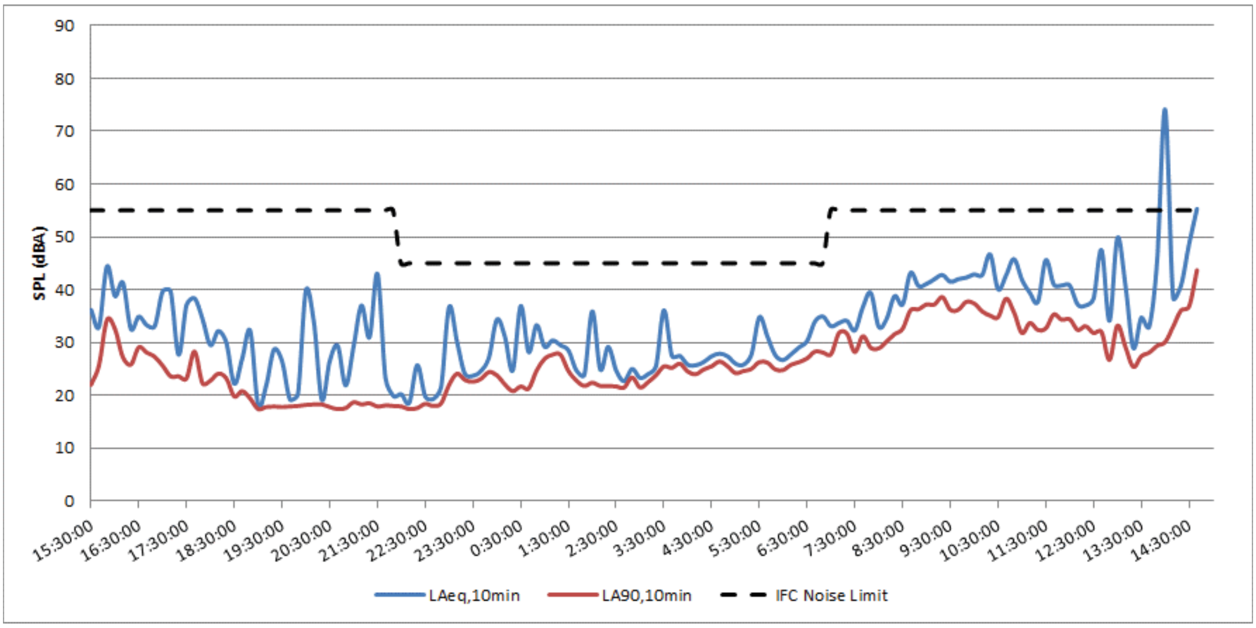


Figure 11: Time history graph of measured baseline noise levels at Kapese Camp (October 23 to 24, 2015)

Water Quality

C3

Major Ions	Units	Detection Limit
Calcium	mg/l	0.2
Magnesium	mg/l	0.1
Potassium	mg/l	0.1
Sodium	mg/l	0.1
Fluoride	mg/l	0.3
Sulphate	mg/l	0.05
Chloride	mg/l	0.3
Alkalinity (HCO3)	mg/l	1
Nutrients		
Ortho Phosphate as PO4	mg/l	0.03
Nitrate as N03	mg/l	0.2
Nitrite	mg/l	0.02
Ammonia as NH3	mg/l	0.07
Physico-chemical		
Total Alkalinity as CaCO3	mg/l	1
Electrical Conductivity	mS/cm	2
pH (lab)	pH units	0.01
Redox (Eh)	mV	
Temperature	°C	0.5
Dissolved Oxygen	mg/l	1
TDS	mg/l	35
TSS	mg/l	10
Total Hardness Dissolved (as CaCO3)	mg/l	1
Silica	mg/l	0.01
Organics and Oils		
TPH CWG - Aliphatics		
>C5-C6 [#]	µg/l	<5
>C8-C10 [#]	µg/l	<5
>C6-C8 [#]	µg/l	<5
>C10-C12[#]	µg/l	<5
>C12-C16[#]	µg/l	<10
>C16-C21[#]	µg/l	<10
>C21-C35[#]	µg/l	<10
Total aliphatics C5-35	µg/l	<10
TPH CWG - Aromatics		
>C5-EC7 [#]	µg/l	<5
>EC7-EC8 [#]	µg/l	<5
>EC8-EC10 [#]	µg/l	<5
>EC10-EC12[#]	µg/l	<5
>EC12-EC16[#]	µg/l	<10
>EC16-EC21[#]	µg/l	<10
>EC21-EC35[#]	µg/l	<10
Total aromatics C5-35	µg/l	<10
Total aliphatics and aromatics(C5-35)	µg/l	<10
Benzene	µg/l	0.5
Toluene	µg/l	0.5
Ethylbenzene	µg/l	0.5
m/p-Xylene	µg/l	1
o-Xylene	µg/l	1
Polyaromatic Hydrocarbons		
Naphthalene	µg/l	0.01
Acenaphthylene	µg/l	0.01
Acenaphthene	µg/l	0.01
Fluorene	µg/l	0.01
Phenanthrene	µg/l	0.01
Anthracene	µg/l	0.01
Fluoranthene	µg/l	0.01
Pyrene	µg/l	0.01
Benzo(a)anthracene	µg/l	0.01
Chrysene	µg/l	0.01
Benzo(bk)fluoranthene	µg/l	0.01
Benzo(a)pyrene	µg/l	0.01
Indeno(123cd)pyrene	µg/l	0.01
Dibenzo(ah)anthracene	µg/l	0.01
Benzo(ghi)perylene	µg/l	0.01

Inorganics and Trace Metals	Units	Detection Limit
Aluminium	µg/l	200
Arsenic	µg/l	0.9
Barium	µg/l	3
Beryllium	µg/l	5
Boron	µg/l	2
Cadmium	µg/l	0.03
Chromium	µg/l	0.2
Copper	µg/l	3
Iron (Ferrous)	µg/l	0.02
Iron (Feric)	µg/l	0.02
Lead	µg/l	0.4
Manganese	µg/l	0.02
Mercury	µg/l	0.5
Nickel	µg/l	0.2
Selenium	µg/l	1.2
Vanadium	µg/l	0.6
Zinc	µg/l	1.5
Strontium	µg/l	5
Sanitary		
BOD	mg/l	1
COD	mg/l	7
Total nitrogen	mg/l	0.5
Total phosphorous	mg/l	0.5
Total coliform bacteria	MPN/100ml	
Fecal coliforms	MPN/100ml	

Field Parameters 23 and 27 of November 2015

Parameter	Locations				
	GW1	GW2	GW3	GW4	GW5
Temp (° C)	39.1	34.7	35.2	31.6	34.5
DO (%)	16	10.7	31	34.1	23.7
DO (mg/l)	1.15	0.7	1.9	2	1.65
pH	7.73	7.96	7.7	6.6	7.39
ORP (mV)	-172.1	-203.9	-166.8	-120.7	-141.5
Conductivity (µS/cm)	910	1317	1663	890	924

Field Parameters 25 May and 1 June 2016

Parameter	Locations				
	SW1	SW3	GW1	GW3	GW5
Temp (° C)	30.1	28.7	34.6	34.7	34.2
DO (ppm)	2.02	5.02	5.51	3.66	3.11
pH	7.37	7.85	7.89	7.92	7.34
ORP (mV)	77.6	62.3	81.9	62.0	149.3
Conductivity (µS/cm)	575	273.5	955	1399	1083

Field Parameters 24 and 31 August 2016

Parameter	Locations				
	GW1	GW2	GW3	GW4	GW5
Temp (° C)	34.5	Pump removed	34.7	29.7	33.1
pH	7.95		8.92	8.59	7.41
Conductivity (µS/cm)	721		1248	525	928
TDS (mg/l)	360		625	263	465

Field Parameters September 2018 and March 2019

Parameter	Locations		
	Turkwel (13 March)	**Malmalte (September 2018)**	**Malmalte - Kainuk (17 March)**
Temp (° C)	23.0	27.2	23.3
DO (ppm)	7.06	No measurement	6.82
DO (mg/l)	No measurement	7.73	No measurement
SPC (uS/cm)	20.7	No measurement	19.8
EC (uS/cm)	19.8	200	19.2
pH	7.07	8.67	6.81
ORP (mV)	+191.4	No measurement	+187.4

Groundwater Data
GW1_East Lokichar C(Kaimegur A)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	27/11/2015	East Lokichar C	East Lokichar C	GW1	East Lokichar C	GW1	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C
						Sample ID	EL-C	3		3-OCT-15	1/NOV/2015	GW1	6-DEC-15	AQ 47836b		AQ 48446b		AQ 48993	AQ 49750	Kapese lab	SGS	SGS (03805.003)	SGS LE-C	(SGS MA18-00633.003)	East Lokichar BH(SGS MA18-0	
			Min	Max	Source	Date	11/08/2014	26/07/2015	21/09/2015	02/11/2015	26/11/2015	27/11/2015	30/12/2015	08/04/2016	28/05/2016	15/06/2016	29/08/2016	30/08/2016	31/10/2016	01/02/2017	01/04/2017	16/08/2017	04/10/2017	09/02/2018	01/05/2018	27/06/2018
Major Ions																										
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		16.9	20.14	18.95	14.12	17.7	10.32	6.53	2.58	28.05	7.66	20.41	8.29	1.58		17.61	18.99	24.28	17.89	24.86	21.15
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		10.9	11.82	11.26	9.38	11.02	7.52	8.15	2.58	11.49	1.6	11.02	11.64	2.43		10.78	12.3	13.8	11.29	12.66	11.04
Potassium	mg/l	0.1		No project standard			3.2	3.63	3.88	3.48	3.65	2.16	2.56	2.35	4.93	7.03	3.82	4.21	3.06	3	3.35	3.41	3.66	3.41	4.06	3.98
Sodium	mg/l	0.1		50	WHO DWS		128	125.94	109.23	121.57	116.47	265.72	315.62	328	146.42	6.42	132.68	339	25.17		117.4	147.83	222.04	90.1	137.2	127.8
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water			1.08	0.79	0.66	1.2	0.54	1.3	1.4	0.76	1.07	1.71	<	<	0.94	0.55	1.02	1.1	0.87	0.84	0.09
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		17	19.14	19.1	18	16.05	11.87	21.8	15.89	17.86	7.28	21.33	23.5	3.23	20	18.34	20.58	27.99	17.29	20.7	22.43
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		34	38	33.75	34.32	41.49	>30	26.59	87.5	243.65	55.3	29.01	50.14	35.39	32	27.34	27.2	34.6	30.37	30.32	30.86
Alkalinity (HCO3)	mg/l	1		No project standard																						
Nutrients																										
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		<0.5	Nil	Not detected	Nil	Nil	0.01	Nil	1.25	0.75	0.56	0.87	13.02	0.85	0.62	<0.02	0.02	0.01	0.12	0.03	0.49
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		28	22.6	2.51	59.5	17.5	1.2	18	2.9	4.07	2.94	2.13	43.75	31.47	Nil	4.55	1.99	1.34	42.36	38.63	45
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			<	<	3	<	<	<	<0.001	<	<0.001	0.05	<0.001	<0.01	0.01	Nil	0.08	0.2	Not detected	not detected	not detected
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water			0.05	0.07	0.06	0.05		0.04	<0.001		<0.001		<0.001	<0.001	0.04	0.02	0.03	0.08	0.03	<0.02	12.26
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water							0.41			3.45		0.03									
Physico-chemical																										
Total Alkalinity as CaCO3	mg/l	1		No project standard				290	290	244	270	250	550	172	80	211	100	516	148.68	285	400	357.3	379.25	287	418.8	392.63
Electrical Conductivity	mS/cm	2		No project standard				0.72	0.749	0.666	0.657	0.814	1.086	0.7	1.061	0.77	0.831	0.7	0.7		0.972	0.844	0.841	0.832	0.914	1.034
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		8.3	7.71	7.75	7.56	7.57	8.39	7.89	8.49	7.84	7.72	7.73	8.02	7.77		8.12	7.56	7.83	7.78	7.84	7.42
Redox (Eh)	mV	not specified		No project standard																						
Temperature	°C	0.5		No project standard								26.4			25.1		23.7									
Dissolved Oxygen	mg/l	1		No project standard								3.14			7.06		7.8									
TDS	mg/l	35		1000	KEBS requirements for drinking water		595	468	486.85	432.9	427	569.8	705.9	350	690.08	386	540	350	350		631.8	476	484	541	526	594
TSS	mg/l	10		0	KEBS requirements for drinking water			Not detectable	Detectable	Not detectable	Not detectable	Not detectable	Not detectable	8	2	Nil	3	Nil	Nil		Not detected	Not detected	Not detected	Not detected	7.84	Not detected
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water			98.98		73.87	89.58	56.73	49.85	15.98	117.34	26	96.36	68	13.95	85	88.35	98.6	117.46	91.18	117.2	98.29
Silica	mg/l	0.01		No project standard			26	15.71	15.19	20.21	2.15	2.24	3.02	<0.001	24.85	<0.001	2.33	<0.001		Nil	2.08	11.76	24.94	21.29	22.75	18.43
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02	<0.02	<0.02	<0.02		<0.02	0.014		0.04		0.015	0.01		<0.02	<0.02	<0.02	<0.02	absent	Absent
Organics and Oils																										
TPH CWG - Aliphatics																										
>C5-C6#	mg/l	0.005		No project standard																						
>C8-C10#	mg/l	0.005		No project standard																						
>C6-C8#	mg/l	0.005		No project standard																						
>C10-C12#	mg/l	0.005		No project standard																						
>C12-C16#	mg/l	0.01		No project standard																						
>C16-C21#	mg/l	0.01		No project standard																						
>C21-C35#	mg/l	0.01		No project standard																						
Total aliphatics C5-35	mg/l	0.01		No project standard																						
TPH CWG - Aromatics																										
>C5-EC7#	mg/l	0.005		No project standard																						
>EC7-EC8#	mg/l	0.005		No project standard																						
>EC8-EC10#	mg/l	0.005		No project standard																						
>EC10-EC12#	mg/l	0.005		No project standard																						
>EC12-EC16#	mg/l	0.01		No project standard																						
>EC16-EC21#	mg/l	0.01		No project standard																						
>EC21-EC35#	mg/l	0.01		No project standard																						
Total aromatics C5-35	mg/l	0.01		No project standard																						
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard								<0.01					0.67									
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water							<0.01			<0.01		0.02									
Toluene	mg/l	0.0005		0.7	WHO DWS							<0.01			<0.01		0.03									
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS							<0.01			<0.01		<0.01									
Xylene (total)	mg/l			0.5	WHO DWS							<0.01														
m/p-Xylene	mg/l	not analysed		No project standard																						
o-Xylene	mg/l	not analysed		No project standard																						
Polyaromatic Hydrocarbons																										
Naphthalene	mg/l	0.00001		No project standard								<0.01			<0.01		0.01									
Acenaphthylene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Acenaphthene	mg/l	0.00001		No project standard								<0.01			0.04		<0.01									
Fluorene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Phenanthrene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Anthracene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Fluoranthene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Pyrene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Benzo(a)anthracene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Chrysene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.02									
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS							<0.01			<0.01		<0.01									
Indeno(123cd)pyrene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Benzo(ghi)perylene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Inorganics and Trace Metals																										
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.3	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.001	<0.04	0.2	<0.04	<0.001	0.1	Nil	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	Nil	Not detected	<0.01	<0.01	<0.01	<0.001	<0.01
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		<0.1	<0.002	<0.002	<0.002	<0.002	0.01	<0.002	<0.001	0.01	<0.001	<0.002	<0.001	<0.01		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Beryllium	mg/l	0.005		No project standard								<0.0003			<0.003		<0.003									
Boron	mg/l	0.002		2.4	WHO DWS							<0.005			0.09		<0.005				0.11			0.1		
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water		<0.5	<0.005	0.06		0.08		0.24	<0.001		<0.001		<0.001	<0.01	0.19	0.61	Not detected	Nil	0.59	Nil	Nil
Bromate as BrO3	mg/L	0.001		No project standard				<0.001	<0.001		<0.001		<0.001	<0.001		<0.001		<0.001	<0.001		<0.001	<0.001	0.04	<0.001	<0.001	
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01		Not detected	Not detected	Not detected	Not detected	not detected	Not detected
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.007	<0.001	<0.007	<0.001	<0.01	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.26	<0.006	0.41	<0.006	<0.001	<0.01	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide	mg/l			0.07	KEBS requirements for drinking water			Nil	Nil	Nil	Nil		Nil	<0.001		<0.001		<0.001	<0.001		Nil	Nil	Nil	<0.001	<0.001	<0.001
Iron (Ferrous)	mg/l	0.00002		No project standard																						
Iron (Feric)	mg/l	0.00002		No project standard																						
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.1	<0.007	<0.007	0.02	<0.007	<0.007	<0.007	0.19	0.02	0.22	<0.007	0.01	0.08	0.23	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01		Not detected	<0.004	Not detected	Not detected	<0.004	<0.004
Lithium	mg/l	0.004		No project standard			<0.05	<0.004	<0.002	<0.004	<0.004		<0.004	<0.001		<0.001		<0.001	<0.001		<0.004	<0.004	<0.004	<0.004	<0.004	<11.04
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.14	<0.002	0.62	<0.002	0.15	0.02	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01		Not detected	Not detected	Not detected	Not detected	not detected	Not detected
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.015	<0.001	<0.015	<0.001	<0.01	Nil	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01		Not detected	Not detected	Not detected	<0.01	<0.01	<0.01
Vanadium	mg/l	0.0006		No project standard								0.04			0.02		0.03									
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.05	<0.002	0.04	0.02	<0.002	<0.002	0.01	1.58	0.02	<0.001	0.01	<0.001	0.21	Nil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/l	0.005		No project standard			0.3	0.35	0.34	0.26	<0.005	0.21	0.23	<0.001	0.35	<0.001	0.34	<0.001	<0.01		0.34	0.33	0.39	0.33	0.37	0.34
Sanitary																										
BOD	mg/l	1		No project standard								3.26			28.16		28.6									
COD	mg/l	7		No project standard								8.76			49.76		54.61									
Total nitrogen	mg/l	0.5		No project standard								0.22			3.07		1.23									
Total phosphorous	mg/l	0.5		No project standard								0.01			0.03		<0.01									
Total coliform bacteria	MPN/100ml	not specified		No project standard								33			1600		17									
Fecal coliforms	MPN/100ml	not specified		No project standard								<			1600		7									

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Groundwater Data
GW1_East Lokichar C(Kaimegur A)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Kaimegur A	Kaimegur A	Kaimegur A	Kaimegur A	Number of Analyses	Number of Analyses with Numerical Result	Result		
			Min	Max	Source	SGS MA18-04598.00 01/09/2018	MA18-05094.007 01/10/2018	MA18-05739.005 30/11/2018	MA19-00061.005 01/12/2018			Min	Mean	Max
Major Ions														
Calcium	mg/l	0.2		150	KEBS requirements for drinking water	17.66	17.7	14.28	11.49	23	23	1.58	15.61	28.05
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water	10.86	11.2	9.34	7.65	23	23	1.6	9.64	13.8
Potassium	mg/l	0.1		No project standard		3.19	3.87	3.3	2.66	24	24	2.16	3.58	7.03
Sodium	mg/l	0.1		50	WHO DWS	**104.86**	**107.05**	**75.65**	**54.73**	23	23	6.42	145.43	339
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water	1.35	1.27	0.71	0.89	23	21	0.09	0.96	1.71
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water	24.49	19.35	32.1	24.28	24	24	3.23	19.15	32.1
Chloride	mg/l	0.3		250	KEBS requirements for drinking water	28.93	28.93	72.34	29.78	24	23	26.59	47.04	243.65
Alkalinity (HCO3)	mg/l	1		No project standard						0	0			
Nutrients														
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water	**3.55**	**3.34**	1.08	<0.02	24	16	0.01	1.66	13.02
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	**20.25**	**40.21**	8.6	5.73	24	23	1.2	19.36	59.5
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water	Not detected	Not detected	**0.033**	Not detected	23	6	0.01	0.56	3
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water	0.42	0.21	**2.18**	<0.1	20	14	0.02	1.11	12.26
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water					3	3	0.03	1.30	3.45
Physico-chemical														
Total Alkalinity as CaCO3	mg/l	1		No project standard		365.04	395.46	304.2	304.2	23	23	80	304.81	550
Electrical Conductivity	mS/cm	2		No project standard		1.057	0.64848	0.926	1.063	22	22	0.648	0.84	1.086
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	7.68	7.67	7.56	7.44	23	23	7.42	7.81	8.49
Redox (Eh)	mV	not specified		No project standard						0	0			
Temperature	°C	0.5		No project standard						3	3	23.7	25.07	26.4
Dissolved Oxygen	mg/l	1		No project standard						3	3	3.14	6.00	7.8
TDS	mg/l	35		1000	KEBS requirements for drinking water	611	380	602	691	23	23	350	516.88	705.9
TSS	mg/l	10		0	KEBS requirements for drinking water	Not detected	Not detected	Not detected	Not detected	22	4	2	5.21	8
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water	88.8	90.31	74.15	60.17	22	22	13.95	78.01	117.46
Silica	mg/l	0.01		No project standard		18.93	21.39	16.78	14.18	23	19	2.08	14.96	26
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water	Absent	Absent	<0.02	<0.02	19	4	0.01	0.02	0.04
Organics and Oils														
TPH CWG - Aliphatics														
>C5-C6 [#]	mg/l	0.005		No project standard						0	0			
>C8-C10 [#]	mg/l	0.005		No project standard						0	0			
>C6-C8 [#]	mg/l	0.005		No project standard						0	0			
>C10-C12 [#]	mg/l	0.005		No project standard						0	0			
>C12-C16 [#]	mg/l	0.01		No project standard						0	0			
>C16-C21 [#]	mg/l	0.01		No project standard						0	0			
>C21-C35 [#]	mg/l	0.01		No project standard						0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard						0	0			
TPH CWG - Aromatics														
>C5-EC7 [#]	mg/l	0.005		No project standard						0	0			
>EC7-EC8 [#]	mg/l	0.005		No project standard						0	0			
>EC8-EC10 [#]	mg/l	0.005		No project standard						0	0			
>EC10-EC12 [#]	mg/l	0.005		No project standard						0	0			
>EC12-EC16 [#]	mg/l	0.01		No project standard						0	0			
>EC16-EC21 [#]	mg/l	0.01		No project standard						0	0			
>EC21-EC35 [#]	mg/l	0.01		No project standard						0	0			
Total aromatics C5-35	mg/l	0.01		No project standard						0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard						2	1	0.67	0.67	0.67
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water					3	1	0.02	0.02	0.02
Toluene	mg/l	0.0005		0.7	WHO DWS					3	1	0.03	0.03	0.03
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS					3	0			
Xylene (total)	mg/l			0.5	WHO DWS					1	0			
m/p-Xylene	mg/l	not analysed		No project standard						0	0			
o-Xylene	mg/l	not analysed		No project standard						0	0			
Polyaromatic Hydrocarbons														
Naphthalene	mg/l	0.00001		No project standard						3	1	0.01	0.01	0.01
Acenaphthylene	mg/l	0.00001		No project standard						3	0			
Acenaphthene	mg/l	0.00001		No project standard						3	1	0.04	0.04	0.04
Fluorene	mg/l	0.00001		No project standard						3	0			
Phenanthrene	mg/l	0.00001		No project standard						3	0			
Anthracene	mg/l	0.00001		No project standard						3	0			
Fluoranthene	mg/l	0.00001		No project standard						3	0			
Pyrene	mg/l	0.00001		No project standard						3	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard						3	0			
Chrysene	mg/l	0.00001		No project standard						3	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard						3	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS					3	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard						3	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard						3	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard						3	0			
Inorganics and Trace Metals														
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water	<0.05	<0.05	<0.05	<0.05	24	2	0.1	0.15	0.2
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water	<0.01	<0.01	<0.01	<0.01	23	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water	<0.004	0.01	<0.004	<0.004	23	3	0.01	0.01	0.01
Beryllium	mg/l	0.005		No project standard						3	0			
Boron	mg/l	0.002		2.4	WHO DWS					5	3	0.09	0.10	0.11
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water	Nil	Nil	Nil	Nil	20	6	0.06	0.30	0.61
Bromate as BrO3	mg/L	0.001		No project standard		<0.001	To follow			15	1	0.04	0.04	0.04
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water	Not detected	Not detected	Not detected	Not detected	22	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water	<0.02	<0.02	<0.02	<0.02	23	1	0.02	0.02	0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	<0.01	<0.01	<0.01	<0.01	24	3	0.08	0.25	0.41
Cyanide	mg/l			0.07	KEBS requirements for drinking water	<0.001	<0.001	<0.001	<0.001	19	0			
Iron (Ferrous)	mg/l	0.00002		No project standard						0	0			
Iron (Feric)	mg/l	0.00002		No project standard						0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water	<0.02	<0.02	<0.02	<0.02	24	7	0.01	0.11	0.23
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water	<0.004	<0.004	<0.004	<0.004	22	0			
Lithium	mg/l	0.004		No project standard		<0.004	<0.004	<0.004	<0.004	20	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water	<0.01	<0.01	<0.01	<0.01	24	5	0.02	0.20	0.62
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water	Not detected	Not detected	Not detected	Not detected	22	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water	<0.02	<0.02	<0.02	<0.02	23	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water	<0.01	**0.02**	<0.01	<0.01	22	1	0.02	0.02	0.02
Vanadium	mg/l	0.0006		No project standard						3	3	0.02	0.03	0.04
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	<0.01	<0.01	<0.01	<0.01	24	7	0.01	0.27	1.58
Strontium	mg/l	0.005		No project standard		0.33	0.33	0.27	0.24	23	18	0.21	0.31	0.39
Sanitary														
BOD	mg/l	1		No project standard						3	3	3.26	20.01	28.6
COD	mg/l	7		No project standard						3	3	8.76	37.71	54.61
Total nitrogen	mg/l	0.5		No project standard						3	3	0.22	1.51	3.07
Total phosphorous	mg/l	0.5		No project standard						3	2	0.01	0.02	0.03
Total coliform bacteria	MPN/100ml	not specified		No project standard						3	3	17	550.00	1600
Fecal coliforms	MPN/100ml	not specified		No project standard						3	2	7	803.50	1600

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Groundwater Data
GW2_Ngamia East

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Ngamia East	Ngamia East	Ngamia East	Ngamia East	Ngamia East	GW2	Ngamia East	Ngamia East	Ngamia East	Ngamia East	Ngamia East	Ngamia East	Ngamia East	Ngamia East	Number of Analyses	Number of Analyses with Numerical Result	Result		
						Sample ID								NG.E (SGS MA18-00633.002)	MA18-02360.002	MA18-0285233.002)	(SGS MA18-04598.007)	MA18-050948.009	MA18-05739.003	MA19-00061.004			Min	Mean	Max
			Min	Max	Source	Date	17/02/2015	26/07/2015	21/09/2015	27/10/2015	27/11/2015	27/11/2015	30/12/2015	09/02/2018	09/03/2018	09/04/2018	01/09/2018	01/10/2018	01/11/2018	01/12/2018					
Major Ions																									
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		5.52	11.02	9.79	10.65	11.22	6.54	31.6	7.03	13.13	6.44	22.27	9.73	7.98	6.6	14	14	5.52	11.39	31.6
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		6.14	8.17	7.79	8.46	8.3	7.8	17.33	6.82	9.27	6.08	14.72	8.65	6.79	5.81	14	14	5.81	8.72	17.33
Potassium	mg/l	0.1		No project standard				2.08	2.3	2.2	2.18	2.59	1.55	1.97	2.02	2.41	1.24	2.4	1.87	1.48	13	13	1.24	2.02	2.59
Sodium	mg/l	0.1		50	WHO DWS			**237.57**	**212.68**	**224.18**	**214.19**	**376.85**	**65.15**	**157.13**	**160.7**	**170.56**	**52.63**	**123.47**	**79.25**	**83.66**	13	13	52.63	166.00	376.85
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		1.11	1.2	0.9	0.63	0.82	0.41	0.83	0.97	0.68	1.18	1.13	1.41	0.98	0.96	14	14	0.41	0.94	1.41
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		44	37.46	38.3	30	34.57	8.43	5.4	26.55	23.3	35.4	6.79	20.79	41.16	28.61	14	14	5.4	27.20	44
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		102.73	66.5	72.32	56.58	67.89	**>30**	8.86	54.96	48.9	64.12	5.1	53.6	75.3	46.79	14	13	5.1	55.67	102.73
Alkalinity (HCO3)	mg/l	1		No project standard																	0	0			
Nutrients																									
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water							0.03		0.09	0.06	0.77	**5.3**	**2.79**	2.18	0.18	8	8	0.03	1.43	5.3
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			**12.2**	3.2	**47.7**	9.9	1.4	**12.9**	**35.77**	**31.98**	6.44	**10.3**	**22.15**	6.39	6.89	13	13	1.4	15.94	47.7
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			<	<	<	<	**0.08**	<	Not detected	Not detected	Not detected	Not detected	**0.04**	**0.103**	Not detected	13	3	0.04	0.07	0.103
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water			0.06	**0.9**	0.01	0.07		0.04	0.04	0.02	**12.01**	0.34	0.27	**2.12**	<0.1	12	11	0.01	1.44	12.01
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water							**0.96**									1	1	0.96	0.96	0.96
Physico-chemical																									
Total Alkalinity as CaCO3	mg/l	1		No project standard				430	430	350	480	350	230	430.5	602.03	575.85	324.48	425.88	446.16	507	13	13	230	429.38	602.03
Electrical Conductivity	mS/cm	2		No project standard				1.073	1.128	1.032	0.994	1.201	0.448	1.117	0.69	1.313	0.763	0.927	1.326	1.428	13	13	0.448	1.03	1.428
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		7.76	7.91	7.87	7.74	7.81	**8.75**	7.84	8.14	7.79	8.07	7.56	7.95		7.92	13	13	7.56	7.93	8.75
Redox (Eh)	mV	not specified		No project standard																	0	0			
Temperature	°C	0.5		No project standard								26.3									1	1	26.3	26.30	26.3
Dissolved Oxygen	mg/l	1		No project standard								2.45									1	1	2.45	2.45	2.45
TDS	mg/l	35		1000	KEBS requirements for drinking water		852	697.45	733.2	670.8	646.1	840.7	291.2	726	407	762	446	539	862	925	14	14	291.2	671.32	925
TSS	mg/l	10		0	KEBS requirements for drinking water			Not detectable	**Detectable**	Not detectable	Not detectable		Not detectable	Not detectable	Not detectable	**Detectable**	Not detected	**Detectable**	Not detected	Not detected	12	0			
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		39.09	61.16		61.4	62.21	48.45	150.28	45.63	70.95	41.11	116.2	59.91	47.87	40.42	13	13	39.09	64.98	150.28
Silica	mg/l	0.01		No project standard				16.7	15.82	22.56	2.29	2.13	3.51								6	6	2.13	10.50	22.56
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	absent	Absent	Absent	Absent	0.02	<0.02	12	1	0.02	0.02	0.02
Organics and Oils																									
TPH CWG - Aliphatics																									
>C5-C6 #	mg/l	0.005		No project standard																	0	0			
>C8-C10 #	mg/l	0.005		No project standard																	0	0			
>C6-C8 #	mg/l	0.005		No project standard																	0	0			
>C10-C12 #	mg/l	0.005		No project standard																	0	0			
>C12-C16 #	mg/l	0.01		No project standard																	0	0			
>C16-C21 #	mg/l	0.01		No project standard																	0	0			
>C21-C35 #	mg/l	0.01		No project standard																	0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard																	0	0			
TPH CWG - Aromatics																									
>C5-EC7 #	mg/l	0.005		No project standard																	0	0			
>EC7-EC8 #	mg/l	0.005		No project standard																	0	0			
>EC8-EC10 #	mg/l	0.005		No project standard																	0	0			
>EC10-EC12 #	mg/l	0.005		No project standard																	0	0			
>EC12-EC16 #	mg/l	0.01		No project standard																	0	0			
>EC16-EC21 #	mg/l	0.01		No project standard																	0	0			
>EC21-EC35 #	mg/l	0.01		No project standard																	0	0			
Total aromatics C5-35	mg/l	0.01		No project standard																	0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard								<0.01									1	0			
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water							<0.01									1	0			
Toluene	mg/l	0.0005		0.7	WHO DWS							<0.01									1	0			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS							<0.01									1	0			
Xylene (total)	mg/l			0.5	WHO DWS							<0.01									1	0			
m/p-Xylene	mg/l	not analysed		No project standard																	0	0			
o-Xylene	mg/l	not analysed		No project standard																	0	0			
Polyaromatic Hydrocarbons																									
Naphthalene	mg/l	0.00001		No project standard								<0.01									1	0			
Acenaphthylene	mg/l	0.00001		No project standard								<0.01									1	0			
Acenaphthene	mg/l	0.00001		No project standard								<0.01									1	0			
Fluorene	mg/l	0.00001		No project standard								<0.01									1	0			
Phenanthrene	mg/l	0.00001		No project standard								<0.01									1	0			
Anthracene	mg/l	0.00001		No project standard								<0.01									1	0			
Fluoranthene	mg/l	0.00001		No project standard								<0.01									1	0			
Pyrene	mg/l	0.00001		No project standard								<0.01									1	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard								<0.01									1	0			
Chrysene	mg/l	0.00001		No project standard								<0.01									1	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard								<0.01									1	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS							<0.01									1	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard								<0.01									1	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard								<0.01									1	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard								<0.01									1	0			
Inorganics and Trace Metals																									
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water			<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	13	0			
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			<	<	<	<	<	<	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	13	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.02	<0.002	<0.002	<0.002	<0.002	0.01	<0.002	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	14	2	0.01	0.02	0.02
Beryllium	mg/l	0.005		No project standard								<0.0003									1	0			
Boron	mg/l	0.002		2.4	WHO DWS							<0.005		0.05							2	1	0.05	0.05	0.05
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water			<0.005	0.1		0.1		0.16	**0.52**	**0.67**	Nil	Nil	Nil	Nil	Nil	11	5	0.1	0.31	0.67
Bromate as BrO3	mg/L	0.001		No project standard				<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001				8	0			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			<	<	<	<	<	<	Not detected	Not detected	not detected	Not detected	Not detected	Not detected	Not detected	13	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	13	0			
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13	0			
Cyanide	mg/l			0.07	KEBS requirements for drinking water			Nil	Nil	Nil	Nil		Nil	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	12	0			
Iron (Ferrous)	mg/l	0.00002		No project standard																	0	0			
Iron (Feric)	mg/l	0.00002		No project standard																	0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		0.007	<0.007	0.05	0.01	<0.007	<0.007	<0.007	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	14	3	0.007	0.02	0.05
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			<	<	<	<	<	<	Not detected	<0.004	<0.004	<0.02	<0.004	<0.004	<0.004	13	0			
Lithium	mg/l	0.004		No project standard				<0.004	<0.002	<0.004	<0.004		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	12	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14	1	0.002	0.00	0.002
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			<	<	<	<	<	<	Not detected	Not detected	Not detected		Not detected	Not detected	Not detected	12	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.02	<0.02	<[0.02	<0.02	<0.02	<0.02	<0.02	13	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01	**0.02**	<0.01	<0.01	13	1	0.02	0.02	0.02
Vanadium	mg/l	0.0006		No project standard								0.05									1	1	0.05	0.05	0.05
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		0.01	<0.002	0.03	<0.002	0.01	<0.002	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14	4	0.01	0.02	0.03
Strontium	mg/l	0.005		No project standard				0.23	0.21	0.22	<0.005	0.24	0.46	0.17	0.25	0.15	0.41	0.24	0.2	0.16	13	12	0.15	0.25	0.46
Sanitary																									
BOD	mg/l	1		No project standard								4.56									1	1	4.56	4.56	4.56
COD	mg/l	7		No project standard								10.23									1	1	10.23	10.23	10.23
Total nitrogen	mg/l	0.5		No project standard								0.18									1	1	0.18	0.18	0.18
Total phosphorous	mg/l	0.5		No project standard								0.03									1	1	0.03	0.03	0.03
Total coliform bacteria	MPN/100ml	not specified		No project standard								14									1	1	14	14.00	14
Fecal coliforms	MPN/100ml	not specified		No project standard								<									1	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Groundwater Data
GW3_Nakukulas 9

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	GW3	Nakukulas 9	Nakukulas 9	GW3	Nakukulas 9	GW3	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9
						Sample ID	NAK-1	5		5-OCT-15	7/NOV/2015		3-DEC-15	AQ 47838b		AQ 48444b		AQ 49002	AQ 49747	Kapese lab	SGS	SGS (03805.001)	SGS NK O9	MA17-0535	SGS MA18-00633.001)	
			Min	Max	Source	Date	11/08/2014	26/07/2015	21/09/2015	02/11/2015	27/11/2015	27/11/2015	30/12/2015	08/04/2016	29/05/2016	15/06/2016	29/08/2016	30/08/2016	31/10/2016	01/02/2017	01/04/2017	16/08/2017	04/12/2017	08/11/2017	09/02/2018	25/05/2018
Major Ions																										
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		7.7	6.3	6.21	6.29	6.58	49.86	20.62	14.85	11.77	6.83	6.9	<0.001	0.62		5.28	6.07	7.42	6.23	5.77	7.2
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		8.5	7.91	8.25	8.32	8.42	17.49	11.15	2.85	7.9	1.19	7.77	4.69	0.09		6.97	7.84	8.82	7.79	7.3	8.54
Potassium	mg/l	0.1		No project standard			<2	2.23	2.52	2.57	2.51	5.49	3.85	2.98	3.39	4.76	2.43	0.69	1.37	1.4	2.17	2.31	2.36	0.24	2.13	2.62
Sodium	mg/l	0.1		50	WHO DWS		**321**	**318.9**	**291.13**	**324.84**	**297.83**	**74.76**	**126.16**	**619**	**347.19**	5.64	**327.06**	**553**	**148.56**		**298.63**	**378.15**	**556.94**	9.25	**217.69**	**247.81**
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water			1.5	1.1	0.68	1.5	0.54	1.1	1.5	0.68	**1.73**	**1.72**	0.82	0.05	1.13	0.47	1.43	**1.67**	0.71	1.07	1.24
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		24	25.31	26.1	21	23.67	8.94	16.3	10.57	52.06	2.82	21.57	2.2	27.71	2	14.28	23.87	23.87	18.32	22.84	21.8
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		30	47.5	33.74	30.18	42.43	**>30**	33.68	87.9	**536.86**	40.55	38.37	42.77	39.82	28	29.35	38.85	30.27	25.95	32.3	30.75
Alkalinity (HCO3)	mg/l	1		No project standard																						
Nutrients																										
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		<0.5	Nil	Not detected	Nil	Nil	0.02	Nil	<0.001	0.54	0.24	0.65	**25.07**	0.75	0.54	<0.02	0.02	0.01	Nil	0.24	0.49
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		**22**	**17**	4.1	**82.3**	**20.6**	3.1	**20.5**	**10.5**	3.65	1.62	3.22	**12**	**16.56**	1.64	4.58	3.26	1.63	2.42	**30.28**	**20.78**
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	**0.03**	<0.001	<0.01	**0.009**	Nil	**0.43**	**0.3**	Nil	not detected	**not detected**
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water			0.01	0.07	0.09	0.02		0.03	<0.001		<0.001		<0.001	<0.001	0.11	0.02	0.26	0.04	0.2	0.02	0.05
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water							**0.71**			**0.54**		0.02									
Physico-chemical																										
Total Alkalinity as CaCO3	mg/l	1		No project standard				640	650	552	550	540	250	309	28	195	210	186	70	590	360	784.08	820	697	697	811,43
Electrical Conductivity	mS/cm	2		No project standard				1.332	1.448	1.276	1.267	1.423	0.591	1.27	1.913	1.28	1.436	1.28	1.26		1.755	1.5	1.519	1.591	1.453	1.624
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		8.5	7.96	7.53	7.65	7.88	**8.84**	7.74	8.39	7.24	8	7.87	7.9	8.01		8.09	7.86	7.82	7.94	8.02	8.13
Redox (Eh)	mV	not specified		No project standard																						
Temperature	°C	0.5		No project standard								26.1			25.5		23.2									
Dissolved Oxygen	mg/l	1		No project standard								4.81			7.54		6.4									
TDS	mg/l	35		1000	KEBS requirements for drinking water		**1246**	865.8	941.2	829.4	823.55	996.1	384.15	635	**1245.26**	640	399.4	640	630		**1140.75**	842	890	**1034**	944	939
TSS	mg/l	10		0	KEBS requirements for drinking water			Not detectable	Not detectable	Not detectable	Not detectable	**2**	Not detectable	Nil	**2**	Nil	**2**	Nil	**2**		Not detected	Not detected	Not detected	not detected	**Detectable**	Not detected
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water			48.29		49.99	51.1	196.53	97.42	47.9	61.9	22	49.25	19	1.91	55	41.88	47.45	54.86	47.65	44.47	53.16
Silica	mg/l	0.01		No project standard			25	15.48	15.12	21.48	2.15	2.53	2.99	<0.001	25.21	<0.001	2.33	<0.001		1.3	2.07	11.99	24.92	2.22	21.45	24.14
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02	<0.02	<0.02	<0.02		<0.02	0.01		0.03		0.01	0.06		<0.02	<0.02	<0.02	<0.02	<0.02	absent
Organics and Oils																										
TPH CWG - Aliphatics																										
>C5-C6#	mg/l	0.005		No project standard																						
>C8-C10#	mg/l	0.005		No project standard																						
>C6-C8#	mg/l	0.005		No project standard																						
>C10-C12#	mg/l	0.005		No project standard																						
>C12-C16#	mg/l	0.01		No project standard																						
>C16-C21#	mg/l	0.01		No project standard																						
>C21-C35#	mg/l	0.01		No project standard																						
Total aliphatics C5-35	mg/l	0.01		No project standard																						
TPH CWG - Aromatics																										
>C5-EC7#	mg/l	0.005		No project standard																						
>EC7-EC8#	mg/l	0.005		No project standard																						
>EC8-EC10#	mg/l	0.005		No project standard																						
>EC10-EC12#	mg/l	0.005		No project standard																						
>EC12-EC16#	mg/l	0.01		No project standard																						
>EC16-EC21#	mg/l	0.01		No project standard																						
>EC21-EC35#	mg/l	0.01		No project standard																						
Total aromatics C5-35	mg/l	0.01		No project standard																						
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard								<0.01					0.63									
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water							<0.01			<0.01		**0.05**									
Toluene	mg/l	0.0005		0.7	WHO DWS							<0.01			<0.01		0.02									
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS							<0.01			<0.01		<0.01									
Xylene (total)	mg/l			0.5	WHO DWS							<0.01														
m/p-Xylene	mg/l	not analysed		No project standard																						
o-Xylene	mg/l	not analysed		No project standard																						
Polyaromatic Hydrocarbons																										
Naphthalene	mg/l	0.00001		No project standard								<0.01			0.04		0.01									
Acenaphthylene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Acenaphthene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Fluorene	mg/l	0.00001		No project standard								<0.01			0.04		<0.01									
Phenanthrene	mg/l	0.00001		No project standard								<0.01			0.03		<0.01									
Anthracene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Fluoranthene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Pyrene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Benzo(a)anthracene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Chrysene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.02									
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS							<0.01			<0.01		<0.01									
Indeno(123cd)pyrene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Benzo(ghi)perylene	mg/l	0.00001		No project standard								<0.01			<0.01		<0.01									
Inorganics and Trace Metals																										
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.3	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.001	**0.12**	**0.28**	<0.04	<0.001	0.1	<0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	Nil	Not detected	<0.01	<0.01	<0.01	<0.01	<0.001
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		<0.1	<0.002	<0.002	<0.002	<0.002	0.04	<0.002	<0.001	<0.002	<0.001	<0.002	<0.001	<0.01		<0.004	<0.004	<0.004	<0.004	<0.004	0.001
Beryllium	mg/l	0.005		No project standard								<0.0003			<0.003		<0.003									
Boron	mg/l	0.002		2.4	WHO DWS							<0.005			0.13		<0.005									
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water		<0.5	<0.005	0.1		0.1		0.2	<0.001		<0.001		<0.001	<0.01	0.15	**0.9**	Not detected	**0.52**	**0.52**	**0.92**	0.08
Bromate as BrO3	mg/L	0.001		No project standard				<0.001	<0.001		<0.001		<0.001	<0.001		<0.001		<0.001	<0.001		<0.001	<0.001	0.016	<0.001	<0.001	<0.001
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01		Not detected	Not detected	Not detected	not detected	not detected	Not detected
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.007	<0.001	<0.007	<0.001	<0.01	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	**0.1**	<0.006	**0.27**	<0.006	<0.001	<0.01	Nil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide	mg/l			0.07	KEBS requirements for drinking water			Nil	Nil	Nil	Nil		Nil	<0.001		<0.001		<0.001	<0.001		Nil	Nil	Nil	Nil	<0.001	
Iron (Ferrous)	mg/l	0.00002		No project standard																						
Iron (Feric)	mg/l	0.00002		No project standard																						
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.1	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.007	0.16	<0.007	**0.34**	0.12	0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01		Not detected	<0.004	Not detected	Not detected	Not detected	<0.004
Lithium	mg/l	0.004		No project standard			<0.05	<0.004	<0.002	<0.004	<0.004		<0.004	<0.001		<0.001		<0.001	<0.001		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.022	<0.002	0.44	<0.002	0.15	0.02	0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.015	<0.001	<0.015	<0.001	<0.01	<0.001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01		Not detected	Not detected	Not detected	<0.01	<0.01	<0.01
Vanadium	mg/l	0.0006		No project standard								0.04			0.05		0.06									
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	0.03	0.04	<0.002	<0.001	<0.002	0.45	0.04	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/l	0.005		No project standard			0.2	0.24	0.24	0.23	<0.005	0.69	0.33	<0.001	0.21	<0.001	0.24	<0.001	<0.01		Not detected	0.22	0.25	0.24	0.22	0.25
Sanitary																										
BOD	mg/l	1		No project standard								2.74			24.56		28.21									
COD	mg/l	7		No project standard								7.42			48.07		57.23									
Total nitrogen	mg/l	0.5		No project standard								0.21			4.69		1.61									
Total phosphorous	mg/l	0.5		No project standard								0.02			<		<0.01									
Total coliform bacteria	MPN/100ml	not specified		No project standard								70			1600		17									
Fecal coliforms	MPN/100ml	not specified		No project standard								23			2		<									

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Groundwater Data
GW3_Nakukulas 9

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	ater flowing from Nak	Number of Analyses	Number of Analyses with Numerical Result	Result		
							S MA18-04598.0	MA18-05094.01	MA18-05739.00	MA19-00061.00	MA18-05739.006					
			Min	Max	Source	27/06/2018	01/09/2018	01/10/2018	30/11/2018	01/12/2018	30/11/2018			Min	Mean	Max
Major Ions																
Calcium	mg/l	0.2		150	KEBS requirements for drinking water	5.78	4.79	5.46	4.41	3.61	6.42	25	24	0.62	8.87	49.86
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water	7.15	6.72	7.94	6.19	5.22	6.59	25	25	0.09	7.26	17.49
Potassium	mg/l	0.1		No project standard		2.47	1.96	2.71	2.13	1.8	2.19	26	25	0.24	2.45	5.49
Sodium	mg/l	0.1		50	WHO DWS	227.21	220.09	171.87	123.91	171.26	110.02	25	25	5.64	259.52	619
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water	1.46	1.84	1.76	0.89	1.19	8.53	25	25	0.05	1.45	8.53
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water	20.79	20.79	18.52	27.99	59.27	41.57	26	26	2	22.24	59.27
Chloride	mg/l	0.3		250	KEBS requirements for drinking water	29.89	28.93	30.63	89.33	29.78	55.3	26	25	25.95	59.33	536.86
Alkalinity (HCO3)	mg/l	1		No project standard								0	0			
Nutrients																
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water	Not detected	0.28	2.97	1.8	0.42	<0.01	26	15	0.01	2.27	25.07
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	1.46	23.16	27.63	8.06	5.72	<0.01	26	25	1.46	13.91	82.3
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		Not detected	Not detected	0.03	Not detected	0.56	24	6	0.009	0.23	0.56
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water	12.1	0.38	0.2	2.03	0.1	<0.02	22	17	0.01	0.93	12.1
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water							3	3	0.02	0.42	0.71
Physico-chemical																
Total Alkalinity as CaCO3	mg/l	1		No project standard		837.6	790.92	760.5	481.65	709.8	557.7	25	24	28	511.09	837.6
Electrical Conductivity	mS/cm	2		No project standard		1.787	1.771	1.166	1.674	1.917	1.482	24	24	0.591	1.46	1.917
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	7.76		8.08	7.87	7.71	8.27	24	24	7.24	7.96	8.84
Redox (Eh)	mV	not specified		No project standard								0	0			
Temperature	°C	0.5		No project standard								3	3	23.2	24.93	26.1
Dissolved Oxygen	mg/l	1		No project standard								3	3	4.81	6.25	7.54
TDS	mg/l	35		1000	KEBS requirements for drinking water	1061	1013	676	1088	1246	981	25	25	384.15	885.22	1246
TSS	mg/l	10		0	KEBS requirements for drinking water	Not detected	Not detected	Not detectable	Not detected	Not detected	Not detected	24	4	2	2.00	2
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water	43.85	39.62	46.33	36.49	30.51	43.17	24	24	1.91	51.24	196.53
Silica	mg/l	0.01		No project standard		18.46	19.14	21.65	16.74	14.11	17.48	25	22	1.3	14.00	25.21
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water	absent	Absent	Absent	<0.02	<0.02	<0.02	21	4	0.01	0.03	0.06
Organics and Oils																
TPH CWG - Aliphatics																
>C5-C6 [#]	mg/l	0.005		No project standard								0	0			
>C8-C10 [#]	mg/l	0.005		No project standard								0	0			
>C6-C8 [#]	mg/l	0.005		No project standard								0	0			
>C10-C12[#]	mg/l	0.005		No project standard								0	0			
>C12-C16[#]	mg/l	0.01		No project standard								0	0			
>C16-C21[#]	mg/l	0.01		No project standard								0	0			
>C21-C35[#]	mg/l	0.01		No project standard								0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard								0	0			
TPH CWG - Aromatics																
>C5-EC7 [#]	mg/l	0.005		No project standard								0	0			
>EC7-EC8 [#]	mg/l	0.005		No project standard								0	0			
>EC8-EC10 [#]	mg/l	0.005		No project standard								0	0			
>EC10-EC12[#]	mg/l	0.005		No project standard								0	0			
>EC12-EC16[#]	mg/l	0.01		No project standard								0	0			
>EC16-EC21[#]	mg/l	0.01		No project standard								0	0			
>EC21-EC35[#]	mg/l	0.01		No project standard								0	0			
Total aromatics C5-35	mg/l	0.01		No project standard								0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard								2	1	0.63	0.63	0.63
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water							3	1	0.05	0.05	0.05
Toluene	mg/l	0.0005		0.7	WHO DWS							3	1	0.02	0.02	0.02
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS							3	0			
Xylene (total)	mg/l			0.5	WHO DWS							1	0			
m/p-Xylene	mg/l	not analysed		No project standard								0	0			
o-Xylene	mg/l	not analysed		No project standard								0	0			
Polyaromatic Hydrocarbons																
Naphthalene	mg/l	0.00001		No project standard								3	2	0.01	0.03	0.04
Acenaphthylene	mg/l	0.00001		No project standard								3	0			
Acenaphthene	mg/l	0.00001		No project standard								3	0			
Fluorene	mg/l	0.00001		No project standard								3	1	0.04	0.04	0.04
Phenanthrene	mg/l	0.00001		No project standard								3	1	0.03	0.03	0.03
Anthracene	mg/l	0.00001		No project standard								3	0			
Fluoranthene	mg/l	0.00001		No project standard								3	0			
Pyrene	mg/l	0.00001		No project standard								3	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard								3	0			
Chrysene	mg/l	0.00001		No project standard								3	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard								3	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS							3	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard								3	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard								3	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard								3	0			
Inorganics and Trace Metals																
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water	<0.05	<0.05	<0.05	<0.06	<0.05	<0.05	26	3	0.1	0.17	0.28
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water	<0.01	<0.01	<0.01	<0.01	<0.01	2.06	25	1	2.06	2.06	2.06
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	25	2	0.001	0.02	0.04
Beryllium	mg/l	0.005		No project standard								3	0			
Boron	mg/l	0.002		2.4	WHO DWS							3	1	0.13	0.13	0.13
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water	not detected	Nil	Nil	Nil	Nil	Not detected	22	9	0.08	0.39	0.92
Bromate as BrO3	mg/L	0.001		No project standard			<0.001				0.077	16	2	0.016	0.05	0.077
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water	not detected	Not detected	Not detected	Not detected	Not detected	<0.01	24	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	25	1	0.02	0.02	0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	<0.01	<0.01	<0.01	<0.01	<0.01		25	2	0.1	0.19	0.27
Cyanide	mg/l			0.07	KEBS requirements for drinking water		<0.001	<0.001	<0.001	<0.001	1.07	19	1	1.07	1.07	1.07
Iron (Ferrous)	mg/l	0.00002		No project standard								0	0			
Iron (Feric)	mg/l	0.00002		No project standard								0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	26	4	0.1	0.18	0.34
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	24	1	0.004	0.00	0.004
Lithium	mg/l	0.004		No project standard		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	22	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water	<0.01	<0.01	<0.01	<0.01	<0.01		25	5	0.004	0.13	0.44
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water	Not detected	Not detected	Not detected	Not detected	Not detected	Nil	24	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water	<0.02	<0.02	<0.02	<0.02	<0.02	<0.001	25	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water	<0.01	<0.01	0.03	<0.01	<0.01	Not detected	24	1	0.03	0.03	0.03
Vanadium	mg/l	0.0006		No project standard								3	3	0.04	0.05	0.06
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	26	5	0.01	0.11	0.45
Strontium	mg/l	0.005		No project standard		0.22	0.21	0.24	0.02	0.16	0.2	25	19	0.02	0.24	0.69
Sanitary																
BOD	mg/l	1		No project standard								3	3	2.74	18.50	28.21
COD	mg/l	7		No project standard								3	3	7.42	37.57	57.23
Total nitrogen	mg/l	0.5		No project standard								3	3	0.21	2.17	4.69
Total phosphorous	mg/l	0.5		No project standard								3	1	0.02	0.02	0.02
Total coliform bacteria	MPN/100ml	not specified		No project standard								3	3	17	562.33	1600
Fecal coliforms	MPN/100ml	not specified		No project standard								3	2	2	12.50	23

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Groundwater Data
GW4

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	GW4	GW4	Number of Analyses	Number of Analyses with Numerical Result	Result		
			Min	Max	Source	Sample ID / Date	27/11/2015	30/08/2016			Min	Mean	Max
Major Ions													
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		49.48	46.31	2	2	46.31	47.90	49.48
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		17.51	16.31	2	2	16.31	16.91	17.51
Potassium	mg/l	0.1		No project standard			5.41	4.55	2	2	4.55	4.98	5.41
Sodium	mg/l	0.1		50	WHO DWS		**72.18**	37.7	2	2	37.7	54.94	72.18
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		0.38	1.4	2	2	0.38	0.89	1.4
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		8.86	14.97	2	2	8.86	11.92	14.97
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		**>30**	30.88	2	1	30.88	30.88	30.88
Alkalinity (HCO3)	mg/l	1		No project standard					0	0			
Nutrients													
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		0.02	0.66	2	2	0.02	0.34	0.66
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		3.4	2.49	2	2	2.49	2.95	3.4
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		<	**0.09**	2	1	0.09	0.09	0.09
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water				0	0			
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water		**0.68**	0.01	2	2	0.01	0.35	0.68
Physico-chemical													
Total Alkalinity as CaCO3	mg/l	1		No project standard			310	110	2	2	110	210.00	310
Electrical Conductivity	mS/cm	2		No project standard			0.419	0.612	2	2	0.419	0.52	0.612
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		8.47	7.46	2	2	7.46	7.97	8.47
Redox (Eh)	mV	not specified		No project standard					0	0			
Temperature	°C	0.5		No project standard			26.4	23.5	2	2	23.5	24.95	26.4
Dissolved Oxygen	mg/l	1		No project standard			3.01	7.7	2	2	3.01	5.36	7.7
TDS	mg/l	35		1000	KEBS requirements for drinking water		293.3	397.8	2	2	293.3	345.55	397.8
TSS	mg/l	10		0	KEBS requirements for drinking water		**2**	**3**	2	2	2	2.50	3
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		195.65	182.8	2	2	182.8	189.23	195.65
Silica	mg/l	0.01		No project standard			2.38	2.61	2	2	2.38	2.50	2.61
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water				0	0			
Organics and Oils													
TPH CWG - Aliphatics													
>C5-C6 [#]	mg/l	0.005		No project standard					0	0			
>C8-C10 [#]	mg/l	0.005		No project standard					0	0			
>C6-C8 [#]	mg/l	0.005		No project standard					0	0			
>C10-C12 [#]	mg/l	0.005		No project standard					0	0			
>C12-C16 [#]	mg/l	0.01		No project standard					0	0			
>C16-C21 [#]	mg/l	0.01		No project standard					0	0			
>C21-C35 [#]	mg/l	0.01		No project standard					0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard					0	0			
TPH CWG - Aromatics													
>C5-EC7 [#]	mg/l	0.005		No project standard					0	0			
>EC7-EC8 [#]	mg/l	0.005		No project standard					0	0			
>EC8-EC10 [#]	mg/l	0.005		No project standard					0	0			
>EC10-EC12 [#]	mg/l	0.005		No project standard					0	0			
>EC12-EC16 [#]	mg/l	0.01		No project standard					0	0			
>EC16-EC21 [#]	mg/l	0.01		No project standard					0	0			
>EC21-EC35 [#]	mg/l	0.01		No project standard					0	0			
Total aromatics C5-35	mg/l	0.01		No project standard					0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard			<0.01	0.58	2	1	0.58	0.58	0.58
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water		<0.01	**0.03**	2	1	0.03	0.03	0.03
Toluene	mg/l	0.0005		0.7	WHO DWS		<0.01	<0.01	2	0	0	#DIV/0!	0
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS		<0.01	<0.01	2	0	0	#DIV/0!	0
Xylene (total)	mg/l			0.5	WHO DWS		<0.01		1	0	0	#DIV/0!	0
m/p-Xylene	mg/l	not analysed		No project standard					0	0			
o-Xylene	mg/l	not analysed		No project standard					0	0			
Polyaromatic Hydrocarbons													
Naphthalene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Acenaphthylene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Acenaphthene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Fluorene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Phenanthrene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Anthracene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Fluoranthene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Pyrene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Benzo(a)anthracene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Chrysene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard			<0.01	<0.02	2	0	0	#DIV/0!	0
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS		<0.01	<0.01	2	0	0	#DIV/0!	0
Indeno(123cd)pyrene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Benzo(ghi)perylene	mg/l	0.00001		No project standard			<0.01	<0.01	2	0	0	#DIV/0!	0
Inorganics and Trace Metals													
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.04	<0.04	2	0	0	#DIV/0!	0
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		<	<	2	0	0	#DIV/0!	0
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.03	0.03	2	2	0.03	0.03	0.03
Beryllium	mg/l	0.005		No project standard			<0.0003	<0.003	2	0	0	#DIV/0!	0
Boron	mg/l	0.002		2.4	WHO DWS		<0.005	<0.005	2	0	0	#DIV/0!	0
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water				0	0			
Bromate as BrO3	mg/L	0.001		No project standard					0	0			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		<	<	2	0	0	#DIV/0!	0
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.007	<0.007	2	0	0	#DIV/0!	0
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.006	<0.006	2	0	0	#DIV/0!	0
Cyanide	mg/l			0.07	KEBS requirements for drinking water				0	0			
Iron (Ferrous)	mg/l	0.00002		No project standard					0	0			
Iron (Feric)	mg/l	0.00002		No project standard					0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.007	0.06	2	1	0.06	0.06	0.06
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		<	<	2	0	0	#DIV/0!	0
Lithium	mg/l	0.004		No project standard					0	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.002	<0.002	2	0	0	#DIV/0!	0
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		<	<	2	0	0	#DIV/0!	0
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.015	<0.015	2	0	0	#DIV/0!	0
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		<0.01	<0.01	2	0	0	#DIV/0!	0
Vanadium	mg/l	0.0006		No project standard			0.04	0.04	2	2	0.04	0.04	0.04
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		0.05	0.16	2	2	0.05	0.11	0.16
Strontium	mg/l	0.005		No project standard			0.68	0.59	2	2	0.59	0.64	0.68
Sanitary													
BOD	mg/l	1		No project standard			3.08	29.03	2	2	3.08	16.06	29.03
COD	mg/l	7		No project standard			7.62	50.63	2	2	7.62	29.13	50.63
Total nitrogen	mg/l	0.5		No project standard			0.18	1.54	2	2	0.18	0.86	1.54
Total phosphorous	mg/l	0.5		No project standard			0.02	<0.01	2	1	0.02	0.02	0.02
Total coliform bacteria	MPN/100ml	not specified		No project standard			23	>1800	2	1	23	23.00	23
Fecal coliforms	MPN/100ml	not specified		No project standard			5	540	2	2	5	272.50	540

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Groundwater Data
GW5

Parameter	Units	Requested Detection Limit	Project Water Quality Standard: Min	Max	Source	Location / Sample ID / Date	27/11/2015 GW5	29/05/2016 GW5	29/08/2016 GW5	Number of Analyses	Number of Analyses with Numerical Result	Result: Min	Mean	Max
Major Ions														
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		0.08	45.88	48.87	3	3	0.08	31.61	48.87
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		<0.03	24.31	27.22	3	2	24.31	25.77	27.22
Potassium	mg/l	0.1		No project standard			<0.01	1.88	0.77	3	2	0.77	1.33	1.88
Sodium	mg/l	0.1		50	WHO DWS		2.48	**122.3**	**110.55**	3	3	2.48	78.44	122.3
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		0.49	0.25	**1.84**	3	3	0.25	0.86	1.84
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		0.09	34.85	39.07	3	3	0.09	24.67	39.07
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		**>30**	**282.17**	58.02	3	2	58.02	170.10	282.17
Alkalinity (HCO3)	mg/l	1		No project standard						0	0			
Nutrients														
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		0.04	2.14	0.41	3	3	0.04	0.86	2.14
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		1	3.05	2.64	3	3	1	2.23	3.05
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		<	<	**0.04**	3	1	0.04	0.04	0.04
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water					0	0			
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water		0.47	**1.07**	0.04	3	3	0.04	0.53	1.07
Physico-chemical														
Total Alkalinity as CaCO3	mg/l	1		No project standard			346	45	130	3	3	45	173.67	346
Electrical Conductivity	mS/cm	2		No project standard			0.762	1.234	1.101	3	3	0.762	1.03	1.234
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		**8.83**	7.16	7.55	3	3	7.16	7.85	8.83
Redox (Eh)	mV	not specified		No project standard						0	0			
Temperature	°C	0.5		No project standard			26.5	24.9	23.1	3	3	23.1	24.83	26.5
Dissolved Oxygen	mg/l	1		No project standard			4.12	6.44	8	3	3	4.12	6.19	8
TDS	mg/l	35		1000	KEBS requirements for drinking water		533.4	800.75	715.65	3	3	533.4	683.27	800.75
TSS	mg/l	10		0	KEBS requirements for drinking water		**2**	**3**	**1**	3	3	1	2.00	3
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		0.26	214.66	234.1	3	3	0.26	149.67	234.1
Silica	mg/l	0.01		No project standard			1.25	39.52	3.64	3	3	1.25	14.80	39.52
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water					0	0			
Organics and Oils														
TPH CWG - Aliphatics														
>C5-C6 #	mg/l	0.005		No project standard						0	0			
>C8-C10 #	mg/l	0.005		No project standard						0	0			
>C6-C8 #	mg/l	0.005		No project standard						0	0			
>C10-C12#	mg/l	0.005		No project standard						0	0			
>C12-C16#	mg/l	0.01		No project standard						0	0			
>C16-C21#	mg/l	0.01		No project standard						0	0			
>C21-C35#	mg/l	0.01		No project standard						0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard						0	0			
TPH CWG - Aromatics														
>C5-EC7 #	mg/l	0.005		No project standard						0	0			
>EC7-EC8 #	mg/l	0.005		No project standard						0	0			
>EC8-EC10 #	mg/l	0.005		No project standard						0	0			
>EC10-EC12#	mg/l	0.005		No project standard						0	0			
>EC12-EC16#	mg/l	0.01		No project standard						0	0			
>EC16-EC21#	mg/l	0.01		No project standard						0	0			
>EC21-EC35#	mg/l	0.01		No project standard						0	0			
Total aromatics C5-35	mg/l	0.01		No project standard						0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard			<0.01		0.61	2	1	0.61	0.61	0.61
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water		<0.01	<0.01	<0.01	3	0			
Toluene	mg/l	0.0005		0.7	WHO DWS		<0.01	<0.01	0.03	3	1	0.03	0.03	0.03
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS		<0.01	<0.01	<0.01	3	0			
Xylene (total)	mg/l			0.5	WHO DWS		<0.01			1	0			
m/p-Xylene	mg/l	not analysed		No project standard						0	0			
o-Xylene	mg/l	not analysed		No project standard						0	0			
Polyaromatic Hydrocarbons														
Naphthalene	mg/l	0.00001		No project standard			<0.01	<0.01	0.01	3	1	0.01	0.01	0.01
Acenaphthylene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Acenaphthene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Fluorene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Phenanthrene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Anthracene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Fluoranthene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Pyrene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Chrysene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard			<0.01	<0.02	<0.02	3	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS		<0.01	<0.01	<0.01	3	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard			<0.01	<0.01	<0.01	3	0			
Inorganics and Trace Metals														
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.04	0.08	<0.04	3	1	0.08	0.08	0.08
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		<	<	<	3	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		<0.002	0.01	<0.002	3	1	0.01	0.01	0.01
Beryllium	mg/l	0.005		No project standard			<0.0003	<0.003	<0.003	3	0			
Boron	mg/l	0.002		2.4	WHO DWS		<0.005	0.09	<0.005	3	1	0.09	0.09	0.09
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water					0	0			
Bromate as BrO3	mg/L	0.001		No project standard						0	0			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		<	<	<	3	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.007	<0.007	<0.007	3	0			
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.006	<0.006	<0.006	3	0			
Cyanide	mg/l			0.07	KEBS requirements for drinking water					0	0			
Iron (Ferrous)	mg/l	0.00002		No project standard						0	0			
Iron (Feric)	mg/l	0.00002		No project standard						0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.007	<0.007	0.03	3	1	0.03	0.03	0.03
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		<	<	<	3	0			
Lithium	mg/l	0.004		No project standard						0	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.002	0.01	<0.002	3	1	0.01	0.01	0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		<	<	<	3	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.015	<0.015	<0.015	3	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		<0.01	<0.01	<0.01	3	0			
Vanadium	mg/l	0.0006		No project standard			<0.008	0.07	0.07	3	2	0.07	0.07	0.07
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.002	<0.002	0.03	3	1	0.03	0.03	0.03
Strontium	mg/l	0.005		No project standard			<0.005	0.34	0.37	3	2	0.34	0.36	0.37
Sanitary														
BOD	mg/l	1		No project standard			2.58	22.46	27.9	3	3	2.58	17.65	27.9
COD	mg/l	7		No project standard			9.69	39.48	52.01	3	3	9.69	33.73	52.01
Total nitrogen	mg/l	0.5		No project standard			0.12	1.58	1.91	3	3	0.12	1.20	1.91
Total phosphorous	mg/l	0.5		No project standard			0.04	0.06	<0.01	3	2	0.04	0.05	0.06
Total coliform bacteria	MPN/100ml	not specified		No project standard			110	1600	7	3	3	7	572.33	1600
Fecal coliforms	MPN/100ml	not specified		No project standard			<	<	<	3	0			

< *non detection and no detection limit provided*
Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.
not analysed for

Groundwater Data
Nakukulas 10

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10
						Sample ID	Nakukulas 10	6		6-OCT-15	6/NOV/2015	4-DEC-15	AQ 49748	Kapese lab	SGS	SGS (03805.002)	SGS NK 10	0 (SGS MA18-00633	GS MA18-02360.00	BH'(SGS MA18-028	GS MA18-04598.00	MA18-05094-010	MA18-05739.002	MA19-00061.003
			Min	Max	Source	Date	09/08/2014	28/07/2015	21/09/2015	27/10/2015	27/11/2015	30/12/2015	31/10/2016	01/02/2017	01/04/2017	16/08/2017	04/10/2017	09/02/2018	25/05/2018	27/06/2018	01/09/2018	01/10/2018	30/11/2018	01/12/2018
Major Ions																								
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		31.97	29.19	29.4	29.5	29.69	6.63	1.87		25.47	27.8	36.02	26.17	33.47	27.4	6.3	24.54	20.64	16.88
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		16.5	17.17	16.77	16.76	17.25	4.91	0.21		14.68	16.69	19.23	16.65	19.25	15.87	6.97	16.1	13.07	10.8
Potassium	mg/l	0.1		No project standard				1.95	1.57	1.59	1.62	1.16	1.54	0.8	1.41	1.46	1.68	1.33	1.53	1.46	1.77	1.5	1.25	1.05
Sodium	mg/l	0.1		50	WHO DWS			81.7	104.41	60.23	62.13	129.65	71.74		57.28	74.71	108.96	60.39	71.52	56.6	158.67	54.98	48.43	32.13
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		1.38	0.92	0.64	0.44	0.87	1	<	0.85	0.73	0.83	0.85	0.67	0.95	0.83	1.6	1.12	0.31	0.72
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		5.4	7.41	6.8	3	5.35	18.9	7.15	1	14.84	57.62	8.83	7.82	7.2	7	29.22	6.79	8.44	23.67
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		9.15	19	9.64	11.32	9.43	26.59	11.79	5	8.66	17	10.81	7.23	4.63	3.86	59.56	10.21	34.03	12.76
Alkalinity (HCO3)	mg/l	1		No project standard																				
Nutrients																								
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water			Nil	Not detected	Nil	Nil	Nil	1.07	0.18	<0.02	0.02	0.01	0.27	5.85	0.06	0.18	5.73	2	0.06
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			7.7	1.8	49.5	5.1	11.8	<0.01	4.4	5.21	2.36	1.27	23.86	16.13	17.94	29.5	19.27	8.06	3.58
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			<	<	<	<	<	<0.01	Nil	Nil	0.11	0.2	Not detected	Not detected	Not detected	Not detected	0.02	0.037	Not detected
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water		0.18	0.04	0.11	0.07	0.04	0.02	<0.001	0.04	0.03	0.13	0.04	0.03	0.03	12.29	0.39	0.21	2.03	<0.1
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water																			
Physico-chemical																								
Total Alkalinity as CaCO3	mg/l	1		No project standard				280	300	240	240	200	47.98	265	220	317.6	358.75	287	444.98	471.15	517.14	385.32	278.85	354.9
Electrical Conductivity	mS/cm	2		No project standard				0.583	1.38	0.512	0.511	0.476	0.51		0.718	0.623	0.594	0.661	1.212	0.742	1.357		0.701	0.789
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		7.95	7.82	7.66	7.55	7.63	7.83	7.65		7.9	7.4	7.71	7.7	8	7.17	8.04	7.51	7.47	7.29
Redox (Eh)	mV	not specified		No project standard																				
Temperature	°C	0.5		No project standard																				
Dissolved Oxygen	mg/l	1		No project standard																				
TDS	mg/l	35		1000	KEBS requirements for drinking water		320	378.95	427.7	332.8	332.15	309.4	255		466.7	356	353	430	707	430	795	285	456	513
TSS	mg/l	10		0	KEBS requirements for drinking water			Detectable	Not detectable	Not detectable	Not detectable	Detectable	2		Not detected	Not detected	Not detected	Detectable	not detectable	not detectable	Detectable	Detectable	Not detected	Not detected
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		147.78	143.59		142.69	145.17	36.74	5.55	170	124.06	138.7	169.14	133.92	162.83	133.76	44.44	127.56	105.33	86.61
Silica	mg/l	0.01		No project standard				18.29	17.43	24.09	2.51	2.1		0.02	2.36	13.76	29.3	24.31	27.68	22.12	20.37	24.48	19.28	15.9
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02	<0.02	<0.02	<0.02	<0.02	0.04		<0.02	<0.02	<0.02	<0.02	absent	absent	Absent	Absent	<0.02	<0.02
Organics and Oils																								
TPH CWG - Aliphatics																								
>C5-C6#	mg/l	0.005		No project standard																				
>C8-C10#	mg/l	0.005		No project standard																				
>C6-C8#	mg/l	0.005		No project standard																				
>C10-C12#	mg/l	0.005		No project standard																				
>C12-C16#	mg/l	0.01		No project standard																				
>C16-C21#	mg/l	0.01		No project standard																				
>C21-C35#	mg/l	0.01		No project standard																				
Total aliphatics C5-35	mg/l	0.01		No project standard																				
TPH CWG - Aromatics																								
>C5-EC7#	mg/l	0.005		No project standard																				
>EC7-EC8#	mg/l	0.005		No project standard																				
>EC8-EC10#	mg/l	0.005		No project standard																				
>EC10-EC12#	mg/l	0.005		No project standard																				
>EC12-EC16#	mg/l	0.01		No project standard																				
>EC16-EC21#	mg/l	0.01		No project standard																				
>EC21-EC35#	mg/l	0.01		No project standard																				
Total aromatics C5-35	mg/l	0.01		No project standard																				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard																				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water																			
Toluene	mg/l	0.0005		0.7	WHO DWS																			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS																			
Xylene (total)	mg/l			0.5	WHO DWS																			
m/p-Xylene	mg/l	not analysed		No project standard																				
o-Xylene	mg/l	not analysed		No project standard																				
Polyaromatic Hydrocarbons																								
Naphthalene	mg/l	0.00001		No project standard																				
Acenaphthylene	mg/l	0.00001		No project standard																				
Acenaphthene	mg/l	0.00001		No project standard																				
Fluorene	mg/l	0.00001		No project standard																				
Phenanthrene	mg/l	0.00001		No project standard																				
Anthracene	mg/l	0.00001		No project standard																				
Fluoranthene	mg/l	0.00001		No project standard																				
Pyrene	mg/l	0.00001		No project standard																				
Benzo(a)anthracene	mg/l	0.00001		No project standard																				
Chrysene	mg/l	0.00001		No project standard																				
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard																				
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS																			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard																				
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard																				
Benzo(ghi)perylene	mg/l	0.00001		No project standard																				
Inorganics and Trace Metals																								
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water			<0.04	<0.04	<0.04	<0.04	<0.04	0.13	Nil	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			<	<	<	<	<	<0.01	Nil	Not detected	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.06	<0.002	<0.002	<0.002	<0.002	<0.002	<0.01		<0.004	<0.004	0.02	<0.004	<0.004	<0.004	<0.004	0.01	<0.004	<0.004
Beryllium	mg/l	0.005		No project standard																				
Boron	mg/l	0.002		2.4	WHO DWS										0.08			0.01						
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water			<0.005	0.03		0.05	0.17	<0.01	0.2	0.47	Not detected	Nil	0.07	Nil	Nil	Nil	Nil	Nil	Nil
Bromate as BrO3	mg/L	0.001		No project standard				<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			<	<	<	<	<	<0.01		Not detected	Not detected	Not detected	Not detected	Not detected	not detected	Not detected	Not detected	Not detected	Not detected
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.007	<0.007	<0.007	<0.007	<0.007	<0.01	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			<0.006	<0.006	<0.006	<0.006	<0.006	<0.01	Nil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide	mg/l			0.07	KEBS requirements for drinking water			Nil	Nil	Nil	Nil	Nil	<0.001		Nil	Nil	Nil	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron (Ferrous)	mg/l	0.00002		No project standard																				
Iron (Feric)	mg/l	0.00002		No project standard																				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water			0.11	<0.007	0.02	<0.007	0.06	0.09	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			<	<	<	<	<	<0.01		Not detected	<0.004	Not detected	Not detected	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Lithium	mg/l	0.004		No project standard				<0.004	<0.002	<0.004	<0.004	<0.004	<0.001		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water			<0.002	<0.002	<0.002	<0.002	<0.002	0.04	0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			<	<	<	<	<	<0.01		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.015	<0.015	<0.015	<0.015	<0.015	<0.01	Nil	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		Not detected	Not detected	Not detected	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	mg/l	0.0006		No project standard																				
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			<0.002	0.01	<0.002	<0.002	0.04	0.07	0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/l	0.005		No project standard				0.46	0.46	0.45	<0.005	0.15	<0.01		0.44	0.43	0.51	0.43	0.49	0.43	0.18	0.44	0.38	0.33
Sanitary																								
BOD	mg/l	1		No project standard																				
COD	mg/l	7		No project standard																				
Total nitrogen	mg/l	0.5		No project standard																				
Total phosphorous	mg/l	0.5		No project standard																				
Total coliform bacteria	MPN/100ml	not specified		No project standard																				
Fecal coliforms	MPN/100ml	not specified		No project standard																				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Groundwater Data
Nakukulas 10

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Number of Analyses	Number of Analyses with Numerical Result	Result		
			Min	Max	Source			Min	Mean	Max
Major Ions										
Calcium	mg/l	0.2		150	KEBS requirements for drinking water	17	17	1.87	23.70	36.02
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water	17	17	0.21	14.05	19.25
Potassium	mg/l	0.1		No project standard		17	17	0.8	1.45	1.95
Sodium	mg/l	0.1		50	WHO DWS	16	16	32.13	77.10	158.67
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water	18	17	0.31	0.87	1.6
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water	18	18	1	12.58	57.62
Chloride	mg/l	0.3		250	KEBS requirements for drinking water	18	18	3.86	15.04	59.56
Alkalinity (HCO3)	mg/l	1		No project standard		0	0			
Nutrients										
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water	17	11	0.01	1.40	5.85
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	17	16	1.27	12.97	49.5
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water	17	4	0.02	0.09	0.2
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water	18	16	0.02	0.98	12.29
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water	0	0			
Physico-chemical										
Total Alkalinity as CaCO3	mg/l	1		No project standard		17	17	47.98	306.39	517.14
Electrical Conductivity	mS/cm	2		No project standard		15	15	0.476	0.76	1.38
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	17	17	7.17	7.66	8.04
Redox (Eh)	mV	not specified		No project standard		0	0			
Temperature	°C	0.5		No project standard		0	0			
Dissolved Oxygen	mg/l	1		No project standard		0	0			
TDS	mg/l	35		1000	KEBS requirements for drinking water	17	17	255	420.45	795
TSS	mg/l	10		0	KEBS requirements for drinking water	16	1	2	2.00	2
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water	17	17	5.55	118.70	170
Silica	mg/l	0.01		No project standard		16	16	0.02	16.50	29.3
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water	16	1	0.04	0.04	0.04
Organics and Oils										
TPH CWG - Aliphatics										
>C5-C6 [#]	mg/l	0.005		No project standard		0	0			
>C8-C10 [#]	mg/l	0.005		No project standard		0	0			
>C6-C8 [#]	mg/l	0.005		No project standard		0	0			
>C10-C12 [#]	mg/l	0.005		No project standard		0	0			
>C12-C16 [#]	mg/l	0.01		No project standard		0	0			
>C16-C21 [#]	mg/l	0.01		No project standard		0	0			
>C21-C35 [#]	mg/l	0.01		No project standard		0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard		0	0			
TPH CWG - Aromatics										
>C5-EC7 [#]	mg/l	0.005		No project standard		0	0			
>EC7-EC8 [#]	mg/l	0.005		No project standard		0	0			
>EC8-EC10 [#]	mg/l	0.005		No project standard		0	0			
>EC10-EC12 [#]	mg/l	0.005		No project standard		0	0			
>EC12-EC16 [#]	mg/l	0.01		No project standard		0	0			
>EC16-EC21 [#]	mg/l	0.01		No project standard		0	0			
>EC21-EC35 [#]	mg/l	0.01		No project standard		0	0			
Total aromatics C5-35	mg/l	0.01		No project standard		0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard		0	0			
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water	0	0			
Toluene	mg/l	0.0005		0.7	WHO DWS	0	0			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS	0	0			
Xylene (total)	mg/l			0.5	WHO DWS	0	0			
m/p-Xylene	mg/l	not analysed		No project standard		0	0			
o-Xylene	mg/l	not analysed		No project standard		0	0			
Polyaromatic Hydrocarbons										
Naphthalene	mg/l	0.00001		No project standard		0	0			
Acenaphthylene	mg/l	0.00001		No project standard		0	0			
Acenaphthene	mg/l	0.00001		No project standard		0	0			
Fluorene	mg/l	0.00001		No project standard		0	0			
Phenanthrene	mg/l	0.00001		No project standard		0	0			
Anthracene	mg/l	0.00001		No project standard		0	0			
Fluoranthene	mg/l	0.00001		No project standard		0	0			
Pyrene	mg/l	0.00001		No project standard		0	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard		0	0			
Chrysene	mg/l	0.00001		No project standard		0	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard		0	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS	0	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard		0	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard		0	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard		0	0			
Inorganics and Trace Metals										
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water	17	1	0.13	0.13	0.13
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water	17	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water	17	3	0.01	0.03	0.06
Beryllium	mg/l	0.005		No project standard		0	0			
Boron	mg/l	0.002		2.4	WHO DWS	2	2	0.01	0.05	0.08
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water	16	6	0.03	0.17	0.47
Bromate as BrO3	mg/L	0.001		No project standard		12	1	0.002	0.00	0.002
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water	16	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water	17	2	0.01	0.02	0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	17	0			
Cyanide	mg/l			0.07	KEBS requirements for drinking water	16	0			
Iron (Ferrous)	mg/l	0.00002		No project standard		0	0			
Iron (Feric)	mg/l	0.00002		No project standard		0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water	17	5	0.02	0.06	0.11
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water	16	0			
Lithium	mg/l	0.004		No project standard		16	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water	17	2	0.001	0.02	0.04
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water	16	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water	17	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water	16	0			
Vanadium	mg/l	0.0006		No project standard		0	0			
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	17	5	0.01	0.04	0.07
Strontium	mg/l	0.005		No project standard		16	14	0.15	0.40	0.51
Sanitary										
BOD	mg/l	1		No project standard		0	0			
COD	mg/l	7		No project standard		0	0			
Total nitrogen	mg/l	0.5		No project standard		0	0			
Total phosphorous	mg/l	0.5		No project standard		0	0			
Total coliform bacteria	MPN/100ml	not specified		No project standard		0	0			
Fecal coliforms	MPN/100ml	not specified		No project standard		0	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Groundwater Data
Kengakalalio C (Kaimegur B)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Kaengakalalio C	Kaengakalalio C/Kaimegur B	Kaengakalalio C/Kaimegur B	Kaengakalalio C/Kaimegur B	Kaimegur B	Kaimegur B	Number of Analyses	Number of Analyses with Numerical Result	Result		
						Sample ID	SGS (KAE-C)	KAN - C (SGS MA18-00633.007)	Kaimegur B(SGS MA18-02360.004)	Kaeng' BH C(SGS MA18-02852.005)	MA18-05094.008	MA18-05739.004			Min	Mean	Max
			Min	Max	Source	Date	17/10/2017	09/02/2018	25/05/2018	27/06/2018	01/10/2018	30/11/2018					
Major Ions																	
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		3.72	1.95	3.46	4.15	1.94	1.62	6	6	1.62	2.81	4.15
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		1.89	1.21	2.58	3.46	1.25	1.13	6	6	1.13	1.92	3.46
Potassium	mg/l	0.1		No project standard			7.15	2.87	5.15	3.89	3.36	3.17	6	6	2.87	4.27	7.15
Sodium	mg/l	0.1		50	WHO DWS		**141.05**	**294.22**	**342.39**	**327.91**	**199.13**	**180.25**	6	6	141.05	247.49	342.39
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		**3.61**	**3.07**	**3.62**	**3.71**	**3.28**	**3.29**	6	6	3.07	3.43	3.71
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		145.71	64.62	85.2	86.64	30.66	94.05	6	6	30.66	84.48	145.71
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		220.57	85.82	93.2	118.6	64.66	96.14	6	6	64.66	113.17	220.57
Alkalinity (HCO3)	mg/l	1		No project standard									0	0			
Nutrients																	
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		0.03	0.12	0.46	**2.33**	**2.91**	2.2	6	6	0.03	1.34	2.91
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		2.31	**39.34**	**32.29**	**41.45**	**24.77**	6.4	6	6	2.31	24.43	41.45
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		**0.1**	**0.21**	Not detected	**0.151**	Not detected	**0.028**	6	4	0.028	0.12	0.21
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water		0.2	0.04	0.02	<0.01	0.2	**2.2**	6	5	0.02	0.53	2.2
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water								0	0			
Physico-chemical																	
Total Alkalinity as CaCO3	mg/l	1		No project standard			809.75	666.25	889.95	942.3	648.96	659.1	6	6	648.96	769.39	942.3
Electrical Conductivity	mS/cm	2		No project standard			2.697	1.725	2.164	2.45	1.331	2.063	6	6	1.331	2.07	2.697
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		**8.73**	8.38	8.36	7.9	8.42	8.42	6	6	7.9	8.37	8.73
Redox (Eh)	mV	not specified		No project standard									0	0			
Temperature	°C	0.5		No project standard									0	0			
Dissolved Oxygen	mg/l	1		No project standard									0	0			
TDS	mg/l	35		1000	KEBS requirements for drinking water		**1564**	**1121**	**1281**	**1419**	774	**1341**	6	6	774	1250.00	1564
TSS	mg/l	10		0	KEBS requirements for drinking water		**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	Not detected	6	0			
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		17.8	**502.25**	19.28	24.73	9.97	8.68	6	6	8.68	97.12	502.25
Silica	mg/l	0.01		No project standard			26.42	21.21	25.54	20.76	21.89	17.17	6	6	17.17	22.17	26.42
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water		<0.02	<0.02	Absent	Absent	Absent	<0.02	6	0			
Organics and Oils																	
TPH CWG - Aliphatics																	
>C5-C6 #	mg/l	0.005		No project standard									0	0			
>C8-C10 #	mg/l	0.005		No project standard									0	0			
>C6-C8 #	mg/l	0.005		No project standard									0	0			
>C10-C12 #	mg/l	0.005		No project standard									0	0			
>C12-C16 #	mg/l	0.01		No project standard									0	0			
>C16-C21 #	mg/l	0.01		No project standard									0	0			
>C21-C35 #	mg/l	0.01		No project standard									0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard									0	0			
TPH CWG - Aromatics																	
>C5-EC7 #	mg/l	0.005		No project standard									0	0			
>EC7-EC8 #	mg/l	0.005		No project standard									0	0			
>EC8-EC10 #	mg/l	0.005		No project standard									0	0			
>EC10-EC12 #	mg/l	0.005		No project standard									0	0			
>EC12-EC16 #	mg/l	0.01		No project standard									0	0			
>EC16-EC21 #	mg/l	0.01		No project standard									0	0			
>EC21-EC35 #	mg/l	0.01		No project standard									0	0			
Total aromatics C5-35	mg/l	0.01		No project standard									0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard									0	0			
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water								0	0			
Toluene	mg/l	0.0005		0.7	WHO DWS								0	0			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS								0	0			
Xylene (total)	mg/l			0.5	WHO DWS								0	0			
m/p-Xylene	mg/l	not analysed		No project standard									0	0			
o-Xylene	mg/l	not analysed		No project standard									0	0			
Polyaromatic Hydrocarbons																	
Naphthalene	mg/l	0.00001		No project standard									0	0			
Acenaphthylene	mg/l	0.00001		No project standard									0	0			
Acenaphthene	mg/l	0.00001		No project standard									0	0			
Fluorene	mg/l	0.00001		No project standard									0	0			
Phenanthrene	mg/l	0.00001		No project standard									0	0			
Anthracene	mg/l	0.00001		No project standard									0	0			
Fluoranthene	mg/l	0.00001		No project standard									0	0			
Pyrene	mg/l	0.00001		No project standard									0	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard									0	0			
Chrysene	mg/l	0.00001		No project standard									0	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard									0	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS								0	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard									0	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard									0	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard									0	0			
Inorganics and Trace Metals																	
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		**1.93**	<0.05	**0.4**	**0.18**	0.07	<0.05	6	4	0.07	0.65	1.93
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	6	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.01	<0.004	<0.004	<0.004	<0.004	<0.004	6	1	0.01	0.01	0.01
Beryllium	mg/l	0.005		No project standard									0	0			
Boron	mg/l	0.002		2.4	WHO DWS		0.06	0.11					2	2	0.06	0.09	0.11
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water		**0.34**	**0.63**	Nil	Nil	0.05	Nil	6	3	0.05	0.34	0.63
Bromate as BrO3	mg/L	0.001		No project standard			<2.5	<0.001	<0.001	<0.001			4	0			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	6	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	6	0			
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6	0			
Cyanide	mg/l			0.07	KEBS requirements for drinking water		Nil	<0.001	<0.001	<0.001	<0.001	<0.001	6	0			
Iron (Ferrous)	mg/l	0.00002		No project standard									0	0			
Iron (Feric)	mg/l	0.00002		No project standard									0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		**2.97**	0.05	**0.32**	0.17	0.05	0.19	6	6	0.05	0.63	2.97
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		Not detected	Not detected	<0.004	<0.004	<0.004	<0.004	6	0			
Lithium	mg/l	0.004		No project standard			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	6	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6	0			
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	6	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	6	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6	0			
Vanadium	mg/l	0.0006		No project standard									0	0			
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.01	0.08	0.02	<0.01	<0.01	<0.01	6	2	0.02	0.05	0.08
Strontium	mg/l	0.005		No project standard			0.11	0.1	0.16	0.18	0.09	0.09	6	6	0.09	0.12	0.18
Sanitary																	
BOD	mg/l	1		No project standard									0	0			
COD	mg/l	7		No project standard									0	0			
Total nitrogen	mg/l	0.5		No project standard									0	0			
Total phosphorous	mg/l	0.5		No project standard									0	0			
Total coliform bacteria	MPN/100ml	not specified		No project standard									0	0			
Fecal coliforms	MPN/100ml	not specified		No project standard									0	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Groundwater Data
Kengomo 1

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Number of Analyses	Number of Analyses with Numerical Result
						Sample ID	K-1	1		1-OCT-15	3/NOV/2015	1-DEC-15	AQ 47835b	AQ 48469b	AQ 49001	AQ 49751	Kapese lab	SGS	SGS (03805.004)	SGS KG01	KE-01 (SGS MA18-00633.005)	MA18-02360.001	MA18-02852.001	(SGS MA18-04598.008)	MA18-05739.00		
			Min	Max	Source	Date	11/08/2014	27/07/2015	21/09/2015	27/10/2015	27/11/2015	30/12/2015	07/04/2016	21/06/2016	30/08/2016	31/10/2016	01/02/2017	01/04/2017	16/08/2017	04/10/2017	09/02/2018	01/05/2018	01/06/2018	01/09/2018	30/11/2018		
Major Ions																											
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		8.9	6.83	12.64	6.66	7.55	7.29	15.2	7.61	<0.001	0.45		5.5	6.14	7.86	5.42	8.05	7.01	7.08	5.36	18	17
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		8.3	7.03	7.12	7.25	8.25	7.87	6.64	1.96	2.47	0.93		6.49	7	8	6.19	8.46	7.55	11.4	6.79	18	18
Potassium	mg/l	0.1		No project standard			3.5	4.52	5.19	5.49	4.8	4.85	1.58	10.26	1.55	3.46	2.8	4.04	3.97	4.13	3.99	5.33	5.32	4.09	4.78	19	19
Sodium	mg/l	0.1		50	WHO DWS		702	690.33	491.51	789.61	599.89	632.09	413.5	5.98	573	52.29		395.27	746.13	534.54	492.89	534.76	506.9	433.35	356	18	18
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water			3.8	3.7	3.3	4.3	4	1.25	1.93	0.24	0.23	1.6	0.72	4.69	4.81	3.99	3.95	4.97	3.84	2.38	18	18
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		135	169.99	177	170.4	129.65	125.7	158	9.88	34.2	20.69	124	21.4	115.25	108.66	124.92	124.1	150.44	133.98	204.36	19	19
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		447	532.03	964.24	535.61	386.62	354.5	268	162.22	294.94	355.41	155	34.73	355.51	320.04	345.2	378	366.89	155.7	331.81	19	19
Alkalinity (HCO3)	mg/l	1		No project standard																						0	0
Nutrients																											
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		<0.5	Nil	Not detected	Nil	Nil	Nil	<0.001	0.75	36.15	1.63	0.41	<0.02	0.04	0.01	0.12	0.06	0.09	0.09	1.53	19	11
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		86	25.6	12.6	17	32	34.85	1.25	10.62	22.26	63.84	3.8	3.99	3.01	4.68	121.25	86.74	84	69.04	9.75	19	19
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			Nil	Nil	Nil	Not detected	Not detected	<0.001	<0.001	<0.001	<0.001	Nil	Nil	0.1	0.3	Not detected	not detected	Not detected	Not detected	0.065	18	3
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water			0.06	0.11	0.08	0.1	0.07	<0.001	<0.001	<0.001	<0.001	0.04	0.04	0.08	0.4	0.02	0.02	12.36	0.43	2.09	18	14
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water																					0	0
Physico-chemical																											
Total Alkalinity as CaCO3	mg/l	1		No project standard				680	890	552	620	660	592	216	88	201.35	380	420	913.1	1168.5	809.75	1073.18	1099.35	1014	481.65	18	18
Electrical Conductivity	mS/cm	2		No project standard				3.38	3.48	3.3	2.792	2.477	2.8	0.82	2.8	2.72		3.73	3.2	3.04	2.854	3.39	3.98	2.571	3.56	17	17
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		8.48	7.95	7.81	7.7	7.87	7.88	8.44	7.65	8.13	7.9		8.28	8.01	7.73	8.07	8.08	7.71	8.22	8	18	18
Redox (Eh)	mV	not specified		No project standard																						0	0
Temperature	°C	0.5		No project standard																						0	0
Dissolved Oxygen	mg/l	1		No project standard																						0	0
TDS	mg/l	35		1000	KEBS requirements for drinking water		2324	2197	2262	2145	1814.8	1610.05	1400	410	1400	1360		2424.5	1818	1739	1855	1983	2316	1483	2314	18	18
TSS	mg/l	10		0	KEBS requirements for drinking water			Not detectable	Detectable	Not detectable	Not detectable	Not detectable	Nil	Nil	Nil	12		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Detectable	Detectable	17	1
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water			46.01		46.47	52.81	50.63	48.56	27	10	4.96	50	40.45	44.13	52.6	39.03	54.95	48.62	64.62	41.34	17	17
Silica	mg/l	0.01		No project standard			41	23.07	22.52	31.54	3.74	5.21	4.62	<0.001	<0.001	4.3	0.16	3.65	20.69	44.11	38.44	41.93	34.37	33	29.63	19	17
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.14	0.016	0.03		<0.02	<0.02	<0.02	<0.02	absent	Absent	Absent	<0.02	17	4
Organics and Oils																											
TPH CWG - Aliphatics																											
>C5-C6 #	mg/l	0.005		No project standard																						0	0
>C8-C10 #	mg/l	0.005		No project standard																						0	0
>C6-C8 #	mg/l	0.005		No project standard																						0	0
>C10-C12#	mg/l	0.005		No project standard																						0	0
>C12-C16#	mg/l	0.01		No project standard																						0	0
>C16-C21#	mg/l	0.01		No project standard																						0	0
>C21-C35#	mg/l	0.01		No project standard																						0	0
Total aliphatics C5-35	mg/l	0.01		No project standard																						0	0
TPH CWG - Aromatics																											
>C5-EC7 #	mg/l	0.005		No project standard																						0	0
>EC7-EC8 #	mg/l	0.005		No project standard																						0	0
>EC8-EC10 #	mg/l	0.005		No project standard																						0	0
>EC10-EC12#	mg/l	0.005		No project standard																						0	0
>EC12-EC16#	mg/l	0.01		No project standard																						0	0
>EC16-EC21#	mg/l	0.01		No project standard																						0	0
>EC21-EC35#	mg/l	0.01		No project standard																						0	0
Total aromatics C5-35	mg/l	0.01		No project standard																						0	0
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard																						0	0
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water																					0	0
Toluene	mg/l	0.0005		0.7	WHO DWS																					0	0
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS																					0	0
Xylene (total)	mg/l			0.5	WHO DWS																					0	0
m/p-Xylene	mg/l	not analysed		No project standard																						0	0
o-Xylene	mg/l	not analysed		No project standard																						0	0
Polyaromatic Hydrocarbons																											
Naphthalene	mg/l	0.00001		No project standard																						0	0
Acenaphthylene	mg/l	0.00001		No project standard																						0	0
Acenaphthene	mg/l	0.00001		No project standard																						0	0
Fluorene	mg/l	0.00001		No project standard																						0	0
Phenanthrene	mg/l	0.00001		No project standard																						0	0
Anthracene	mg/l	0.00001		No project standard																						0	0
Fluoranthene	mg/l	0.00001		No project standard																						0	0
Pyrene	mg/l	0.00001		No project standard																						0	0
Benzo(a)anthracene	mg/l	0.00001		No project standard																						0	0
Chrysene	mg/l	0.00001		No project standard																						0	0
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard																						0	0
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS																					0	0
Indeno(123cd)pyrene	mg/l	0.00001		No project standard																						0	0
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard																						0	0
Benzo(ghi)perylene	mg/l	0.00001		No project standard																						0	0
Inorganics and Trace Metals																											
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.3	<0.04	<0.04	<0.04	<0.04	<0.04	0.02	0.09	<0.001	0.09	Nil	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	19	3
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			<	<	<	<	<	<0.001	<0.001	<0.001	<0.01	Nil	Not detected	<0.01	<0.01	<0.01	<0.001	<.01	<0.01	<0.01	18	0
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		<0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.01		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	18	0
Beryllium	mg/l	0.005		No project standard																						0	0
Boron	mg/l	0.002		2.4	WHO DWS													0.22			0.21					2	2
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water		<0.5	<0.005	0.19		0.18	0.4	<0.001	<0.001	<0.001	<0.001	0.65	1.24	2.4	0.61	1.2	0.69	0.25	Nil	Nil	18	10
Bromate as BrO3	mg/L	0.001		No project standard				<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	0.003	<0.001	<0.001	<0.001			14	1
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			<	<	<	<	<	<0.001	<0.001	<0.001	<0.01		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	17	0
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.001	<0.001	<0.01	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	18	1
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.001	0.52	<0.001	<0.01	Nil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19	1
Cyanide	mg/l			0.07	KEBS requirements for drinking water			Nil	Nil	Nil	Nil	Nil	<0.001	<0.001	<0.001	<0.001		Nil	Nil	Nil	<0.001	<0.001	<0.001	<0.001	<0.001	17	0
Iron (Ferrous)	mg/l	0.00002		No project standard																						0	0
Iron (Feric)	mg/l	0.00002		No project standard																						0	0
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.1	<0.007	<0.007	<0.007	<0.007	<0.007	0.008	0.24	0.38	0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.11	19	6
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			<	<	<	<	<	<0.001	<0.001	<0.001	<0.01		Not detected	<0.004	Not detected	Not detected	<0.004	<0.004	<0.004	<0.004	17	0
Lithium	mg/l	0.004		No project standard			<0.05	<0.004	<0.004	<0.004	<0.004	<0.004	<0.001	<0.001	<0.001	<0.001		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	18	0
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	0.45	0.2	0.06	Nil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19	3
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			<	<	<	<	<	<0.001	<0.001	<0.001	<0.01		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	not detected	17	0
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.001	<0.001	<0.01	Nil	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	18	0
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.01		Not detected	Not detected	Not detected	<0.01	0.03	<0.01	<0.01	<0.01	17	1
Vanadium	mg/l	0.0006		No project standard																						0	0
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.05	<0.002	0.01	<0.002	<0.002	<0.002	0.01	<0.001	0.44	0.28	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<.01	<0.01	<0.01	19	5
Strontium	mg/l	0.005		No project standard			0.3	0.29	0.29	0.29	<0.005	0.3	<0.001	<0.001	<0.001	<0.01		0.26	0.25	0.28	0.23	0.29	0.29	0.36	0.25	18	13
Sanitary																											
BOD	mg/l	1		No project standard																						0	0
COD	mg/l	7		No project standard																						0	0
Total nitrogen	mg/l	0.5		No project standard																						0	0
Total phosphorous	mg/l	0.5		No project standard																						0	0
Total coliform bacteria	MPN/100ml	not specified		No project standard																						0	0
Fecal coliforms	MPN/100ml	not specified		No project standard																						0	0

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

(shaded cell) *not analysed for*

Groundwater Data
Kengomo 1

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Result		
			Min	Max	Source	Min	Mean	Max
Major Ions								
Calcium	mg/l	0.2		150	KEBS requirements for drinking water	0.45	7.39	15.2
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water	0.93	6.65	11.4
Potassium	mg/l	0.1		No project standard		1.55	4.40	10.26
Sodium	mg/l	0.1		50	WHO DWS	5.98	497.22	789.61
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water	0.23	2.98	4.97
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water	9.88	117.77	204.36
Chloride	mg/l	0.3		250	KEBS requirements for drinking water	34.73	354.92	964.24
Alkalinity (HCO3)	mg/l	1		No project standard				
Nutrients								
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water	0.01	3.72	36.15
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	1.25	36.44	121.25
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water	0.065	0.16	0.3
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water	0.02	1.14	12.36
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water			
Physico-chemical								
Total Alkalinity as CaCO3	mg/l	1		No project standard		88	658.83	1168.5
Electrical Conductivity	mS/cm	2		No project standard		0.82	2.99	3.98
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	7.65	8.00	8.48
Redox (Eh)	mV	not specified		No project standard				
Temperature	°C	0.5		No project standard				
Dissolved Oxygen	mg/l	1		No project standard				
TDS	mg/l	35		1000	KEBS requirements for drinking water	410	1825.30	2424.5
TSS	mg/l	10		0	KEBS requirements for drinking water	12	12.00	12
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water	4.96	42.48	64.62
Silica	mg/l	0.01		No project standard		0.16	22.47	44.11
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water	0.016	0.05	0.14
Organics and Oils								
TPH CWG - Aliphatics								
>C5-C6 [#]	mg/l	0.005		No project standard				
>C8-C10 [#]	mg/l	0.005		No project standard				
>C6-C8 [#]	mg/l	0.005		No project standard				
>C10-C12[#]	mg/l	0.005		No project standard				
>C12-C16[#]	mg/l	0.01		No project standard				
>C16-C21[#]	mg/l	0.01		No project standard				
>C21-C35[#]	mg/l	0.01		No project standard				
Total aliphatics C5-35	mg/l	0.01		No project standard				
TPH CWG - Aromatics								
>C5-EC7 [#]	mg/l	0.005		No project standard				
>EC7-EC8 [#]	mg/l	0.005		No project standard				
>EC8-EC10 [#]	mg/l	0.005		No project standard				
>EC10-EC12[#]	mg/l	0.005		No project standard				
>EC12-EC16[#]	mg/l	0.01		No project standard				
>EC16-EC21[#]	mg/l	0.01		No project standard				
>EC21-EC35[#]	mg/l	0.01		No project standard				
Total aromatics C5-35	mg/l	0.01		No project standard				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water			
Toluene	mg/l	0.0005		0.7	WHO DWS			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS			
Xylene (total)	mg/l			0.5	WHO DWS			
m/p-Xylene	mg/l	not analysed		No project standard				
o-Xylene	mg/l	not analysed		No project standard				
Polyaromatic Hydrocarbons								
Naphthalene	mg/l	0.00001		No project standard				
Acenaphthylene	mg/l	0.00001		No project standard				
Acenaphthene	mg/l	0.00001		No project standard				
Fluorene	mg/l	0.00001		No project standard				
Phenanthrene	mg/l	0.00001		No project standard				
Anthracene	mg/l	0.00001		No project standard				
Fluoranthene	mg/l	0.00001		No project standard				
Pyrene	mg/l	0.00001		No project standard				
Benzo(a)anthracene	mg/l	0.00001		No project standard				
Chrysene	mg/l	0.00001		No project standard				
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard				
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard				
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard				
Benzo(ghi)perylene	mg/l	0.00001		No project standard				
Inorganics and Trace Metals								
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water	0.02	0.07	0.09
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water			
Beryllium	mg/l	0.005		No project standard				
Boron	mg/l	0.002		2.4	WHO DWS	0.21	0.22	0.22
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water	0.18	0.78	2.4
Bromate as BrO3	mg/L	0.001		No project standard		0.003	0.00	0.003
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water	0.01	0.01	0.01
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	0.52	0.52	0.52
Cyanide	mg/l			0.07	KEBS requirements for drinking water			
Iron (Ferrous)	mg/l	0.00002		No project standard				
Iron (Feric)	mg/l	0.00002		No project standard				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water	0.008	0.13	0.38
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			
Lithium	mg/l	0.004		No project standard				
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water	0.06	0.24	0.45
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water	0.03	0.03	0.03
Vanadium	mg/l	0.0006		No project standard				
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1	0.01	0.16	0.44
Strontium	mg/l	0.005		No project standard		0.23	0.28	0.36
Sanitary								
BOD	mg/l	1		No project standard				
COD	mg/l	7		No project standard				
Total nitrogen	mg/l	0.5		No project standard				
Total phosphorous	mg/l	0.5		No project standard				
Total coliform bacteria	MPN/100ml	not specified		No project standard				
Fecal coliforms	MPN/100ml	not specified		No project standard				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Groundwater Data
Kengomo 2

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Number of Analyses	Number of Analyses with Numerical Result	Result		
						Sample ID	Kengomo 2	2		2-OCT-15	4/NOV/15	2-DEC-15	SGS	SGS	SGS MA18-04598.009	MA18-05739.008	MA19-00061.006			Min	Mean	Max
			Min	Max	Source	Date	17/02/2015	27/07/2015	21/09/2015	27/10/2015	27/11/2015	30/12/2015	16/08/2017	01/05/2018	01/09/2018	30/11/2018	01/12/2018					
Major Ions																						
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		11.57	12.72	6.47	11.93	12.13	12.23	9.48	11.66	5.09	0.97	6.4	11	11	0.97	9.15	12.72
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		16.8	16.86	17.52	16.3	16.29	15.77	13.5	14.99	6.12	0.51	9.79	11	11	0.51	13.13	17.52
Potassium	mg/l	0.1		No project standard				5.34	5.98	6	5.49	5.69	4.47	5.4	4.23	1.38	3.83	10	10	1.38	4.78	6
Sodium	mg/l	0.1		50	WHO DWS			390.57	357.25	406.16	353.42	378.19	408.47	302.67	601.55	248	173.16	10	10	173.16	361.94	601.55
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		1.83	3.16	2.5	2.5	3	3.4	3.07	3.14	4.58	4.4		10	10	1.83	3.16	4.58
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		61	60.3	52.7	54	57.01	51.7	44.55	46.7	129.65	295.12	72.44	11	11	44.55	84.11	295.12
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		97.84	95.01	94.01	115.04	103.73	93.06	92.28	68.38	361.59	114.86	89.33	11	11	68.38	120.47	361.59
Alkalinity (HCO3)	mg/l	1		No project standard														0	0			
Nutrients																						
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water			Nil	Not detected	Nil	Nil	Nil	0.03	0.06	0.15	2.1	4.13	10	5	0.03	1.29	4.13
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			14.3	3.14	12.4	16.4	16.8	3.46	49.57	80.38	11.93	15.85	10	10	3.14	22.42	80.38
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			Nil	Nil	Nil	Not detected	Not detected	0.152	Not detected	0.72	0.032	Not detected	10	3	0.032	0.30	0.72
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water			0.04	0.07	0.06	0.08	0.27	0.04	0.05	0.47	2.09	<0.1	10	9	0.04	0.35	2.09
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water													0	0			
Physico-chemical																						
Total Alkalinity as CaCO3	mg/l	1		No project standard				690	660	548	590	570	680	889.95	1044.42	461.37	760.5	10	10	461.37	689.42	1044.42
Electrical Conductivity	mS/cm	2		No project standard				1.749	1.789	1.731	1.646	1.429	2.133	2.018	3.54	2.612	2.525	10	10	1.429	2.12	3.54
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		7.54	8	7.72	7.76	7.76	7.81	7.63	7.8	8.21	8.6	7.72	11	11	7.54	7.87	8.6
Redox (Eh)	mV	not specified		No project standard														0	0			
Temperature	°C	0.5		No project standard														0	0			
Dissolved Oxygen	mg/l	1		No project standard														0	0			
TDS	mg/l	35		1000	KEBS requirements for drinking water		1190	1136.85	1162	1125.15	1069.9	928.85	1386.5	1179	2078	1698	1641	11	11	928.85	1326.84	2078
TSS	mg/l	10		0	KEBS requirements for drinking water			Not detectable	Not detectable	Not detectable	Not detectable	Not detectable	Not detected	Detectable	Detectable	Detectable	Not detected	10	0			
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		98.06	101.19		96.87	97.36	95.47	79.27	90.86	37.9	4.53	56.31	10	10	4.53	75.78	101.19
Silica	mg/l	0.01		No project standard				24.29	24.4	32.33	3.15	4.41	17.39	37.18	34.53	31	23.36	10	10	3.15	23.20	37.18
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	absent	Absent	<0.02	<0.02	10	0			
Organics and Oils																						
TPH CWG - Aliphatics																						
>C5-C6 #	mg/l	0.005		No project standard														0	0			
>C8-C10 #	mg/l	0.005		No project standard														0	0			
>C6-C8 #	mg/l	0.005		No project standard														0	0			
>C10-C12 #	mg/l	0.005		No project standard														0	0			
>C12-C16 #	mg/l	0.01		No project standard														0	0			
>C16-C21 #	mg/l	0.01		No project standard														0	0			
>C21-C35 #	mg/l	0.01		No project standard														0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard														0	0			
TPH CWG - Aromatics																						
>C5-EC7 #	mg/l	0.005		No project standard														0	0			
>EC7-EC8 #	mg/l	0.005		No project standard														0	0			
>EC8-EC10 #	mg/l	0.005		No project standard														0	0			
>EC10-EC12 #	mg/l	0.005		No project standard														0	0			
>EC12-EC16 #	mg/l	0.01		No project standard														0	0			
>EC16-EC21 #	mg/l	0.01		No project standard														0	0			
>EC21-EC35 #	mg/l	0.01		No project standard														0	0			
Total aromatics C5-35	mg/l	0.01		No project standard														0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard														0	0			
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water													0	0			
Toluene	mg/l	0.0005		0.7	WHO DWS													0	0			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS													0	0			
Xylene (total)	mg/l			0.5	WHO DWS													0	0			
m/p-Xylene	mg/l	not analysed		No project standard														0	0			
o-Xylene	mg/l	not analysed		No project standard														0	0			
Polyaromatic Hydrocarbons																						
Naphthalene	mg/l	0.00001		No project standard														0	0			
Acenaphthylene	mg/l	0.00001		No project standard														0	0			
Acenaphthene	mg/l	0.00001		No project standard														0	0			
Fluorene	mg/l	0.00001		No project standard														0	0			
Phenanthrene	mg/l	0.00001		No project standard														0	0			
Anthracene	mg/l	0.00001		No project standard														0	0			
Fluoranthene	mg/l	0.00001		No project standard														0	0			
Pyrene	mg/l	0.00001		No project standard														0	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard														0	0			
Chrysene	mg/l	0.00001		No project standard														0	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard														0	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS													0	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard														0	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard														0	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard														0	0			
Inorganics and Trace Metals																						
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water			<0.04	<0.04	<0.04	<0.04	<0.04	<0.05	<0.05	<0.05	<0.05	<0.05	10	0			
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			Not detected	Not detected	Not detected	Not detected	Not detected	<0.01	<0.001	<0.01	<0.01	<0.01	10	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water			<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.004	<0.004	<0.004	<0.004	10	0			
Beryllium	mg/l	0.005		No project standard														0	0			
Boron	mg/l	0.002		2.4	WHO DWS													0	0			
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water			<0.005	0.12		0.16	0.36	Not detected	Nil	Nil	Nil	Nil	9	3	0.12	0.21	0.36
Bromate as BrO3	mg/L	0.001		No project standard				<0.001	<0.001		<0.001	<0.001	<0.001	<0.001				6	0			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	10	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.007	<0.007	<0.007	<0.007	<0.007	<0.02	<0.02	<0.02	<0.02	<0.02	10	0			
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			<0.006	<0.006	<0.006	<0.006	<0.006	<0.01	<0.01	<0.01	<0.01	<0.01	10	0			
Cyanide	mg/l			0.07	KEBS requirements for drinking water			Nil	Nil	Nil	Nil	Nil	<0.001	<0.001	<0.001	<0.001	<0.001	10	0			
Iron (Ferrous)	mg/l	0.00002		No project standard														0	0			
Iron (Feric)	mg/l	0.00002		No project standard														0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.02	0.06	<0.02	<0.02	<0.02	11	2	0.007	0.03	0.06
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			Not detected	Not detected	Not detected	Not detected	Not detected	<0.004	<0.004	<0.004	<0.004	<0.004	10	0			
Lithium	mg/l	0.004		No project standard				<0.004	<0.002	<0.004	<0.004	<0.004	<0.004	<0.001	<0.004	<0.004	<0.004	10	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	11	1	0.002	0.00	0.002
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	10	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.015	<0.015	<0.015	<0.015	<0.015	<0.02	<0.02	<0.02	<0.02	<0.02	10	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.08	<0.01	<0.01	<0.01	10	2	0.02	0.05	0.08
Vanadium	mg/l	0.0006		No project standard														0	0			
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		0.04	0.03	0.16	<0.002	<0.002	0.04	<0.01	0.04	<0.01	<0.01	<0.01	11	5	0.03	0.06	0.16
Strontium	mg/l	0.005		No project standard				0.65	0.67	0.6	<0.005	0.59	0.41	0.51	0.24	0.03	0.38	10	9	0.03	0.45	0.67
Sanitary																						
BOD	mg/l	1		No project standard														0	0			
COD	mg/l	7		No project standard														0	0			
Total nitrogen	mg/l	0.5		No project standard														0	0			
Total phosphorous	mg/l	0.5		No project standard														0	0			
Total coliform bacteria	MPN/100ml	not specified		No project standard														0	0			
Fecal coliforms	MPN/100ml	not specified		No project standard														0	0			

< *non detection and no detection limit provided*
Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.
not analysed for

Groundwater Data
Nabolei

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Nabolei	Nabolei BH
						Sample ID		MA18-05739.009
			Min	Max	Source	Date	19/06/2014	30/11/2018
Major Ions								
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		7.11	6.68
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		1.74	9.88
Potassium	mg/l	0.1		No project standard				
Sodium	mg/l	0.1		50	WHO DWS			**182.66**
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		**2.07**	**2.84**
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		381.5	95.08
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		**1720**	125.49
Alkalinity (HCO3)	mg/l	1		No project standard				
Nutrients								
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water			2.2
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		**75.8**	9.35
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water			**0.887**
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water			
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water			**2.01**
Physico-chemical								
Total Alkalinity as CaCO3	mg/l	1		No project standard				55.77
Electrical Conductivity	mS/cm	2		No project standard				2.14
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		7.91	7.58
Redox (Eh)	mV	not specified		No project standard				
Temperature	°C	0.5		No project standard				
Dissolved Oxygen	mg/l	1		No project standard				
TDS	mg/l	35		1000	KEBS requirements for drinking water		**4150**	**1391**
TSS	mg/l	10		0	KEBS requirements for drinking water			**Detectable**
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		24.92	57.38
Silica	mg/l	0.01		No project standard				28..96
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water			<0.02
Organics and Oils								
TPH CWG - Aliphatics								
>C5-C6#	mg/l	0.005		No project standard				
>C8-C10#	mg/l	0.005		No project standard				
>C6-C8#	mg/l	0.005		No project standard				
>C10-C12#	mg/l	0.005		No project standard				
>C12-C16#	mg/l	0.01		No project standard				
>C16-C21#	mg/l	0.01		No project standard				
>C21-C35#	mg/l	0.01		No project standard				
Total aliphatics C5-35	mg/l	0.01		No project standard				
TPH CWG - Aromatics								
>C5-EC7#	mg/l	0.005		No project standard				
>EC7-EC8#	mg/l	0.005		No project standard				
>EC8-EC10#	mg/l	0.005		No project standard				
>EC10-EC12#	mg/l	0.005		No project standard				
>EC12-EC16#	mg/l	0.01		No project standard				
>EC16-EC21#	mg/l	0.01		No project standard				
>EC21-EC35#	mg/l	0.01		No project standard				
Total aromatics C5-35	mg/l	0.01		No project standard				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water			
Toluene	mg/l	0.0005		0.7	WHO DWS			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS			
Xylene (total)	mg/l			0.5	WHO DWS			
m/p-Xylene	mg/l	not analysed		No project standard				
o-Xylene	mg/l	not analysed		No project standard				
Polyaromatic Hydrocarbons								
Naphthalene	mg/l	0.00001		No project standard				
Acenaphthylene	mg/l	0.00001		No project standard				
Acenaphthene	mg/l	0.00001		No project standard				
Fluorene	mg/l	0.00001		No project standard				
Phenanthrene	mg/l	0.00001		No project standard				
Anthracene	mg/l	0.00001		No project standard				
Fluoranthene	mg/l	0.00001		No project standard				
Pyrene	mg/l	0.00001		No project standard				
Benzo(a)anthracene	mg/l	0.00001		No project standard				
Chrysene	mg/l	0.00001		No project standard				
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard				
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard				
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard				
Benzo(ghi)perylene	mg/l	0.00001		No project standard				
Inorganics and Trace Metals								
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water			<0.05
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water			<0.01
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water			<0.004
Beryllium	mg/l	0.005		No project standard				
Boron	mg/l	0.002		2.4	WHO DWS			
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water			Nil
Bromate as BrO3	mg/L	0.001		No project standard				
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water			Not detected
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water			<0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			<0.01
Cyanide	mg/l			0.07	KEBS requirements for drinking water			<0.001
Iron (Ferrous)	mg/l	0.00002		No project standard				
Iron (Feric)	mg/l	0.00002		No project standard				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water			<0.02
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water			<0.004
Lithium	mg/l	0.004		No project standard				
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water			<0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water			Not detected
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water			<0.02
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water			<0.01
Vanadium	mg/l	0.0006		No project standard				
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1			0.04
Strontium	mg/l	0.005		No project standard				0.34
Sanitary								
BOD	mg/l	1		No project standard				
COD	mg/l	7		No project standard				
Total nitrogen	mg/l	0.5		No project standard				
Total phosphorous	mg/l	0.5		No project standard				
Total coliform bacteria	MPN/100ml	not specified		No project standard				
Fecal coliforms	MPN/100ml	not specified		No project standard				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Groundwater Data
Others inside AOI

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	ACS Tank Lokichar	Kaimegur BH	Ngamia II	Katilu Hand pump
						Sample ID	SGS	SGS (KAIME)	Clear water pit	(SGS MA18-006
			Min	Max	Source	Date	01/04/2017	17/10/2017	05/10/2017	09/02/2018
Major Ions										
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		15.04	2.25		33.05
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		10.05	1.87		45.38
Potassium	mg/l	0.1		No project standard			4.61	2.74		13.19
Sodium	mg/l	0.1		50	WHO DWS		**158.25**	**188.79**		**283.81**
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		0.68	**2.54**		**1.69**
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		33.6	16.46		267.95
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		26.91	75.69		155.24
Alkalinity (HCO3)	mg/l	1		No project standard						
Nutrients										
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		<0.02	0.02		0.09
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		4.18	1.64		**141.89**
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		Nil	**0.415**		**0.22**
Ammonia as N	mg/l			0.5	KEBS requirements for drinking water		0.02	0.1		0.03
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water					
Physico-chemical										
Total Alkalinity as CaCO3	mg/l	1		No project standard			120	533		625.25
Electrical Conductivity	mS/cm	2		No project standard			1.125	1.228		2.317
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		7.74	**8.65**	8.5	7.49
Redox (Eh)	mV	not specified		No project standard						
Temperature	^{o}C	0.5		No project standard						
Dissolved Oxygen	mg/l	1		No project standard						
TDS	mg/l	35		1000	KEBS requirements for drinking water		731.25	700		**1506**
TSS	mg/l	10		0	KEBS requirements for drinking water		Not detected	**Detectable**		Not detectable
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		78.92	13.81		269.4
Silica	mg/l	0.01		No project standard			2.3	21.9		25.06
Residual Chlorine	mg/l	0.02		0.2	KEBS requirements for drinking water		<0.02	<0.02		<0.02
Organics and Oils										
TPH CWG - Aliphatics										
>C5-C6 [#]	mg/l	0.005		No project standard						
>C8-C10 [#]	mg/l	0.005		No project standard						
>C6-C8 [#]	mg/l	0.005		No project standard						
>C10-C12[#]	mg/l	0.005		No project standard						
>C12-C16[#]	mg/l	0.01		No project standard						
>C16-C21[#]	mg/l	0.01		No project standard						
>C21-C35[#]	mg/l	0.01		No project standard						
Total aliphatics C5-35	mg/l	0.01		No project standard						
TPH CWG - Aromatics										
>C5-EC7 [#]	mg/l	0.005		No project standard						
>EC7-EC8 [#]	mg/l	0.005		No project standard						
>EC8-EC10 [#]	mg/l	0.005		No project standard						
>EC10-EC12[#]	mg/l	0.005		No project standard						
>EC12-EC16[#]	mg/l	0.01		No project standard						
>EC16-EC21[#]	mg/l	0.01		No project standard						
>EC21-EC35[#]	mg/l	0.01		No project standard						
Total aromatics C5-35	mg/l	0.01		No project standard						
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard						
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water					
Toluene	mg/l	0.0005		0.7	WHO DWS					
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS					
Xylene (total)	mg/l			0.5	WHO DWS					
m/p-Xylene	mg/l	not analysed		No project standard						
o-Xylene	mg/l	not analysed		No project standard						
Polyaromatic Hydrocarbons										
Naphthalene	mg/l	0.00001		No project standard						
Acenaphthylene	mg/l	0.00001		No project standard						
Acenaphthene	mg/l	0.00001		No project standard						
Fluorene	mg/l	0.00001		No project standard						
Phenanthrene	mg/l	0.00001		No project standard						
Anthracene	mg/l	0.00001		No project standard						
Fluoranthene	mg/l	0.00001		No project standard						
Pyrene	mg/l	0.00001		No project standard						
Benzo(a)anthracene	mg/l	0.00001		No project standard						
Chrysene	mg/l	0.00001		No project standard						
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard						
Benzo(a)pyrene	mg/l	0.00001		0.0007	WHO DWS					
Indeno(123cd)pyrene	mg/l	0.00001		No project standard						
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard						
Benzo(ghi)perylene	mg/l	0.00001		No project standard						
Inorganics and Trace Metals										
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.05	<0.05		<0.05
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		Not detected	<0.01		<0.01
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.02	<0.004		0.04
Beryllium	mg/l	0.005		No project standard						
Boron	mg/l	0.002		2.4	WHO DWS		0.11	<0.05		0.13
Boron as boric acid	mg/L	0.001		0.3	KEBS requirements for drinking water		**0.62**	Nil		**0.71**
Bromate as BrO3	mg/L	0.001		No project standard			<0.001	<2.5		<0.001
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		Not detected	Not detected		Not detected
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.02	<0.02		<0.02
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.01	<0.01		<0.01
Cyanide	mg/l			0.07	KEBS requirements for drinking water		Nil	Nil		<0.001
Iron (Ferrous)	mg/l	0.00002		No project standard						
Iron (Feric)	mg/l	0.00002		No project standard						
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.02	0.05		<0.02
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected
Lithium	mg/l	0.004		No project standard			<0.004	<0.004		<0.004
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.01	<0.01		0.02
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		Not detected	Not detected		Not detected
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.02	<0.02		<0.02
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		Not detected	<0.01		<0.01
Vanadium	mg/l	0.0006		No project standard						
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		<0.01	<0.01		0.1
Strontium	mg/l	0.005		No project standard			0.28	0.06		1.02
Sanitary										
BOD	mg/l	1		No project standard						
COD	mg/l	7		No project standard						
Total nitrogen	mg/l	0.5		No project standard						
Total phosphorous	mg/l	0.5		No project standard						
Total coliform bacteria	MPN/100ml	not specified		No project standard						
Fecal coliforms	MPN/100ml	not specified		No project standard						

< *non detection and no detection limit provided*
Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.
not analysed for

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location / Sample ID	SW1	SW3
			Min	Max	Source	Date	29/05/2016	28/05/2016
Major Ions								
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		77.74	35.3
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		10.15	4.41
Potassium	mg/l	0.1		No project standard			8.41	6.12
Sodium	mg/l	0.1		50	WHO DWS		22.69	20.09
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		**1.65**	1.24
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		28.54	34.46
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		108.72	64.86
Alkalinity (HCO3)	mg/l	1		No project standard				
Nutrients								
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		1.86	1.89
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		2.54	4.18
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		<	<
Ammonia as N	mg/L			0.5	KEBS requirements for drinking water			
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water		**1.16**	**1.78**
Physico-chemical								
Total Alkalinity as CaCO3	mg/l	1		No project standard			140	35
Electrical Conductivity	mS/cm	2		No project standard			0.655	0.348
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water/Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1		6.85	7.56
Redox (Eh)	mV	not specified		No project standard				
Temperature	°C	0.5		No project standard			25	24.8
Dissolved Oxygen	mg/l	1		No project standard			7.71	6.8
TDS	mg/l	35		1000	KEBS requirements for drinking water		429.16	226.2
TSS	mg/l	10		0	KEBS requirements for drinking water		**4**	**345**
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		235.9	106.3
Silica	mg/l	0.01		No project standard			10.87	8.52
Residual Chlorine	mg/L			0.2	KEBS requirements for drinking water			
Organics and Oils								
TPH CWG - Aliphatics								
>C5-C6 [#]	mg/l	0.005		No project standard				
>C8-C10 [#]	mg/l	0.005		No project standard				
>C6-C8 [#]	mg/l	0.005		No project standard				
>C10-C12 [#]	mg/l	0.005		No project standard				
>C12-C16 [#]	mg/l	0.01		No project standard				
>C16-C21 [#]	mg/l	0.01		No project standard				
>C21-C35 [#]	mg/l	0.01		No project standard				
Total aliphatics C5-35	mg/l	0.01		No project standard				
TPH CWG - Aromatics								
>C5-EC7 [#]	mg/l	0.005		No project standard				
>EC7-EC8 [#]	mg/l	0.005		No project standard				
>EC8-EC10 [#]	mg/l	0.005		No project standard				
>EC10-EC12 [#]	mg/l	0.005		No project standard				
>EC12-EC16 [#]	mg/l	0.01		No project standard				
>EC16-EC21 [#]	mg/l	0.01		No project standard				
>EC21-EC35 [#]	mg/l	0.01		No project standard				
Total aromatics C5-35	mg/l	0.01		No project standard				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water		<0.01	<0.01
Toluene	mg/l	0.0005		0.7	WHO DWS		<0.01	<0.01
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS		<0.01	<0.01
Xylene (total)	mg/l			0.5	WHO DWS			
m/p-Xylene	mg/l	0.001		No project standard				
o-Xylene	mg/l	0.001		No project standard				
Polyaromatic Hydrocarbons								
Naphthalene	mg/l	0.00001		No project standard			<0.01	4
Acenaphthylene	mg/l	0.00001		No project standard			<0.01	<0.01
Acenaphthene	mg/l	0.00001		No project standard			<0.01	<0.01
Fluorene	mg/l	0.00001		No project standard			<0.01	<0.01
Phenanthrene	mg/l	0.00001		No project standard			<0.01	<0.01
Anthracene	mg/l	0.00001		No project standard			<0.01	<0.01
Fluoranthene	mg/l	0.00001		No project standard			<0.01	<0.01
Pyrene	mg/l	0.00001		No project standard			0.03	<0.01
Benzo(a)anthracene	mg/l	0.00001		No project standard			<0.01	<0.01
Chrysene	mg/l	0.00001		No project standard			<0.01	<0.01
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard			<0.01	<0.02
Benzo(a)pyrene	mg/l	0.00001		0.0007			<0.01	<0.01
Indeno(123cd)pyrene	mg/l	0.00001		No project standard			<0.01	<0.01
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard			<0.01	<0.01
Benzo(ghi)perylene	mg/l	0.00001		No project standard			<0.01	<0.01
Inorganics and Trace Metals								
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.04	<0.04
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		<	<
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.07	0.02
Beryllium	mg/l	0.005		No project standard			<0.003	<0.003
Boron	mg/l	0.002		2.4	WHO DWS		0.1	0.08
Boron as boric acid	mg/L			0.3	KEBS requirements for drinking water			
Bromate as BrO3	mg/L			0.01	KEBS requirements for drinking water			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		<	<
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.007	<0.007
Cyanide as CN	mg/L			0.07	KEBS requirements for drinking water			
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		<0.006	<0.006
Iron (Ferrous)	mg/l	0.00002		No project standard				
Iron (Feric)	mg/l	0.00002		No project standard				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.007	<0.007
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		<	<
Lithium	mg/L			No project standard				
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.002	0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		<	<
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.015	<0.015
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		<0.01	<0.01
Vanadium	mg/l	0.0006		No project standard			0.01	0.01
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		0.02	<0.002
Strontium	mg/l	0.005		No project standard			0.9	0.36
Sanitary								
BOD	mg/l	1		No project standard			36.54	54.98
COD	mg/l	7		No project standard			64.78	109.76
Total nitrogen	mg/l	0.5		No project standard			2.86	3.68
Total phosphorous	mg/l	0.5		No project standard			0.01	0.08
Total coliform bacteria	MPN/100ml	not specified		No project standard			>1800	>1800
Fecal coliforms	MPN/100ml	not specified		No project standard			>1800	>1800

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Turkwel Dam reservoir	Turkwel Dam reservoir	Turkwel Dam reservoir	Turkwel Dam reservoir	Turkwel Dam reservoir	Number of Analyses	Number of Analyses with Numerical Result	Result			
						Sample ID		TURKWEL DAM (SGS MA18-00633.004)	MA18-04598.005. Sample 05	MA18-05739.013	MA19-00061.007			Min	Mean	95th percentile	Max
			Min	Max	Source	Date	May-18	Jun-18	Sep-18	Nov-18	Dec-18						
Major Ions																	
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		21.23	16.15	13.45	12.85	10.95	5	5	10.95	14.93	20.21	21.23
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		<0.01	4.51	4.37	4.16	3.7	5	4	3.7	4.19	4.49	4.51
Potassium	mg/l	0.1		No project standard			3.43	3.38	2.9	2.55	2.21	5	5	2.21	2.89	3.42	3.43
Sodium	mg/l	0.1		50	WHO DWS		7.07	6.51	6.04	5.23	4.9	5	5	4.9	5.95	6.96	7.07
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		absent	0.67	0.93	0.48	0.77	5	4	0.48	0.71	0.91	0.93
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		2.4	2.88	1.65	5.76	5.35	5	5	1.65	3.61	5.68	5.76
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		3.28	28.45	9.36	13.61	11.91	5	5	3.28	13.32	25.48	28.45
Alkalinity (HCO3)	mg/l	1	No project standard	No project standard								0	0				
Nutrients																	
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		3	5.61	0.09	0.19	Nil	5	4	0.09	2.22	5.22	5.61
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		3.41	6.07	2.03	1.89	4.48	5	5	1.89	3.58	5.75	6.07
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		3.41	Not detected	Not detected	0.146	Not detected	5	2	0.146	1.78	3.25	3.41
Ammonia as N	mg/L			0.5	KEBS requirements for drinking water		0.02	12.44	0.65	2.13	0.05	5	5	0.02	3.06	10.38	12.44
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water							0	0				
Physico-chemical																	
Total Alkalinity as CaCO3	mg/l	1		No project standard			183.23	130.88	106.47	70.98	152.1	5	5	70.98	128.73	177.00	183.23
Electrical Conductivity	mS/cm	2		No project standard			0.2278	0.241	0.2623	0.2293	0.2627	5	5	0.2278	0.24	0.26	0.2627
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water		8.4	7.74	8.05	7.5	7.67	5	5	7.5	7.87	8.33	8.4
Redox (Eh)	mV	not specified		No project standard								0	0				
Temperature	°C	0.5		No project standard								0	0				
Dissolved Oxygen	mg/l	1		No project standard								0	0				
TDS	mg/l	35		1000	KEBS requirements for drinking water		136	136	151	149	171	5	5	136	148.60	167.00	171
TSS	mg/l	10		0	KEBS requirements for drinking water		Detectable	Detectable	Detectable	Detectable	Detected	5	0				
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		77.56	58.87	51.55	49.22	42.57	5	5	42.57	55.95	73.82	77.56
Silica	mg/l	0.01		No project standard			3.68	2.85	2.71	2.1	1.5	5	5	1.5	2.57	3.51	3.68
Residual Chlorine	mg/L			0.2	KEBS requirements for drinking water		Absent	Absent	Absent	<0.02	<0.02	5	0				
Organics and Oils																	
TPH CWG - Aliphatics																	
>C5-C6[#]	mg/l	0.005		No project standard								0	0				
>C8-C10[#]	mg/l	0.005		No project standard								0	0				
>C6-C8[#]	mg/l	0.005		No project standard								0	0				
>C10-C12[#]	mg/l	0.005		No project standard								0	0				
>C12-C16[#]	mg/l	0.01		No project standard								0	0				
>C16-C21[#]	mg/l	0.01		No project standard								0	0				
>C21-C35[#]	mg/l	0.01		No project standard								0	0				
Total aliphatics C5-35	mg/l	0.01		No project standard								0	0				
TPH CWG - Aromatics																	
>C5-EC7[#]	mg/l	0.005		No project standard								0	0				
>EC7-EC8[#]	mg/l	0.005		No project standard								0	0				
>EC8-EC10[#]	mg/l	0.005		No project standard								0	0				
>EC10-EC12[#]	mg/l	0.005		No project standard								0	0				
>EC12-EC16[#]	mg/l	0.01		No project standard								0	0				
>EC16-EC21[#]	mg/l	0.01		No project standard								0	0				
>EC21-EC35[#]	mg/l	0.01		No project standard								0	0				
Total aromatics C5-35	mg/l	0.01		No project standard								0	0				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard								0	0				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water							0	0				
Toluene	mg/l	0.0005		0.7	WHO DWS							0	0				
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS							0	0				
Xylene (total)	mg/l			0.5	WHO DWS												
m/p-Xylene	mg/l	0.001		No project standard								0	0				
o-Xylene	mg/l	0.001		No project standard								0	0				
Polyaromatic Hydrocarbons																	
Naphthalene	mg/l	0.00001		No project standard								0	0				
Acenaphthylene	mg/l	0.00001		No project standard								0	0				
Acenaphthene	mg/l	0.00001		No project standard								0	0				
Fluorene	mg/l	0.00001		No project standard								0	0				
Phenanthrene	mg/l	0.00001		No project standard								0	0				
Anthracene	mg/l	0.00001		No project standard								0	0				
Fluoranthene	mg/l	0.00001		No project standard								0	0				
Pyrene	mg/l	0.00001		No project standard								0	0				
Benzo(a)anthracene	mg/l	0.00001		No project standard								0	0				
Chrysene	mg/l	0.00001		No project standard								0	0				
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard								0	0				
Benzo(a)pyrene	mg/l	0.00001		0.0007								0	0				
Indeno(123cd)pyrene	mg/l	0.00001		No project standard								0	0				
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard								0	0				
Benzo(ghi)perylene	mg/l	0.00001		No project standard								0	0				
Inorganics and Trace Metals																	
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		0.39	0.14	<0.05	<0.05	<0.05	5	2	0.14	0.27	0.38	0.39
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		<0.001	<0.01	<0.01	<0.01	<0.01	5	0				
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.08	<0.004	<0.004	<0.004	0.04	5	2	0.04	0.06	0.08	0.08
Beryllium	mg/l	0.005		No project standard								0	0				
Boron	mg/l	0.002		2.4	WHO DWS							0	0				
Boron as boric acid	mg/L			0.3	KEBS requirements for drinking water		Nil	Nil	Nil	Nil	Nil	5	0				
Bromate as BrO3	mg/L			0.01	KEBS requirements for drinking water		<0.001		<0.001			2	0				
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	5	0				
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.02	<0.02	<0.02	<0.02	<0.02	5	0				
Cyanide as CN	mg/L			0.07	KEBS requirements for drinking water		Nil	<0.001	<0.001	<0.001	<0.001	5	0				
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		<0.01	<0.01	<0.01	<0.01	<0.01	5	0				
Iron (Ferrous)	mg/l	0.00002		No project standard								0	0				
Iron (Feric)	mg/l	0.00002		No project standard								0	0				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		0.19	0.07	<0.02	<0.02	0.03	5	3	0.03	0.10	0.18	0.19
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		<0.004	<0.004	<0.004	<0.004	<0.004	5	0				
Lithium	mg/L			No project standard			<0.004	<0.004	<0.004	<0.004	<0.004	5	0				
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.01	<0.01	<0.01	<0.01	<0.01	5	0				
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	5	0				
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.02	<0.02	<0.02	<0.02	<0.02	5	0				
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		0.04	<0.02	<0.01	<0.01	<0.01	5	1	0.04	0.04	0.04	0.04
Vanadium	mg/l	0.0006		No project standard								0	0				
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		<0.01	<0.01	<0.01	<0.01	<0.01	5	0				
Strontium	mg/l	0.005		No project standard			0.1	0.17	0.17	0.16	0.14	5	5	0.1	0.15	0.17	0.17
Sanitary																	
BOD	mg/l	1		No project standard								0	0				
COD	mg/l	7		No project standard								0	0				
Total nitrogen	mg/l	0.5		No project standard								0	0				
Total phosphorous	mg/l	0.5		No project standard								0	0				
Total coliform bacteria	MPN/100ml	not specified		No project standard								0	0				
Fecal coliforms	MPN/100ml	not specified		No project standard								0	0				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Location	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace canal	Tailrace Canal	Tailrace Canal	Tailrace Canal	Tailrace Canal	Tailrace Canal
						Sample ID	TD1 Tailrace	TD2 Tailrace	17		08-Oct-15	11/NOV/2015	7-DEC-15	AQ 47599b	AQ 48994	AQ 49745	SGS	MA17-05350.001	TURK 1 (SGS MA18-02852.003)	MA18-02852.007	(SGS MA18-04598.006)	MA18-05094.001	MA18-05739.012	MA19-00061.001
			Min	Max	Source	Date	16/6/15	16/6/15	5/8/15	20/9/15	28/10/15	2/12/15	30/12/2015	30/03/2016	30/08/2016	16/10/2016	Aug-17	Nov-17	Feb-18	Jun-18	Sep-18	Oct-18	Nov-18	Dec-18
Major Ions																								
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		20.98	20.94	20.59	20.44	21.65	19.64	35.58	15.75	13.13	0.09	18.17	16.71	16.48	12.67	13.11	14.88	13.01	9.84
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		6.32	6.27	6.62	6.49	6.81	6.69	33.53	4.56	4.11	0.07	5.77	4.68	4.99	3.76	4.12	4.76	4.13	3.42
Potassium	mg/l	0.1		No project standard			4.2	4.19	3.93	3.82	3.73	3.83	1.61	3.9	4.61	1.18	3.84	3.47	2.93	2.96	2.8	2.91	2.48	2.1
Sodium	mg/l	0.1		50	WHO DWS		10.97	10.97	8.32	8.65	7.31	7.31	**217.13**	**70.19**	13.6	47.1	8.54	7.17	6.17	5.98	6.18	6.19	5.3	4.57
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		0.84	0.96	0.96	0.53	0.27	0.69	**1.8**	1.25	0.12	Nil	0.66	0.36	0.49	0.56	0.93	0.89	0.47	0.47
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		2.47	2.06	2.68	2.9	1.8	2.06	20.6	1.08	54.5	7.92	1.65	1.03	2.26	4.12	2.06	2.26	1.65	4.32
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		5.98	4.79	7.13	14.46	10.56	11.32	4.43	4.42	11.8	14.75	8.26	0.87	2.89	30.86	9.78	4.25	12.76	21.27
Alkalinity (HCO3)	mg/l	1	No project standard	No project standard																				
Nutrients																								
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		0.04	Nil	Nil	Not detected	Nil	Nil	Nil	0.33	**4.89**	0.83	0.02	Nil	0.09	2.02	0.34	**2.54**	0.11	Nil
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		2.1	1.8	6.1	Nil	**10.7**	0.8	0.57	0.16	**12.63**	**29.11**	1.24	1.06	9.12	7.17	3.55	6.69	1.96	2.33
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		Not detected	Not detected	Nil	Nil	Nil	Not detected	Not detected	<0.001	<0.001	<0.001	**0.12**	Nil	Not detected	Not detected	Not detected	Not detected	**0.148**	Not detected
Ammonia as N	mg/L			0.5	KEBS requirements for drinking water		0.11	0.11	0.05	0.1	0.08	0.31	0.01	0.19	0.001	<0.001	0.02	Nil	0.03	**12.39**	0.38	**1.06**	**2.1**	0.06
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water																			
Physico-chemical																								
Total Alkalinity as CaCO3	mg/l	1		No project standard			100	95	140	210	106	80	590	180.6	375	187.3	119.1	92.25	102.5	130.88	101.4	131.82	76.05	202.8
Electrical Conductivity	mS/cm	2		No project standard			0.2314	0.23	0.204	0.322	0.1964	0.1853	1.024	0.22	0.17	0.17	0.2095	0.2185	0.2278	0.1707	0.2695	0.184	0.2307	0.2569
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water		6.65	6.94	7.54	6.75	7.24	7.27	7.33	8.02	7.66	7.64	7.44	7.09	7.91	7.45	7.61	7.55	7.54	7.43
Redox (Eh)	mV	not specified		No project standard																				
Temperature	°C	0.5		No project standard																				
Dissolved Oxygen	mg/l	1		No project standard																				
TDS	mg/l	35		1000	KEBS requirements for drinking water		150.41	149.5	132.6	209.3	127.66	120.45	665.6	110	85	85	118	142	148	97	157	107	132	167
TSS	mg/l	10		0	KEBS requirements for drinking water		**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	Not detectable	Not detectable	Nil	**2**	Nil	**Detectable**	Not detectable	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		78.4	78.12	78.67		82.1	76.57	226.92	74	50	12.51	69.14	60.98	61.68	47.12	49.68	56.78	49.48	38.66
Silica	mg/l	0.01		No project standard			4.28	4.11	3.45	3.38	4.73	5.93	5.44	4.57	<0.001	3.5	4.22	6.58	4.23	8.83	4.18	3.46	2.2	1.72
Residual Chlorine	mg/L			0.2	KEBS requirements for drinking water		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	0.011	<0.01	<0.02	<0.02	<0.02	Absent	Absent	Absent	<0.02	<0.02
Organics and Oils																								
TPH CWG - Aliphatics																								
>C5-C6 #	mg/l	0.005		No project standard																				
>C8-C10 #	mg/l	0.005		No project standard																				
>C6-C8 #	mg/l	0.005		No project standard																				
>C10-C12#	mg/l	0.005		No project standard																				
>C12-C16#	mg/l	0.01		No project standard																				
>C16-C21#	mg/l	0.01		No project standard																				
>C21-C35#	mg/l	0.01		No project standard																				
Total aliphatics C5-35	mg/l	0.01		No project standard																				
TPH CWG - Aromatics																								
>C5-EC7 #	mg/l	0.005		No project standard																				
>EC7-EC8 #	mg/l	0.005		No project standard																				
>EC8-EC10 #	mg/l	0.005		No project standard																				
>EC10-EC12#	mg/l	0.005		No project standard																				
>EC12-EC16#	mg/l	0.01		No project standard																				
>EC16-EC21#	mg/l	0.01		No project standard																				
>EC21-EC35#	mg/l	0.01		No project standard																				
Total aromatics C5-35	mg/l	0.01		No project standard																				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard																				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water																			
Toluene	mg/l	0.0005		0.7	WHO DWS																			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS																			
Xylene (total)	mg/l			0.5	WHO DWS																			
m/p-Xylene	mg/l	0.001		No project standard																				
o-Xylene	mg/l	0.001		No project standard																				
Polyaromatic Hydrocarbons																								
Naphthalene	mg/l	0.00001		No project standard																				
Acenaphthylene	mg/l	0.00001		No project standard																				
Acenaphthene	mg/l	0.00001		No project standard																				
Fluorene	mg/l	0.00001		No project standard																				
Phenanthrene	mg/l	0.00001		No project standard																				
Anthracene	mg/l	0.00001		No project standard																				
Fluoranthene	mg/l	0.00001		No project standard																				
Pyrene	mg/l	0.00001		No project standard																				
Benzo(a)anthracene	mg/l	0.00001		No project standard																				
Chrysene	mg/l	0.00001		No project standard																				
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard																				
Benzo(a)pyrene	mg/l	0.00001		0.0007																				
Indeno(123cd)pyrene	mg/l	0.00001		No project standard																				
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard																				
Benzo(ghi)perylene	mg/l	0.00001		No project standard																				
Inorganics and Trace Metals																								
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.001	<0.001	0.05	**2.08**	<0.05	0.07	**4.08**	<0.05	<0.05	<0.05	<0.05
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.004	<0.01		<0.01	<0.01
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.09	0.09	0.08	0.07	0.09	0.09	<0.002	<0.001	<0.001	<0.001	0.07	0.05	0.05	<0.004	<0.004	0.05	<0.004	0.04
Beryllium	mg/l	0.005		No project standard																				
Boron	mg/l	0.002		2.4	WHO DWS														0.05					
Boron as boric acid	mg/L			0.3	KEBS requirements for drinking water		<0.005	<0.005	<0.005	<0.002		0.02	0.18	<0.001	<0.001	<0.001	**2.4**	<0.005	**0.31**	Nil	Nil	Nil	Nil	Nil
Bromate as BrO3	mg/L			0.01	KEBS requirements for drinking water		<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	<0.001	0.001	<0.001			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	<0.001	<0.001	<0.001	Not detected	Not detected	Not detected	**12.67**	Not detected	Not detected	Not detected	Not detected
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cyanide as CN	mg/L			0.07	KEBS requirements for drinking water		Nil	Nil	Nil	Nil	Nil	Nil	Nil	<0.001	<0.001	<0.001	Nil	Nil	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	**0.11**	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron (Ferrous)	mg/l	0.00002		No project standard																				
Iron (Feric)	mg/l	0.00002		No project standard																				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		<0.007	<0.007	0.04	<0.007	0.06	**0.62**	**0.34**	<0.001	0.05	0.09	**1.22**	**0.93**	0.03	**2.56**	0.12	<0.02	<0.02	0.03
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	<0.001	<0.001	<0.001	<0.004	Not detected	Not detected	<0.004	<0.004	<0.004	<0.004	<0.004
Lithium	mg/L			No project standard					<0.004	<0.002	<0.004	<0.004	<0.004	<0.001	<0.001	<0.001	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.002	<0.002	<0.002	<0.002	<0.002	0.01	0.01	0.04	0.18	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	<0.001	<0.001	<0.001	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		Not detected	Not detected	<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	Not detected	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	mg/l	0.0006		No project standard																				
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		0.01	<0.002	<0.002	<0.002	<0.002	<0.002	0.13	0.12	<0.001	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/l	0.005		No project standard			<0.0005	<0.0005	0.23	0.22	0.23	<0.005	1.23	<0.001	<0.001	<0.001	0.19	0.18	0.18	0.14	0.17	0.18	0.16	0.13
Sanitary																								
BOD	mg/l	1		No project standard																				
COD	mg/l	7		No project standard																				
Total nitrogen	mg/l	0.5		No project standard																				
Total phosphorous	mg/l	0.5		No project standard																				
Total coliform bacteria	MPN/100ml	not specified		No project standard																				
Fecal coliforms	MPN/100ml	not specified		No project standard																				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard			Tailrace Canal	Number of Analyses	Number of Analyses with Numerical Result	Result			
			Min	Max	Source	MA19-00061.008 Jan-18			Min	Mean	95th percentile	Max
Major Ions												
Calcium	mg/l	0.2		150	KEBS requirements for drinking water	10.95	19	19	0.09	16.56	23.04	35.58
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water	3.69	19	19	0.07	6.36	9.48	33.53
Potassium	mg/l	0.1		No project standard		2.16	19	19	1.18	3.19	4.24	4.61
Sodium	mg/l	0.1		50	WHO DWS	4.77	19	19	4.57	24.02	84.88	217.13
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water	0.55	19	18	0.12	0.71	1.33	1.8
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water	4.73	19	19	1.03	6.43	23.99	54.5
Chloride	mg/l	0.3		250	KEBS requirements for drinking water	8.51	19	19	0.87	9.95	22.23	30.86
Alkalinity (HCO3)	mg/l	1	No project standard	No project standard			0	0				
Nutrients												
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water	Nil	19	10	0.02	1.12	3.83	4.89
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water	3.64	19	18	0.16	5.60	15.10	29.11
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water	Not detected	19	2	0.12	0.13	0.15	0.148
Ammonia as N	mg/L			0.5	KEBS requirements for drinking water	0.06	19	17	0.001	1.00	4.16	12.39
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water		0	0				
Physico-chemical												
Total Alkalinity as CaCO3	mg/l	1		No project standard		152.1	19	19	76.05	166.99	396.50	590
Electrical Conductivity	mS/cm	2		No project standard		0.2609	19	19	0.17	0.26	0.39	1.024
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water	7.54	19	19	6.65	7.40	7.92	8.02
Redox (Eh)	mV	not specified		No project standard			0	0				
Temperature	°C	0.5		No project standard			0	0				
Dissolved Oxygen	mg/l	1		No project standard			0	0				
TDS	mg/l	35		1000	KEBS requirements for drinking water	170	19	19	85	161.76	254.93	665.6
TSS	mg/l	10		0	KEBS requirements for drinking water	Detectable	19	1	2	2.00	2.00	2
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water	42.48	18	18	12.51	68.52	103.82	226.92
Silica	mg/l	0.01		No project standard		1.58	19	18	1.58	4.24	6.92	8.83
Residual Chlorine	mg/L			0.2	KEBS requirements for drinking water	<0.02	19	2	0.011	0.03	0.05	0.05
Organics and Oils												
TPH CWG - Aliphatics												
>C5-C6 #	mg/l	0.005		No project standard			0	0				
>C8-C10 #	mg/l	0.005		No project standard			0	0				
>C6-C8 #	mg/l	0.005		No project standard			0	0				
>C10-C12#	mg/l	0.005		No project standard			0	0				
>C12-C16#	mg/l	0.01		No project standard			0	0				
>C16-C21#	mg/l	0.01		No project standard			0	0				
>C21-C35#	mg/l	0.01		No project standard			0	0				
Total aliphatics C5-35	mg/l	0.01		No project standard			0	0				
TPH CWG - Aromatics												
>C5-EC7 #	mg/l	0.005		No project standard			0	0				
>EC7-EC8 #	mg/l	0.005		No project standard			0	0				
>EC8-EC10 #	mg/l	0.005		No project standard			0	0				
>EC10-EC12#	mg/l	0.005		No project standard			0	0				
>EC12-EC16#	mg/l	0.01		No project standard			0	0				
>EC16-EC21#	mg/l	0.01		No project standard			0	0				
>EC21-EC35#	mg/l	0.01		No project standard			0	0				
Total aromatics C5-35	mg/l	0.01		No project standard			0	0				
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard			0	0				
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water		0	0				
Toluene	mg/l	0.0005		0.7	WHO DWS		0	0				
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS		0	0				
Xylene (total)	mg/l			0.5	WHO DWS							
m/p-Xylene	mg/l	0.001		No project standard			0	0				
o-Xylene	mg/l	0.001		No project standard			0	0				
Polyaromatic Hydrocarbons												
Naphthalene	mg/l	0.00001		No project standard			0	0				
Acenaphthylene	mg/l	0.00001		No project standard			0	0				
Acenaphthene	mg/l	0.00001		No project standard			0	0				
Fluorene	mg/l	0.00001		No project standard			0	0				
Phenanthrene	mg/l	0.00001		No project standard			0	0				
Anthracene	mg/l	0.00001		No project standard			0	0				
Fluoranthene	mg/l	0.00001		No project standard			0	0				
Pyrene	mg/l	0.00001		No project standard			0	0				
Benzo(a)anthracene	mg/l	0.00001		No project standard			0	0				
Chrysene	mg/l	0.00001		No project standard			0	0				
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard			0	0				
Benzo(a)pyrene	mg/l	0.00001		0.0007			0	0				
Indeno(123cd)pyrene	mg/l	0.00001		No project standard			0	0				
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard			0	0				
Benzo(ghi)perylene	mg/l	0.00001		No project standard			0	0				
Inorganics and Trace Metals												
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water	0.07	19	5	0.05	1.27	3.68	4.08
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water	<0.01	18	0				
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water	0.04	19	12	0.04	0.07	0.09	0.09
Beryllium	mg/l	0.005		No project standard			0	0				
Boron	mg/l	0.002		2.4	WHO DWS		1	1	0.05	0.05	0.05	0.05
Boron as boric acid	mg/L			0.3	KEBS requirements for drinking water	Nil	18	4	0.02	0.73	2.09	2.4
Bromate as BrO3	mg/L			0.01	KEBS requirements for drinking water		14	2	0.001	0.00	0.01	0.007
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water	Not detected	19	1	12.67	12.67	12.67	12.67
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water	<0.02	19	0				
Cyanide as CN	mg/L			0.07	KEBS requirements for drinking water	<0.001	19	0				
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water	<0.01	19	1	0.11	0.11	0.11	0.11
Iron (Ferrous)	mg/l	0.00002		No project standard			0	0				
Iron (Feric)	mg/l	0.00002		No project standard			0	0				
Iron (total)	mg/l			0.3	KEBS requirements for drinking water	0.04	19	13	0.03	0.47	1.76	2.56
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water	<0.004	19	0				
Lithium	mg/L			No project standard		<0.004	17	0				
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water	<0.01	19	5	0.01	0.05	0.15	0.18
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water	Not detected	19	0				
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water	<0.02	19	0				
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water	<0.01	19	0				
Vanadium	mg/l	0.0006		No project standard			0	0				
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water	<0.01	19	4	0.01	0.07	0.13	0.13
Strontium	mg/l	0.005		No project standard		0.14	19	13	0.13	0.26	0.63	1.23
Sanitary												
BOD	mg/l	1		No project standard			0	0				
COD	mg/l	7		No project standard			0	0				
Total nitrogen	mg/l	0.5		No project standard			0	0				
Total phosphorous	mg/l	0.5		No project standard			0	0				
Total coliform bacteria	MPN/100ml	not specified		No project standard			0	0				
Fecal coliforms	MPN/100ml	not specified		No project standard			0	0				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Project Water Quality Standard: Min	Project Water Quality Standard: Max	Project Water Quality Standard: Source	Location / Sample ID / Date	Malmalte River / MA19-01403.001 / 25/3/19	Number of Analyses	Number of Analyses with Numerical Result	Result: Min	Result: Mean	Result: Max
Major Ions												
Calcium	mg/l	0.2		150	KEBS requirements for drinking water		31.64	1	1	31.64	31.64	31.64
Magnesium	mg/l	0.1		100	KEBS requirements for drinking water		11.54	1	1	11.54	11.54	11.54
Potassium	mg/l	0.1		No project standard			2.94	1	1	2.94	2.94	2.94
Sodium	mg/l	0.1		50	WHO DWS		11.11	1	1	11.11	11.11	11.11
Fluoride	mg/l	0.3		1.5	KEBS requirements for drinking water		0.18	1	1	0.18	0.18	0.18
Sulphate	mg/l	0.05		400	KEBS requirements for drinking water		9.7	1	1	9.7	9.70	9.7
Chloride	mg/l	0.3		250	KEBS requirements for drinking water		6.41	1	1	6.41	6.41	6.41
Alkalinity (HCO3)	mg/l	1	No project standard	No project standard			152.1	1	1	152.1	152.10	152.1
Nutrients												
Ortho Phosphate as PO4	mg/l	0.03		2.2	KEBS requirements for drinking water		1.15	1	1	1.15	1.15	1.15
Nitrate as N03	mg/l	0.2		10	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		5.49	1	1	5.49	5.49	5.49
Nitrite	mg/l	0.02		0.003	KEBS requirements for drinking water		<0.01	1	0			
Ammonia as N	mg/L			0.5	KEBS requirements for drinking water			0	0			
Ammonia as NH3	mg/l	0.07		0.5	KEBS requirements for drinking water		**3.27**	1	1	3.27	3.27	3.27
Physico-chemical												
Total Alkalinity as CaCO3	mg/l	1		No project standard			235.5	1	1	235.5	235.50	235.5
Electrical Conductivity	mS/cm	2		No project standard			567.69	1	1	567.69	567.69	567.69
pH (lab)	pH units	0.01	6.5	8.5	KEBS requirements for drinking water		7.87	1	1	7.87	7.87	7.87
Redox (Eh)	mV	not specified		No project standard				0	0			
Temperature	°C	0.5		No project standard				0	0			
Dissolved Oxygen	mg/l	1		No project standard			10.13	1	1	10.13	10.13	10.13
TDS	mg/l	35		1000	KEBS requirements for drinking water		369	1	1	369	369.00	369
TSS	mg/l	10		0	KEBS requirements for drinking water		**6**	1	1	6	6.00	6
Total Hardness Dissolved (as CaCO3)	mg/l	1		300	KEBS requirements for drinking water		126.51	1	1	126.51	126.51	126.51
Silica	mg/l	0.01		No project standard			12.84	1	1	12.84	12.84	12.84
Residual Chlorine	mg/L			0.2	KEBS requirements for drinking water			0	0			
Organics and Oils												
TPH CWG - Aliphatics												
>C5-C6[#]	mg/l	0.005		No project standard				0	0			
>C8-C10[#]	mg/l	0.005		No project standard				0	0			
>C6-C8[#]	mg/l	0.005		No project standard				0	0			
>C10-C12[#]	mg/l	0.005		No project standard				0	0			
>C12-C16[#]	mg/l	0.01		No project standard				0	0			
>C16-C21[#]	mg/l	0.01		No project standard				0	0			
>C21-C35[#]	mg/l	0.01		No project standard				0	0			
Total aliphatics C5-35	mg/l	0.01		No project standard				0	0			
TPH CWG - Aromatics												
>C5-EC7[#]	mg/l	0.005		No project standard				0	0			
>EC7-EC8[#]	mg/l	0.005		No project standard				0	0			
>EC8-EC10[#]	mg/l	0.005		No project standard				0	0			
>EC10-EC12[#]	mg/l	0.005		No project standard				0	0			
>EC12-EC16[#]	mg/l	0.01		No project standard				0	0			
>EC16-EC21[#]	mg/l	0.01		No project standard				0	0			
>EC21-EC35[#]	mg/l	0.01		No project standard				0	0			
Total aromatics C5-35	mg/l	0.01		No project standard				0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01		No project standard			<0.1	1	0			
Benzene	mg/l	0.0005		0.01	WHO DWS and KEBS requirements for drinking water		<0.01	1	0			
Toluene	mg/l	0.0005		0.7	WHO DWS		<0.01	1	0			
Ethylbenzene	mg/l	0.0005		0.3	WHO DWS		<0.01	1	0			
Xylene (total)	mg/l			0.5	WHO DWS			0	0			
m/p-Xylene	mg/l	0.001		No project standard				0	0			
o-Xylene	mg/l	0.001		No project standard				0	0			
Polyaromatic Hydrocarbons												
Naphthalene	mg/l	0.00001		No project standard			<50	1	0			
Acenaphthylene	mg/l	0.00001		No project standard			<50	1	0			
Acenaphthene	mg/l	0.00001		No project standard			<50	1	0			
Fluorene	mg/l	0.00001		No project standard			<50	1	0			
Phenanthrene	mg/l	0.00001		No project standard			<50	1	0			
Anthracene	mg/l	0.00001		No project standard			<50	1	0			
Fluoranthene	mg/l	0.00001		No project standard			<50	1	0			
Pyrene	mg/l	0.00001		No project standard			<50	1	0			
Benzo(a)anthracene	mg/l	0.00001		No project standard			<50	1	0			
Chrysene	mg/l	0.00001		No project standard			<50	1	0			
Benzo(bk)fluoranthene	mg/l	0.00001		No project standard			<100	1	0			
Benzo(a)pyrene	mg/l	0.00001		0.0007			<50	1	0			
Indeno(123cd)pyrene	mg/l	0.00001		No project standard			<50	1	0			
Dibenzo(ah)anthracene	mg/l	0.00001		No project standard			<50	1	0			
Benzo(ghi)perylene	mg/l	0.00001		No project standard			<50	1	0			
Inorganics and Trace Metals												
Aluminium	mg/l	0.2		0.1	KEBS requirements for drinking water		**0.199**	1	1	0.199	0.20	0.199
Arsenic	mg/l	0.0009		0.01	KEBS requirements for drinking water		<0.01	1	0			
Barium	mg/l	0.003		0.7	KEBS requirements for drinking water		0.09	1	1	0.09	0.09	0.09
Beryllium	mg/l	0.005		No project standard			<0.003	1	0			
Boron	mg/l	0.002		2.4	WHO DWS		<0.005	1	0			
Boron as boric acid	mg/L			0.3	KEBS requirements for drinking water			0	0			
Bromate as BrO3	mg/L			0.01	KEBS requirements for drinking water			0	0			
Cadmium	mg/l	0.00003		0.003	KEBS requirements for drinking water		<0.007	1	0			
Chromium	mg/l	0.0002		0.05	KEBS requirements for drinking water		<0.02	1	0			
Cyanide as CN	mg/L			0.07	KEBS requirements for drinking water			0	0			
Copper	mg/l	0.003		0.05	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		<0.01	1	0			
Iron (Ferrous)	mg/l	0.00002		No project standard				0	0			
Iron (Feric)	mg/l	0.00002		No project standard				0	0			
Iron (total)	mg/l			0.3	KEBS requirements for drinking water		0.19	1	1	0.19	0.19	0.19
Lead	mg/l	0.0004		0.01	KEBS requirements for drinking water		<0.004	1	0			
Lithium	mg/L			No project standard				0	0			
Manganese	mg/l	0.00002		0.5	KEBS requirements for drinking water		<0.01	1	0			
Mercury	mg/l	0.0005		0.001	KEBS requirements for drinking water		<0.01	1	0			
Nickel	mg/l	0.0002		0.02	KEBS requirements for drinking water		<0.02	1	0			
Selenium	mg/l	0.0012		0.01	KEBS requirements for drinking water		<0.01	1	0			
Vanadium	mg/l	0.0006		No project standard				0	0			
Zinc	mg/l	0.0015		1.5	Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water		<0.01	1	0			
Strontium	mg/l	0.005		No project standard			0.21	1	1	0.21	0.21	0.21
Sanitary												
BOD	mg/l	1		No project standard				0	0			
COD	mg/l	7		No project standard				0	0			
Total nitrogen	mg/l	0.5		No project standard				0	0			
Total phosphorous	mg/l	0.5		No project standard				0	0			
Total coliform bacteria	MPN/100ml	not specified		No project standard			33	1	1	33	33.00	33
Fecal coliforms	MPN/100ml	not specified		No project standard			13	1	1	13	13.00	13

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Water Quantity

C4

WATER QUANTITY BASELINE SUPPORTING INFORMATION

Figure 1: Dip to water level

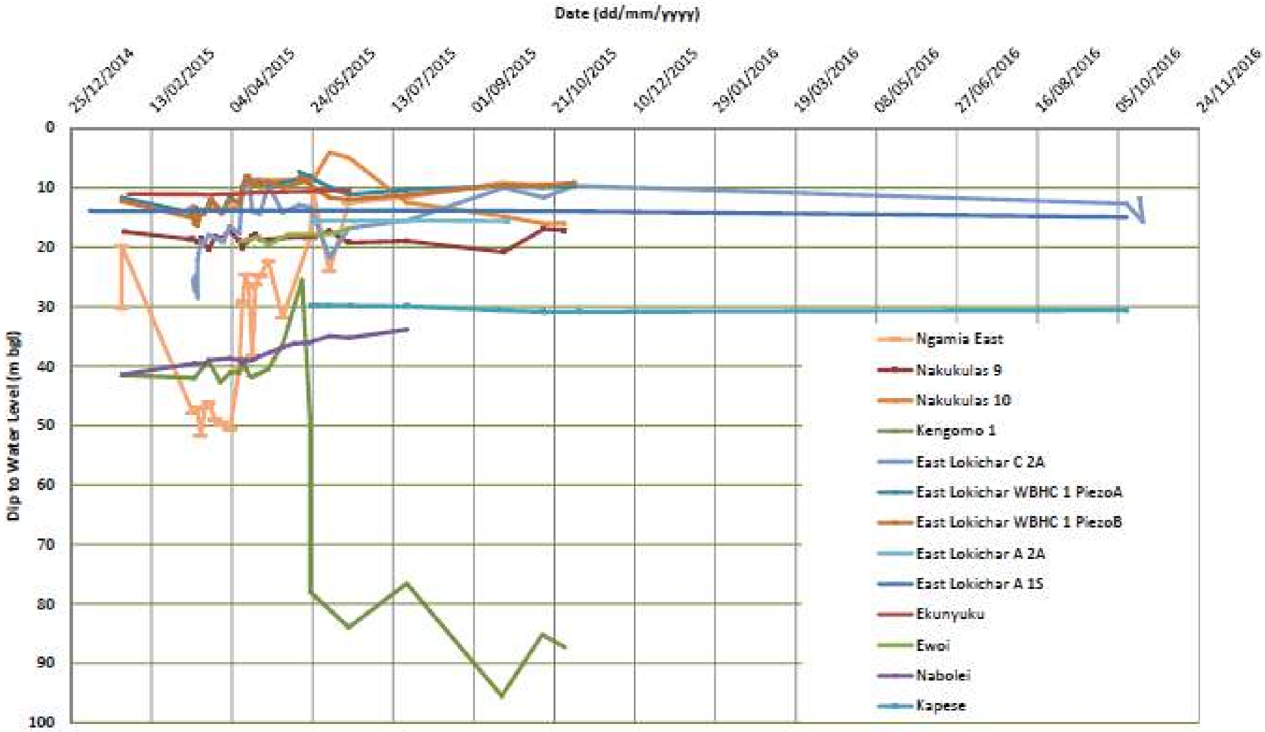


Figure 2: Groundwater Elevation

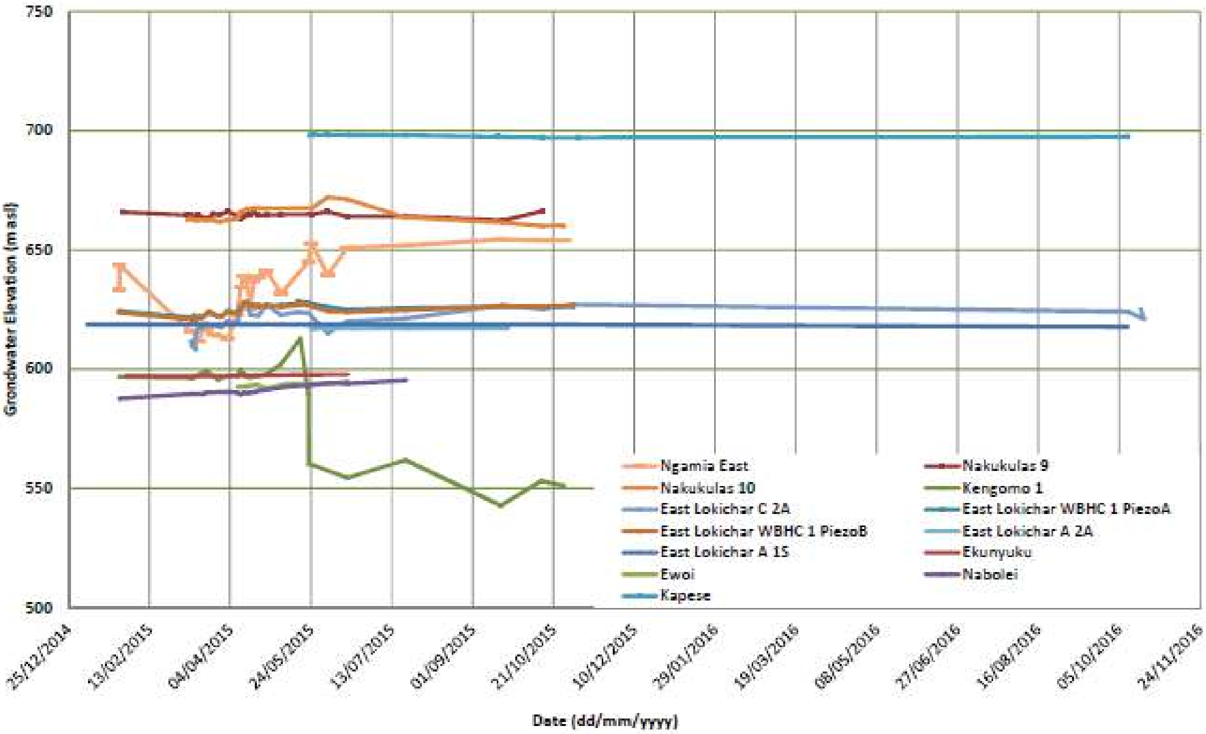
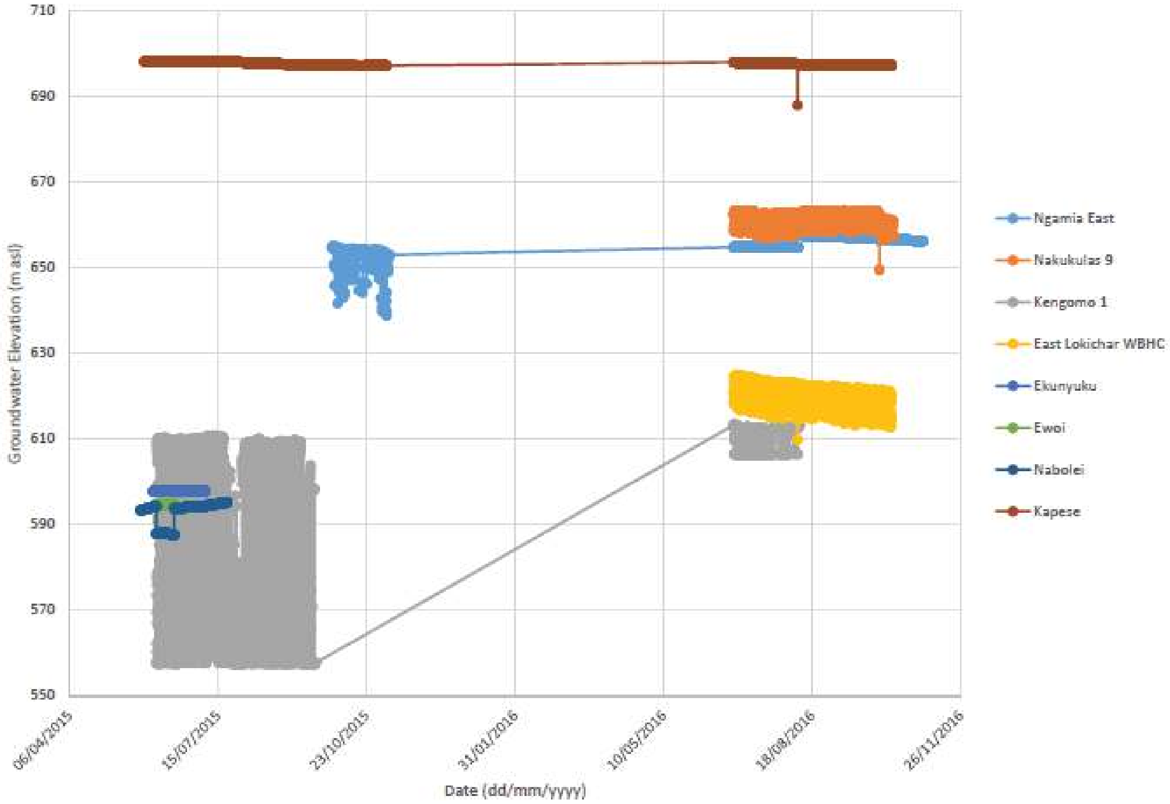
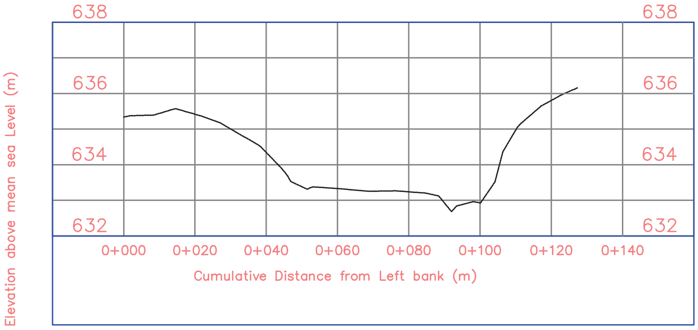


Figure 3: Groundwater Elevations from Level Logger Data



SW 1

100m UPSTREAM



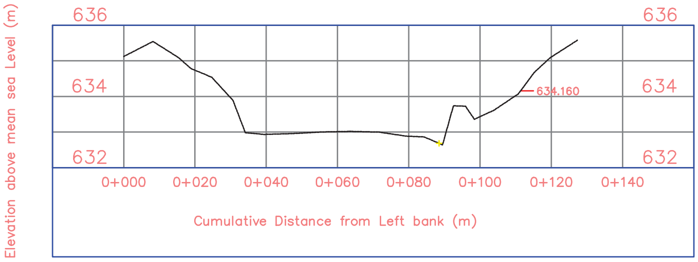
Logger
625.032 Flood debris elevation
Surveyed river profile

*Scale 1:1500 (printed on A3 paper)

*Coordinate System
UTM, WGS84, 36N

50m UPSTREAM

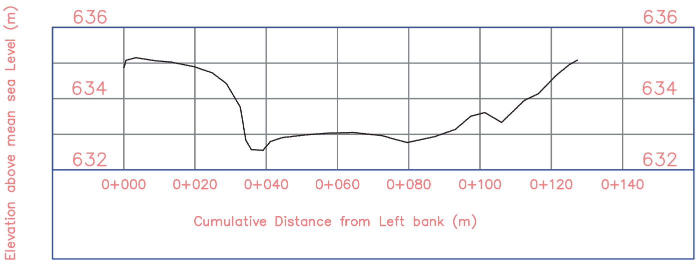
LOGGER SECTION



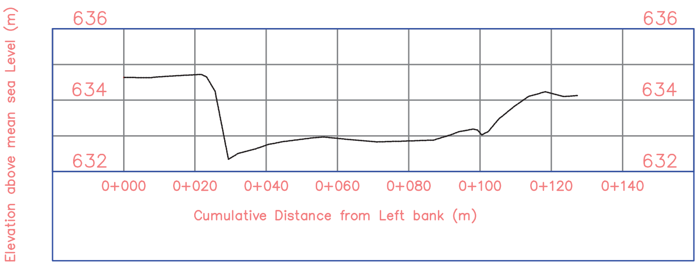
Logger Coordinates

Northing: 255385.86
Easting: 814142.20
Elevation: 632.684

50m DOWNSTREAM



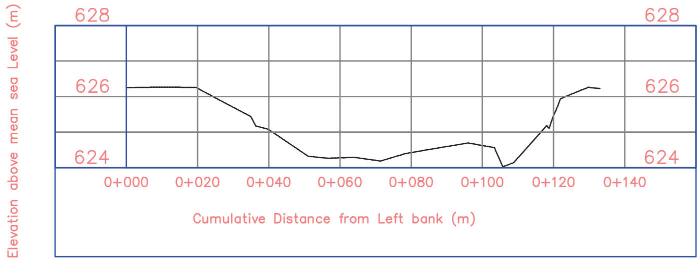
100m DOWNSTREAM



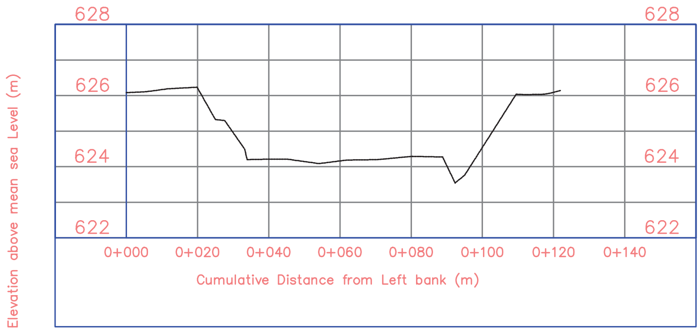
Surveyed & drawn by Erick Rapela

SW 2

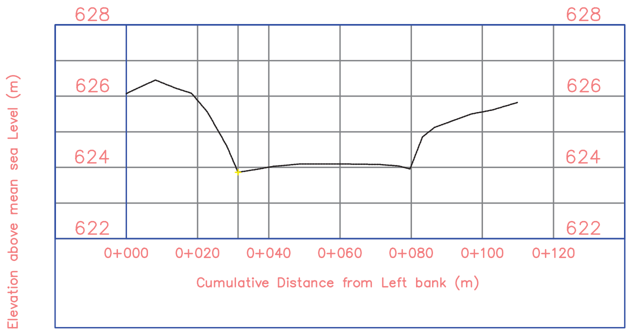
100m UPSTREAM



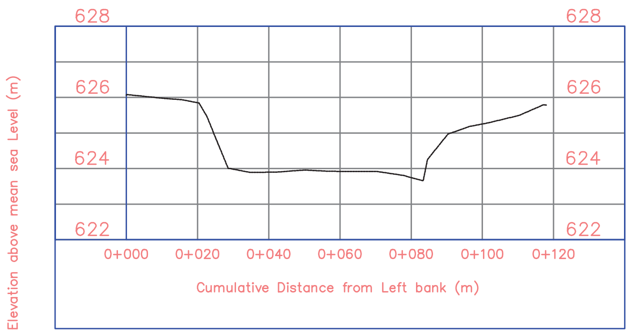
50m UPSTREAM



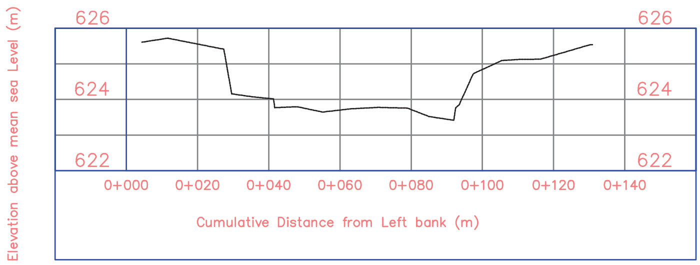
LOGGER SECTION



50m DOWNSTREAM



100m DOWNSTREAM



Logger

Surveyed river profile

*Scale 1:2000 (printed on A3 paper)

*Coordinate System
UTM, WGS84, 36N

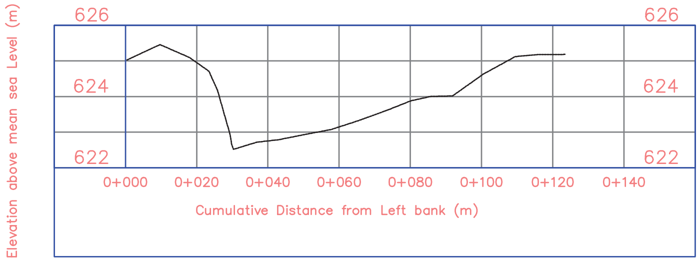
Logger Coordinates

Northing: 257717.81
Easting: 814446.54
Elevation: 623.863

Surveyed & drawn by Erick Rapela

SW 3

100m UPSTREAM



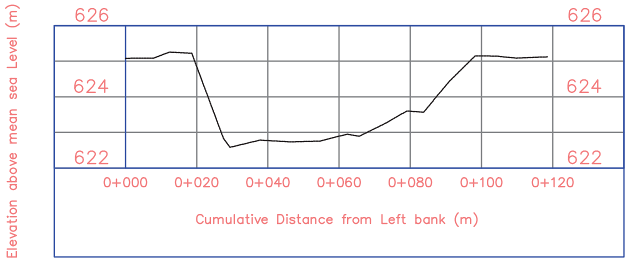
Logger

Surveyed river profile

*Scale 1:2000 (printed on A3 paper)

*Coordinate System
UTM, WGS84, 36N

50m UPSTREAM

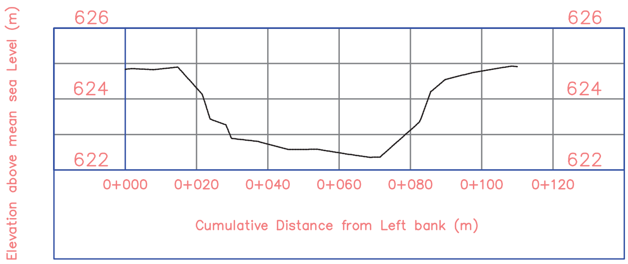


LOGGER SECTION

Logger Coordinates

Northing: 257870.32
Easting: 814854.77
Elevation: 622.658

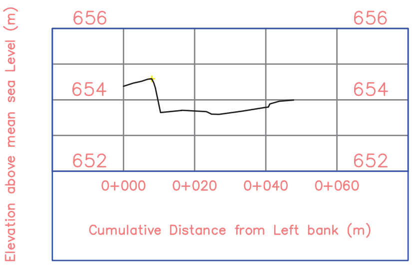
50m DOWNSTREAM



100m DOWNSTREAM

Surveyed & drawn by Erick Rapela

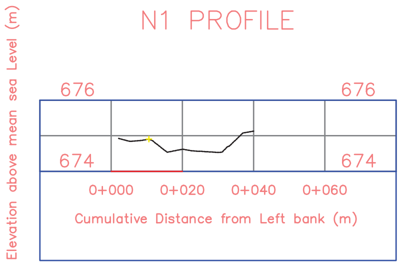
E1 PROFILE



Reference Mark Coordinates

Northing: 257488.30
Easting: 805594.154
Elevation: 654.592

N1 PROFILE



Reference Mark Coordinates

Northing: 246618.99
Easting: 810096.78
Elevation: 674.910

\+ Reference mark

Surveyed river profile

*Scale 1:2000 (printed on A3 paper)

*Coordinate System
UTM, WGS84, 36N

Surveyed & drawn by Erick Rapela

Biodiversity

C5

Potential Species of Conservation Concern

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10
Scientific name	**Common Name**	**Conservation Status**						**Distribution and habitat**	**Likelihood of occurrence in Upstream RSA**
		Wildlife Conservation & Mgmt Act (2013)	**KWS Priority Species (2019)**	**IUCN (2019)**	**CMS (2019)**	**CITES (2019)**	**Other**		
Plants									
Aloe turkanensis			-	-	-	-	Restricted range	Range restricted GBIF (2017) holds two records of this species within the Upstream AOI.	Probable
Blepharis turkanae				VU				A dwarf shrub species occurring in Acacia bushland on rocky lava hills (Luke et al., 2015), its estimated AOO is 39.9Km^2	Probable
								GBIF holds no records of this species within the AOI, however this species is only known from Turkana County (Vollesen, 2008)	
Dalbergia melanoxylon	African Blackwood	-	-	LR/nt				Occurs in a range of woodland habitats throughout sub-Saharan Africa.	Unlikely
Dalbergia vacciniifolia		-	-	VU				This species is a climbing shrub occurring in patches of dry coastal forest at unusually high altitudes, in Kenya and Tanzania (Lovett & Clarke, 1998).	Unlikely
Delonix baccal	Poinciana	-	-	NT				Occurs throughout north-east Africa, in Commiphora-Acacia bushland/thicket or riverine woodland (Rivers, 2014).	Unlikely
Erianthemum occultum		-	-	VU			Restricted range	A small shrub parasitizing Commiphora, with an area of occupancy of 59.9136 km2 which includes Tsavo West and Tsavo East National Parks (IUCN SSC East African Plants Red List Authority. 2013).	Unlikely
Euphorbia turkanensis						II	Restricted range	Although not yet assessed by the IUCN, this species is listed in CITES Appendix II. It's type locality is 1.5 km south-west of Lokichar and the species is known from a limited distribution at a small area of north-west Kenya (Carter & Smith 1988). GBIF (2017) holds several records of this species near Lokichar and Kangetet within the Upstream AOI.	Probable
Juniperus procera	African Pencil Cedar		-	LC	-	-	-	· Although this species has been logged in many areas resulting in localised declines, it is still common or abundant in many areas of its extensive range.	Unlikely
								· Depletion of old growth forest groves of this species is a threat in in Kenya and Ethiopia (Farjon, 2013)	
								· GBIF records of this species occur at Mt Kulal and Mt. Nyiru, outside the AOI	
Justicia brevipila		-	-	VU			Restricted range	A local species of the dry bushlands and woodlands of eastern Kenya, with an area of occupancy (AOO) of 190 km^2 (Luke et al., 2015).	Unlikely
Marsilea fadeniana		-	-	CR				An ephemeral herb of dry stream beds and seasonal waterholes, with an estimated AOO of 9.9 km^2 (IUCN SSC East African Plants Red List Authority, 2013)	Unlikely
Neuracanthus kenyensis	-	-	-	-	-	-	Restricted range	Only known from northern Kenya (MaAOlbit, Isiolo and Turkana), at Kora National Reserve and in the Gemu Gofa region of Ethiopia-Kenya border (Darbyshire et al. 2010)	Possible
								There are no GBIF (2017) records of this species occurring within the Upstream AOI	
Ocotea kenyensis	Camphor	VU	Y	VU	-	-	-	· A timber species found in areas of moist forest, is heavily exploited for its hardwood through most of its range (WCMC, 1998).	Probable
								· Last assessed by IUCN in 1998, no details on current population trends are available	
								· GBIF records of this species occur at Kieni Forest within the Upstream AOI	
Prunus africana	Red Stinkwood	VU	Y	VU	-	-	-	· Locally can be very common; threatened in some areas by harvest of bark for medicinal market.	Unlikely
								· Last assessed by IUCN in 1998, no details on current population trends are available	
								· Occurs in Montane forest, usually at about 1800-2200 m alt. (World Conservation Monitoring Centre 1998)	
								· GBIF records of this species occur at Mt. Nyiru; there are no records of its occurrence within the AOI	
Xerophyta schnizleinia		-	-	VU				This species is known from the northern Frontier in Kenya, Karamoja in Uganda, Ethiopia, Somali republic and Nigeria (Smith & Ayensu 1975)	Possible
								There are no GBIF (2017) records of this species occurring within the Upstream AOI	
Invertebrates									
Belenois aurota	Brown-veined white butterfly	-	-	-			Migratory	· NMK and GBIF (2017) hold records of this migratory butterfly species within the AOI.	Probable
								· Has not yet been assessed by IUCN red list therefore status is uncertain	
Gabbiella rosea	Unnamed mud snail	-	-	NT	-	-	-	· Endemic to the western shore of Lake Turkana - found on the littoral rocky bottom and soft muddy substrata to 5 m depth.	Possible
								· Close to meeting Endangered B1 (triggering Criterion 8) as it has an EOO of less than 20,000 km² based on the shallow waters of Lake Turkana.	
								· It occurs at an unknown number of sites, and is therefore assessed as Near Threatened (Lange, 2010)	
Lachnocnema riftensis	Rift Valley Wooly Legs	-	-	DD				Known from just two records, one of which is the type record from Naivasha which was collected in open savannah in the Rift Valley (Larsen, 2011)	Possible
								· No GBIF records of this species occur within the AOI (GBIF, 2017); however it may occur in suitable habitat.	
Samba turkana	New bee species	-	-	-	-	-	-	· A new bee species recently discovered in the Turkana basin, in arid habitat with vegetation consisting of mixture of acacia woodland dominated by *Acacia tortilis* , and open semi-desert scrub (Packer and Martins, 2015)	Probable
								· No GBIF records of this species occur within the AOI (GBIF, 2017); however it may occur in suitable habitat.	
Fish									
Aplocheilichthys sp. nov. 'Baringo'		-	-				Restricted range	This species occurs in the Lake Baringo drainage system, and is possibly endemic (Odhiambo & Hanssens, 2006)	Unlikely
								Its taxonomic status is uncertain and may be close to *Aplocheilichthys maculatus* (Odhiambo & Hanssens, 2006)	
Aplocheilichthys jeanneli	-	-	-	LC	-	-	-	· Restricted to northern Kenya (Lake Turkana and Omo river), and Ethiopia, it inhabits small streams, swamps and shallows in the delta of the Omo River and shore regions of Lake Turkana	Possible
								· Harvested for human consumption (Getahun & Hanssens, 2010).	
Aplocheilichthys rudolfianus	Lake Rudolf Lampeye	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana; occurs in shallow, quiet and weedy parts around Lake Turkana.	Unlikely
								· EOO for this species is not defined, and thus may not trigger restricted range criterion of <20,000 km^2	
								· Spawns in the littoral region and feeds on zooplankton and insects (Odhiambo, 2006)	
Bagrus docmak	Sudan catfish	-	-	LC	-	-	-	· Widely distributed throughout western, central and eastern Africa , it inhabits lakes, swamps and rivers, and is probably associated with rocky bottoms/coarse substrates (Azeroul et al., 2010)	Possible
								· Within eastern Africa there is heavy fishing pressure upon this species, as well as changes in inshore biotopes.	
								· Competition for food and predation from introduced Nile Perch is a major threat, and has largely displaced the species from the inshore and open waters of many lakes in the region (Azeroul et al., 2010)	
Barbus intermedius	-	-	-	LC	-	-	-	· Widespread distribution including Northern Ewaso Nyiro, Lake Baringo drainage, Lake Bogoria system (affluent rivers), Lake Turkana basin (Turkwell River system, Kerio River system), and Suguta drainage (Vreven, 2006).	Probable
								· Information on its ecology is limited.	
Barbus neumayeri	-		-	LC	-	-	-	· Widely distributed in Kenya and Tanzania - recorded from the Northern and southern Ewaso Nyiro drainge, Athi and Tana River systems, Lake Victoria basin and Lake Turkana system.	Probable
								· Found in permanent and seasonal fast flowing streams, and probably also in shallow zones of the lakes (Hansenns et al., 2015).	
								· Harvested for human consumption	
Barbus stigmatopygus	-	-	-	LC	-	-	-	· Known from the Nile, Niger and Volta River systems, Chad and Bandama Rivers, and from rivers of Guinea-Buissau. It is also known from the Chad and Bandama Rivers (Awaïss et al., 2010). Synonyms include *B. werneri*	Unlikely
								· Information on its ecology is limited.	
Barbus turkanae	-	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Confined to deeper waters below 10 m and spawns within the lake. Little information but not fished commercially (Odhiambo, 2006)	
Brycinus ferox	Large-toothed Lake Turkana Robber	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Occurs in the mid and open water but spawns in the open water (Akinyi, 2006).	
Brycinus minutus	Dwarf Lake Turkana Robber	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Occurs in the mid and open water but spawns in the open water (Akinyi, 2006).	
Distichodus niloticus	Nile Distichodus	-	-	LC	-	-	-	· Known from the White Nile, and Lakes Albert and Turkana.	Probable
								· Found in shallow inshore zones, especially in river deltas, but also sometimes in pelagic zones.	
								· Harvested for human consumption and experiences heavy fishing pressure in E. Africa (Akinyi et al., 2010).	
Haplochromis macconneli	-	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Confined to water more than 20 m deep spawns in deep waters of the main lake.	
								· Not commercially important and therefore is not over-fished (Odhiambo & Hanssens, 2006)	
Haplochromis rudolfianus	-	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Apparently confined to the shallow and protected inshore areas of the lake and spawns in sheltered marginal areas of the lake.	
								· Not fished commercially (Odhiambo & Hanssens, 2006)	
Haplochromis turkanae	-	-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Breeds within the lake (Odhiambo & Hanssens, 2006). Population and major threats unknown	
Labeo brunellii	-	-	-	DD	-	-	-	· Currently known only from the type locality of Lake Abaya, but likely to be more widespread within the region (Getahun, 2010). More information is needed on the species distribution and threats.	Unlikely
Lates longispinis	Rudolf Lates	-	-	DD	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Occurs both in mid-waters and in deep waters and spawns in the open lake (Akinyi, 2006).	
Lates niloticus	Nile Perch	-	-	LC	-	-	-	· Widely distributed in the rivers and lakes of tropical Africa, occurring commonly in all major river basins including the Nile, Chad, Senegal, Volta and Congo.	Unlikely
								· The species is commercially fished and is declining due to overfishing and pollution in some parts of its distribution. (Azeroul et al., 2010)	
Malapterurus electricus	African Electric Catfish	-	-	LC	-	-	-	· This species has a wide distribution, with no known major widespread threats	Possible
								· Although marketable when caught it is of minor commercial importance; nonetheless it is threatened by overfishing in eastern Africa (Azeroul et al., 2010b).	
Mormyrus kannume	Bottlenose	-	-	LC	-	-	-	· Widespread distribution in eastern Africa including the Lake Victoria drainage, Lake Turkana basin, Lake Kamnarok (Kerio system), River Turkwell, Omo delta, Northern Ewaso Nyiro), Middle and Lower Akagera, Lakes Edward, George, Albert and Kyoga systems, and the entire Nile system as far as the delta (Victoria, Murchison and Albert Niles	Probable
								· It is a commercial species (Azeroul et al., 2010a)	
Neobola stellae		-	-	LC	-	-	Restricted range	· Endemic to Lake Turkana (approx. 70,000 km^2); however EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	Unlikely
								· Spawns in the open lake (Odhiambo, 2006).	
Oreochromis niloticus	Nile Tilapia	-	-	-	-	-	-	· Widespread throughout northern, central and eastern Africa, including Omo River system and Lake Turkana (Fishbase, 2015)	Possible
Amphibians									
Amietia wittei		-	-	DD	-	-	-	· Restricted to the central highlands of Kenya on the Mau Escarpment, the Aberdare Mountains, Mount Kenya and the Cherangani Hills, Arusha and Mount Meru in northern Tanzania between 2,080 and 3,100 m asl; its extent of occurrence is 1,226 km^2 (IBAT, 2016). There are no records of its occurrence within the AOI (GBIF, 2017)	Unlikely

Potential Species of Conservation Concern

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10
								· It is presumably associated with streams in montane grassland, and perhaps also forest, but it has also been found in a town (Lötters et al., 2004)	
Sclerophrys turkanae	Lake Turkana Toad	-	Y	DD	-			Known from two localities in north-central Kenya: Loiengalani on the south-eastern shores of Lake Turkana, and Uaso Nyiro River in the Samburu Game Reserve; presumably occurs more widely (IUCN SSC Amphibian Specialist Group, 2016)	Probable
								· Its EOO is 14 km2 (IBAT, 2017). GBIF (2017) holds no records of this species occurrence within the AOI.	
Poyntonophrynus lughensis		-	-	LC	-	-	-	· Occurs in arid lowlands from Somalia, through eastern and southern Ethiopia, extreme southeastern South Sudan, to northern and eastern Kenya as far south as the Ngulia Hills in Tsavo West National Park. It has not been recorded within the AOI (GBIF, 2017).	Unlikely
								· It lives in very dry savannah where it apparently breeds in temporarily flooded hollows, including roadside ditches, immediately after the beginning of the rains(IUCN SSC Amphibian Specialist Group 2013)	
Phrynobatrachus zavattarii		-	-	LC	-	-	-	· This form almost certainly consists of a number of cryptic species (Rödel 2000), including one endemic to Lake Turkana freshwater ecoregion (IUCN SSC Amphibian Specialist Group 2013)	Probable
								· Typically associated with herbaceous vegetation along the margins of shallow marshes, lakes, rivers, streams and pools, both permanent and temporary, and breeds in temporary water bodies (IUCN SSC Amphibian Specialist Group 2013)	
Reptiles									
Boulengerula taitana	Taita Hills Caecilian	-	-	EN	-	-		This species occurs in moist forest on the Taitana Hills (IUCN SSC ASG, 2013c);	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Chamaleo dilepsis	Flap-neck Chameleon	Protected	Y	LC	-	-		This species is widespread in coastal thicket and forest, wet and dry savanna (Spawls et al., 2017)	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Eryx colubrinus	Kenya Sand Boa	Protected	Y	-	-	II		A widely distributed species, preferring desert, semi-desert and dry savannah habitats (Spawls et al. 2004)	Probable
								GBIF holds no records for this species within the AOI (GBIF, 2017); however it is distributed widely throughout Kenya and the horn of Africa	
Hemidactylus barbierii	Barnier's Gecko	-	-	DD	-	-		This species is known from two localities on the eastern border of Lake Turkana in Kenya (Sindaco et al. 2007). The eastern shore of Lake Turkana forms the western range limit of a number of Somali-arid zone Hemidactylus taxa (Sindaco et al. 2007)	Possible
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Kinyongia boehmei	Taita Blade-horned Chameleon	-	-	NT	-	II		This species prefers temperate forest of the Taita Hills (Tolley, 2014), which lie within the AOI;	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Kinyongia excubitor	Mount Kenya Hornless Chameleon		-	VU		II	Restricted range	GBIF holds no records for this species within the AOI (GBIF, 2017).	Unlikely
								Has recently been discovered in forests towards the southern end of the Aberdares (Spawls et al., 2017)	
Kinyongia tavetana	Kilimanjaro Blade-horned Chameleon	-	-	NT	-	II		This species occurs in Afro-temperate forest (Tolley and Menegon, 2014)	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017), and its known distribution does not coincide with the AOI	
Lygodactylus scheffleri	Scheffler's Dwarf Gecko	-	-	DD	-	-		This species is known from the Chuyulu Hills in Tsavo National Park (Spawls et al., 2014), which lie within the AOI	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Malacochersus tornieri	Softshell Tortoise	Threatened	Y	VU	-	-	-	Native to Kenya and Tanzania; terrestrial systems (Tortoise & Freshwater Turtle Specialist Group, 1996b)	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017); however NMK (2017) have a record of this species at Mkinud and Mitito within the Midstream AOI	
Naja ashei	Large Brown Spitting Cobra	Protected	Y	-	-	-		Occurs sporadically on the coast and in the dry country of eastern and northern Kenya, up to altitudes of 1 500 m in the Mt Kenya foothills	Unlikely
								GBIF holds a single record of this species within the AOI near Marieh Pass (GBIF, 2017); its known distribution includes the coastal extent of the Midstream AOI	
Naja nigricollis	Black-necked Spitting Cobra	Protected	Y	-	-	-		Occurs mostly in the south-west, in well-watered savannah in medium altitude areas, but also known from the Chyulu Hills, Nairobi NP, and surrounds	Unlikely
								GBIF holds a single record of this species within the AOI in Nairobi (GBIF, 2017); its known distribution overlaps the Midstream AOI	
Pelusios broadleyi	Lake Turkana Hinged Terrapin	Threatened	Y	VU	-	-	-	· Apparently confined to Lake Turkana (Tortoise & Freshwater Turtle Specialist Group, 1996a); GBIF holds no records for this species within the AOI (GBIF, 2017).	Possible
								· However, EOO for this species is not defined and thus may not trigger restricted range criterion of <20,000 km^2	
Philochortus rudolfensis	Southern Shield-backed Lizard			DD			Restricted range	Occurs in Acacia-Commiphora dry bushland or semi-desert scrub, known only from five localites in northern Kenya	Possible
								GBIF holds no records for this species within the AOI (GBIF, 2017); however NMK (2017) have a record of this species at Lake Turkana within the Upstream AOI	
Python sebae	Rock Python	CR	Y	-	-	II		Occurs across a wide variety of habitats, throughout sub-Saharan Africa	Possible
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Rieppeleon kersteni	Kenya Pygmy-Chameleon	-	-	-		-		Occurs in coastal woodland and thicket, and moist and dry savanna. Inland records occur throughout Kenya, concentrated south-east Kenya particularly parts of Tsavo National Park (Spawls et al., 2017)	Unlikely
								GBIF holds no records for this species within the AOI (GBIF, 2017).	
Birds									
Acrocephalus griseldis	Basra Reed-warbler	EN	Y	EN	I/II	-	-	· Winters in Sudan, South Sudan, Ethiopia, south Somalia, south-east Kenya, east Tanzania, south Malawi (few records) and Mozambique.	Possible
								· Breeds in aquatic vegetation in or around shallow fresh or brackish water, still or flowing (BirdLife International 2012a)	
Ardea cinerea	Grey Heron	-		LC		-	-	· This species is a generalist in its habitat use, it inhabits any kind of shallow water, fresh, brackish or saline, either standing or flowing, and shows a preference for areas with trees as it is commonly an arboreal rooster and nester. (BirdLife International 2012e).	Unlikely
Ardea purpurea	Purple Heron	-		LC	II	-	-	This species is a wetland habitat generalist inhabiting densely vegetated swamps, shore lines and artificial water bodies (BirdLife International 2017).	Possible
								Indications are that the populations are decreasing (BirdLife International 2017).	
Ardeotis kori	Kori Bustard	-		NT		II	-	A trigger species for Nairobi National Park IBA, it has been recorded frequently there, as well as at Lake Nakuru National Park and Tsavo East and West National Parks, within the Midstream AOI (GBIF, 2017)	Probable
								Occurs in flat, arid, mostly open country such as grassland, bushveld, thornveld, scrubland and savanna, and may move into woodland during the dry season in Kenya (BirdLife International, 2017)	
Apalis karamojae	Karamoja Apalis	VU	Y	VU	-	-	-	· Occurs mainly in north-east Uganda and northern Tanzania; an individual was recorded in southern Kenya in August 2004.	Unlikely
								· Suitable habitat occurs in riverine areas, along seasonal watercourses and in seasonally inundated land (BirdLife International 2017)	
Aquila heliaca	Eastern Imperial Eagle	VU	Y	VU	I/II	I	-	· On passage and in winter, birds are found in the Middle East, east Africa south to Tanzania, the Arabian peninsula, the Indian Subcontinent and south and east Asia.	Possible
								· Wetlands are apparently preferred on the wintering grounds (BirdLife International, 2013a)	
								· This species has been recorded in Nairobi National Park (GBIF 2017), with the most recent record being from 2003	
Aquila nipalensis	Steppe Eagle	-		EN	II	II	-	A migratory species, wintering in south-east Africa and breeding in north-eastern Europe (BirdLife International, 2017)	Possible
Ardeola idae	Madagascar Pond-heron	EN	Y	EN	I/II	-	-	· Non-breeding range includes Kenya; in its non-breeding range it is commonly found along the banks of small streams, including those inside forest (BirdLife International 2012c)	Possible
Balearica pavonina	Black Crowned-crane	NT	-	VU	-	II	-	· Breeds July to January in East Africa (subject to local seasonal variation), nesting in single pairs in territories. During the dry (non-breeding) season it is more congregatory, forming large flocks of up to several hundred individuals.	Unlikely
								· Found in wet and dry open habitats, but prefers freshwater marshes, wet grasslands, and the peripheries of water-bodies (BirdLife International 2012e)	
Balearica regulorum	Grey Crowned-crane	Protected	-	EN	-	II	-	· Inhabits wetlands such as marshes, pans and dams with tall emergent vegetation, riverbanks, open riverine woodland, shallowly flooded plains and temporary pools with adjacent grasslands, open savannas, croplands, pastures, fallow fields and irrigated areas (BirdLife International, 2013b)	Possible
Bucorvus leadbeateri	Southern Ground-hornbill	-	-	VU	-	-	-	· Population data for range countries other than South Africa is lacking	Unlikely
								· It inhabits woodland and savanna, also frequenting grassland adjoining patches of forest up to 3,000 m asl. in parts of its range in eastern Africa (BirdLife International 2012f).	
Buteo oreophilus	Mountain Buzzard	-		NR	II	II		A trigger species for the Kikuyu Escarpment, Mau Forest, Kinangop Grasslands and Lake Elmenteita IBAs (BirdLife International, 2017)	Unlikely
Calidris ferruginea	Curlew Sandpiper	-	-	NT	II	-	Annex II Bern Convention (EU Birds Directive)	A Palearctic migrant, wintering in sub-Saharan Africa, south-east Asia and Australasia. During wintering it occurs on muddy edges of inland waterbodies (BIrdLife International, 2017)	Possible
Calidris minuta	Little Stint	-	-	LC	II	-	-	· Over 100,000 (7% of global popn. of min. 1.4 million) have been recorded at Lake Turkana (Bennun & Njoroge 1999).	Possible
Charadrius hiaticula	Common ringed plover	-	-	LC	II	-	-	· Winters in coastal habitats and inland aquatic habitats such as mudbanks or sandbanks along rivers and lakes, lagoons, saltmarshes, short grassland, farmland, flooded fields, gravel pits, reservoirs, sewage works and saltpans (Birdlife International, 2017).	Possible
								· Small congregations have been recorded at Lake Turkana, within the AOI (Peck, 2013).	
Charadrius asiaticus	Caspian plover		-	LC	-	-	-	· Winters in the a range of habitats including recently burnt or heavily grazed grassland, dry floodplains, ploughed cultivated land, coastal dunes, and dried mud of lake shores (Birdlife International, 2017).	Possible
								· Small congregations have been recorded at Lake Turkana, within the Upstream AOI (Peck, 2013); however GBIF (2017) holds no records of this species within the Upstream AOI	
Charadrius pecuarius	Kittlitz's plover	-	-	LC	II	-	-	· Primarily inhabits flat, open, dry ground with very short grass or dried mud, often near the margins of lakes, reservoirs and rivers, or on small permanent and temporary pools, flood plains, dry sandy riverbeds and marshes (Birdlife International, 2015).	Possible
								· Small congregations have been recorded at Lake Turkana, within the AOI (Peck, 2013); however no records are available for the Upstream AOI (GBIF, 2017)	
Chlidonias leucopterus	White-winged Tern	-	-	LC	II	_	_	This species primarily inhabits freshwater lakes, swampy standing water, rivers and shallow naturally flooded grassland (BirdLife International 2012j).	Possible
								The populations of this species are stable (BirdLife International 2012j).	
Circus macrourus	Pallid Harrier	NT	-	NT	II	II	-	· The global population is estimated at 9,000-15,000 pairs.	Possible
								· Most birds winter in sub-Saharan Africa or south-east Asia, where they occur in Semi-desert, scrub, savanna and wetlands (BirdLife International, 2013c)	
Clanga clanga	Greater Spotted Eagle	VU	Y	VU	_	_	-	A migratory species, breeding in northern Europe and wintering in SE Europe, Middle East, S Asia and NE Africa (Mayberg et al., 2017)	Possible
Coracias garrulus	European Roller	NT	-	NT	I	-	-	· Overwinters in two distinct regions of Africa, from Senegal east to Cameroon and from Ethiopia west to Congo and south to South Africa.	Possible
								· Winters primarily in dry wooded savanna and bushy plains (BirdLife International 2012g).	
Crex crex	Corncrake	NT	-	LC	II	-	-	· Winters in sub-Saharan Africa; in the wintering grounds dry grassland and savanna are preferred with birds also occurring in rank grass near rivers, sewage ponds and pools and in relatively short grass in wetter areas, moist sedgebeds and reedbeds and in tall grass within young conifer plantations (Birdlife International, 2015)	Unlikely
Ephippiorhynchus senegalensis	Saddle-billed Stork	Protected	-	LC	-	-	-	Tends to prefer wetlands and the margins of water bodies (BirdLife International 2012d).	Possible

Potential Species of Conservation Concern

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10
								This species has an extremely large range. Its population trend appears to be decreasing (BirdLife International 2012d).	
Falco cherrug	Saker Falcon	EN	Y	EN	I/II	II	-	· Migrant birds winter in East Africa, Southern Europe and southern Asia.	Possible
								· Specialises on mid-sized diurnal terrestrial rodents (especially ground squirrels Citellus, which were observed during the Scoping Site visit (ref. Scoping Report)) of open grassy landscapes such as desert edge, semi-desert, steppes and arid montane areas (BirdLife International, 2013d)	
								· Distribution overlaps the AOI; however this species has not been recorded in the AOI (GBIF 2017)	
Falco concolor	Sooty Falcon	NT	-	NT	II	II	-	It is a migratory species, breediing throughout north east Africa and wintering in Madagascar (BirdLife International, 2017)	Possible
Falco fasciinucha	Taita Falcon	NT	-	VU	-	II	-	The species' range, distribution and population are poorly known. It occurs at gorges and escarpments, using the cliffs for nesting. It is thought to occur at low densities throughout Kenya (Birdlife International, 2017).	Unlikely
Falco naumanni	Lesser Kestrel	VU	Y	LC	I/II	II	-	· Birds winter in southern Spain, southern Turkey, Malta and across much of Africa, particularly South Africa (BirdLife International, 2017).	Probable
								· It has been recorded in the Upstream AOI (NMK, 2015) and is a trigger species for Lake Nakuru and Tsavo East IBAs.	
Falco vespertinus	Red-footed Falcon	NT	-	NT	I/II	II	-	· It winters in southern Africa, from South Africa northwards to southern Kenya.	Possible
								· No information on its wintering habitat preferences is evident but in breeding areas it prefers open lowlands with trees and plenty of insects, on which it feeds, including steppe and forest-steppe, open woodland, cultivation and pastureland (Birdlife International, 2017).	
Ficedula semitorquata	Semi-collared Flycatcher	NT	-	NT	II	-	-	· It winters in a comparatively small region of East Africa, from Sudan and South Sudan through western Kenya, eastern Democratic Republic of Congo, Uganda, Rwanda and Burundi to Tanzania (BirdLife International 2012j)	Unlikely
								Frequents forest edge, gallery forest, light woodland, gardens and open country with leafy trees e.g. Brachystegia woodland and Acacia savanna/woodland (Taylor et al., 2017)	
Gallinago media	Great Snipe	NT	-	NT	II	-	-	· Migrates through central Asia, central and south-eastern Europe Tunisia and Egypt, with birds gathering in wet high-plateau grasslands in Ethiopia. When these dry out in October, birds follow the rains south and west to sub-Saharan countries including Kenya (Van Gils et al., 2017)	Possible
								· Distribution overlaps the AOI; however this species has not been recorded in the AOI (GBIF 2017)	
Glareola nordmanni	Black-winged pratincole	-	-	NT	II	-	-	· Migrates through southern Africa	Unlikely
								· During the non-breeding season it occupies seasonally wet grasslands, savannas, and sandbanks along large rivers	
								· Has not been recorded in the AOI (GBIF, 2017)	
Glareola pratincola	Collared Pratincole	-	-	LC	II	-	-	This species has an extremely large range, and the populations in northern Africa are nomadic or migratory. Their population trend appears to be decreasing (BirdLife International 2012c).	Unlikely
Gyps africanus	White-backed Vulture	NT	-	CR	II	II	-	· The most widespread and common vulture in Africa, although now undergoing rapid declines.	Possible
								· A lowland species of open wooded savanna, particularly areas of *Acacia*. It requires tall trees for nesting. A gregarious species congregating at carcasses, in thermals and at roost sites. It nests in loose colonies (Birdlife International, 2015)	
Gyps rueppelli	Ruepell's Vulture	NT	-	CR	II	II	-	· Occurs across Sahel region of Africa from Senegal, Gambia and Mali in the west to Sudan, South Sudan and Ethiopia in the east. Also south through the savanna regions of East Africa in Kenya, Tanzania and Mozambique.	Possible
								· Largely restricted to protected areas within its range; frequents open areas of *Acacia* woodland, grassland and montane regions, and it is gregarious, congregating at carrion, soaring together in flocks and breeding mainly in colonies on cliff faces and escarpments at a broad range of elevations (Birdlife International, 2015)	
Hieraaetus ayresii	Ayres's Hawk-Eagle	-	-	LC	-	-	-	It prefers woodland and forest (Stevenson and Fanshawe 2002), particularly well wooded savanna areas, riparian forest, and forest patches and may also enter cities and exotic plantations after breeding (Irwin 1981)	Possible
								This species has an extremely large range. Its population trend appears to be stable (BirdLife International 2017)	
Himantopus himantopus	Black-winged Stilt	-	-	LC	II	-	-	Prefers freshwater sites, including marshes and swamps, lake edges, riverbeds, sewage ponds and flooded fields, but also saltpans and coastal saltmarshes (Pierce et al., 2017)	Possible
Hirundo atrocaerulea	Blue Swallow	VU	Y	VU	I/II	-	-	· Non-breeding visitor to north-east DRC, south Uganda and west Kenya. In its non-breeding range it favours open grassland, often with bushes and trees and marshy areas (Birdlife International, 2012m)	Unlikely
								· This species has not been recorded in the AOI (GBIF 2017)	
Laniarius mufumbiri	Papyrus Gonolek	NT	-	NT	-	-	-	· Locally distributed in north-eastern Democratic Republic of Congo (DRC), Uganda, eastern Rwanda, Burundi, north-western Tanzania and western Kenya (Lake Victoria).	Unlikely
								· Confined to papyrus *Cyperus papyrus* swamps and beds, in meandering river valleys and along lake-shores; locally common in Kenya in this habitat (Birdlife International, 2015)	
Lanius dorsalis	Taita Fiscal	Protected	-	LC	-	-	-	Found in dry open bush, acacia (Acacia) woodland and other dry open woodland (Yosef & International Shrike Working Group 2017)	Unlikely
Limosa limosa	Black-tailed Godwit	NT	-	NT	II	-	-	· Wintering populations occur across Europe, Africa, the Middle East and Australasia	Unlikely
Melierax poliopterus	Eastern Chanting-Goshawk	-	-	LC	II	II	-	This species has been recorded in the AOI (GBIF,2017)	Probable
Merops oreobates	Cinnamon-chested Bee-eater	-	-	LC	-	-	-	This species prefers wooded hillsides and forest edges (Stevenson and Fanshawe 2002).	Possible
								Their population trend is unknown (BirdLife International 2012q).	
Mirafra pulpa	Friedmann's Lark	-	-	DD	-	-	-	A poorly known and rare species, it may prefer dense grassland, and could be at least partially migratory (BirdLife International, 2017)	Unlikely
Necrosyrtes monachus	Hooded Vulture	-	-	EN	II	II	-	· Widespread in sub-Saharan Africa; often associated with human settlements, but is also found in open grassland, forest edge, wooded savanna, desert and along coasts (Birdlife International, 2012o)	Possible
Nectarinia erythrocerca	*Red-chested Sunbird*	-	-	LC	-	-	-	This species prefers associated with wooded hillsides and forest edges (Stevenson and Fanshawe 2002).	Unlikely
								Their population trend appears to be stable (BirdLife International 2012s).	
Neophron percnopterus	Egyptian Vulture	Endangered	Y	EN	I/II	II	-	· Bulk of the resident population occurs in Ethiopia and East Africa.	Possible
								· Typically nests on ledges or in caves on cliffs, crags and rocky outcrops, but occasionally also in large trees; forages in lowland and montane regions over open, often arid, country. Also scavenges at human settlements (Birdlife International, 2012p)	
								· This species has been recorded in the AOI (GBIF, 2014)	
Neotis denhami	Denham's Bustard	NT	-	NT		II	-	· Very widely distributed across Africa, however it has suffered population declines through much, if not all, of its range.	Possible
								· Inhabits grasslands, grassy Acacia-studded dunes, fairly dense shrubland, light woodland, farmland, crops, dried marsh and arid scrub plains.	
								· There are now probably fewer than 300 in all of Kenya and its range has contracted in this country (Birdlife International, 2014)	
Numenius arquata	Eurasian Curlew	NT	-	NT	II	-	EU Birds directive II	· Winters around the coasts of north-west Europe, the Mediterranean, Africa, the Middle East, the Indian Subcontinent, South-East Asia, Japan and the Sundas.	Unlikely
								· It has a large global population estimated to number 765,000-1,065,000 individuals (Birdlife International, 2012q)	
Oxyura maccoa	Maccoa Duck	NT	-	NT	II	-	-	During breeding it prefers shallow, nutrient-rich, small inland freshwater lakes with extensive emergent vegetation. Outside the breeding season it also occurs on larger lakes and brackish lagoons (BirdLife International, 2017)	Possible
Pelecanus onocrotalus	Great White Pelican	-		LC	I/II	-	-	Associated with relatively large, warm, shallow fresh, brackish, alkaline or saline lakes, lagoons (Elliot et al., 2017)	Unlikely
Phoeniconaias minor	Lesser Flamingo	NT	-	NT	II	II	-	· The Asian and southern African populations are partially migratory, with many making regular movements from their breeding sites inland to coastal wetlands when not breeding.	Unlikely
								· The species breeds in huge colonies of many thousands of pairs often mixed with Greater Flamingo *Phoenicopterus roseus* (Birdlife International, 2012r)	
Platalea alba	African Spoonbill	_	-	LC	II		-	Typically occurs at lakes, reservoirs, marshes, shallow inland watercourses (Matheu et al., 2017)	Possible
Ploceus spekeoides	Fox's Weaver	-	-	NT	-	-	-	· A poorly recorded species known from a restricted area of seasonally flooded wetlands in northern Uganda. The species has been recorded at two Important Bird Areas, Lake Bisina (250 km2) and Lake Opeta (570 km2), and is found in the marshland habitat stretching between these lakes (BirdLife International, 2017)	Unlikely
Poicephalus rufiventris	Red-bellied Parrot	_	-	LC		II	-	Prefers Commiphora bush with baobabs, lowland Acacia short-grass savanna and Acacia-Commiphora thorn bush, riverine forest and bushland. Where sympatric with P. meyeri, uses open savanna (Collar & Kirwan, 2017)	Unlikely
Polemaetus bellicosus	Martial Eagle	Protected	-	VU	II	-	-	· This species has an extensive range across much of sub-Saharan Africa, and typically occurs in open woodland, wooded savanna, bushy grassland, thornbush (BirdLife International, 2013a)	Possible
Psalidoprocne albiceps	White-headed Saw-wing	-	-	LC	-	-	Biome restricted	This species prefers Savannah, woodland, scrub and forest in upland areas, including miombo woodland and montane areas (Stevenson and Fanshawe 2002).	Unlikely
								Their population trend appears to be stable (BirdLife International 2012u).	
Recurvirostra avosetta	Pied Avocet	_	-	LC	II	-	-	Favours shallow saline lakes, lagoons, pools, saltpans and estuaries with sparse vegetation for breeding; outside breeding season also frequents muddy tidal flats; infrequently found on freshwater lakes and rivers	Possible
Rynchops flavirostris	African Skimmer	NT	-	NT	II	-	-	· Non-breeding flocks of at least 1,000 individuals have been recorded in Tanzania and Kenya; widespread in sub-Saharan Africa	Possible
								· In the non-breeding season, disperses to rivers, lakes and coasts (Birdlife International, 2012s).	
Sagittarius serpentarius	Secretarybird	Protected	-	VU	-	II	-	· Occurs throughout sub-Saharan Africa, inhabiting grasslands, ranging from open plains to lightly wooded savanna, but is also found in agricultural areas and sub-desert (BirdLife International 2013c).	Possible
Scleroptila streptophora	Ring-necked Francolin	-	-	NT	-	-	-	· Disjunct distribution with populations in Burundi, Cameroon, Kenya, Rwanda, Tanzania and Uganda.	Unlikely
								· Recorded sporadically in western Kenya; inhabits stony hillsides with sparse grass and shrub cover, and wooded grasslands at 600-1,800 m (Birdlife International, 2012t)	
Scotopelia peli	Pel's Fishing-owl	-	-	LC	-	-	-	It preferred habitat is around forested edges of lowland perennial rivers, swamps and lakes, and estuaries; favours large riparian trees with deep cover and shade (Holt et al., 2017)	Unlikely

Potential Species of Conservation Concern

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10
								Their population trend appears to be decreasing (BirdLife International 2012ae).	
Gelochelidon nilotica	Gull-biled Tern	-	-	NR	II		-	GBIF (2018) has no records of this species in the Upstream AOI	Unlikely
Struthio molybdophanes	Somali Ostrich	-	-	VU	-	-	-	It is found in a variety of habitats including semi-arid and arid grassland, dense thornbush and woodland (BirdLife International, 2017)	Unlikely
Tauraco hartlaubi	Hartlaub's Turaco	_	-	LC		II	-	No GBIF (2018) records of this species in the Upstream AOI	Unlikely
Terathopius ecaudatus	Bateleur	-	-	NT	II	II	-	· Extensive range across much of sub-Saharan Africa, inhabiting open country, including grasslands, savanna and subdesert thornbush. The nest is built in the canopy of a large tree (Birdlife International, 2012u)	Possible
Torgos tracheliotos	Lappet-faced Vulture	VU	Y	EN	II	II	-	· Inhabits dry savannah, arid plains, deserts and open mountain slopes up to 3,500 m.	Possible
								· builds solitary nests (usually containing just one egg), often in *Acacia*, but also in *Balanites* and *Terminalia* (Birdlife International, 2012v).	
								· *Acacia* sp. and *Balanites* sp. trees were observed within the study area during the scoping site visit	
Tricholaema lacrymosa	Spot-flanked Barbet	-	-	LC	-	-	-	Inhabits wet woodland, wetter areas in dry woodland, also riverine woods, patches of forest (Stevenson and Fanshawe 2002).	Possible
								Their population trend appears to be stable (BirdLife International 2012y).	
Trigonoceps occipitalis	White-headed Vulture	VU	Y	CR	II	II	-	· Extremely large range in sub-Saharan Africa; prefers mixed, dry woodland at low altitudes, avoiding semi-arid thorn-belt areas.	Possible
								· It generally avoids human habitation (Birdlife International, 2012w).	
Tringa hypoleucos	Common Sandpiper	-	-	LC	II	-	-	Non-breeding migrants frequent a wide variety of habitats, such as small pools, ditches, riverbanks, streams, lake shores, marshy areas (BirdLife International 2012z).	Possible
								The populations of this species are decreasing (BirdLife International 2012z).	
Vanellus spinosus	Spur-winged lapwing	-	-	LC	II	-	-	· Frequents a wide range of habitats including dry ground close to fresh or saline pools, lakes, rivers, lagoons or marshes as well as burnt grassland, cultivated, flooded or irrigated fields (Birdlife International, 2015)	Possible
								· Small congregations have been recorded at Lake Turkana (Peck, 2013)	
Mammals									
Acinonyx jubatus	Cheetah	EN	Y	VU	-	I	-	· The number of known resident cheetahs in Eastern Africa (Ethiopia, southern Sudan, Uganda, Kenya and Tanzania) is estimated at 2,572 adults and independent adolescents	Possible
								· Less than half of the estimated cheetah population inhabits protected areas; in addition, approximately half lives in habitat blocks which are trans-boundary, requiring international cooperation for conservation of the population.	
								· Cheetahs possibly occur over an area which is several times as large as the range of the known population (Anon. 2007).	
								· Primarily found in open grassy habitats, but also make use of dry forest, savanna woodland, semi-desert and scrub, being absent from tropical rainforest (Durant et al., 2008).	
Aonyx capensis	African Clawless Otter	-	-	NT	-	-	-	This species is widely distributed across sub-Saharan Africa,	Probable
								It typically occurs in association with freshwater riparian systems, and occasionally in rocky shore coastal environments (Jaques et al., 2015)	
Bdeogale jacksoni	Jackson's Mongoose	VU	-	NT	-	-	Restricted range	· Known only from central and southern Kenya, south-eastern Uganda, and from the Udzungwa Mountains in Tanzania; recorded to montane elevations in the Aberdares, Mt. Kenya and Mt. Elgon up to 3,300 m asl (Van Rompaey et al., 2008).	Unlikely
Canis aureus	Golden Jackal	-	-	LC	-	II	-	· Widespread in North and north-east Africa and fairly common throughout its range (Jhala & Moehlman, 2008)	Unlikely
Ceratotherium simum	White Rhinoceros	EN	Y	NT	-	I	-	· Kenya has not been a White Rhino range state in the last two hundred years; however evidence from fossils and cave paintings in Kenya and northern Tanzania suggests that the White Rhinoceros was widespread and a part of the East African savanna fauna until 3,000 years ago or less, when it was probably displaced by pastoralists.	Unlikely
								· White Rhino as a species but not C. s. simum as a subspecies has probably been reintroduced to Kenya (with the latter being an introduction of a probable out of range subspecies) (Emslie, 2012).	
								· This species has not been recorded in the AOI (GBIF 2017).	
Crocuta crocuta	Spotted Hyena	VU	-	LC	-	-	-	A widespread species in sub-Saharan Africa, present in all habitats (Bohm & Honer, 2015)	Probable
								There are no GBIF (2017) records of this species occurring within the Upstream or Midstream AOI	
Damaliscus lunatus (ssp tiang/ssp topi)	Topi / Tiang	-	-	LC	-	-	-	· About one-quarter of ssp. tiang occur in protected areas, including Sibiloi National Park in Kenya (East 1999). 90% of ssp. Topi occur in protected areas.	Unlikely
								· Topi (subspecies uncertain) has been recorded within the Upstream AOI (NMK, 2015).	
Diceros bicornis	Black Rhinoceros	CR	Y	CR	-	I	-	· Range includes South Africa, Namibia, Zimbabwe and Kenya (Emslie, 2012). It occurs in a wide variety of habitats from desert areas in Namibia to wetter forested areas; highest densities of black rhino are found in savannas on nutrient-rich soils and in succulent valley bushveld areas.	Unlikely
								· As with White Rhinos, four range states (South Africa, Namibia, Zimbabwe and Kenya) currently conserve the majority (96.1%) of remaining wild Black Rhino (Emslie, 2012). Black Rhino is an EDGE-identified species (ZSL, 2013)	
								· This species has not been recorded in the AOI (GBIF 2017).	
Eidolon helvum	African Straw-coloured Fruit-bat	-	-	NT	-	-	-	· This species is in significant decline because it is being seriously over-harvested for food and 'medicine'. It forms large colonies of thousands to even millions of individuals.	Unlikely
								· Colonies may show extreme roost-site fidelity. A well-known colony in Kampala (Uganda) declined in numbers over a forty-year period from ca. 250,000 animals to 40,000 in 2007 (Monadjem et al. 2007).	
								· *Eidolon helvum* is the most heavily harvested bat for bushmeat in West and Central Africa (Mickelburgh et al., 2008), and this is believed to be a major factor in reported population declines (Mickelburgh et al., 2008)	
Equus grevyi	Grevy's Zebra	EN	Y	EN	-	I	-	· Confined to the Horn of Africa, specifically Ethiopia and Kenya, and may persist in South Sudan.	Unlikely
								· Has a discontinuous range, and are found from the eastern side of the Rift Valley in Kenya to the Tana River. There is a small, isolated population in the Alledeghi Plains northeast of Awash N.P. in Ethiopia. From Lake Ch'ew Bahir in southern Ethiopia, the population extends to just north of Mt. Kenya although a few animals are found further southeast along the Tana River. A small introduced population survives in and around Tsavo East N.P. in Kenya. (Moehlman et al., 2013)	
								· This species has not been recorded in the AOI (GBIF 2017)	
Eudorcas thomsonii	Thomson's Gazelle	-	-	NT	-	-	-	This species occurs in the short grasslands of Kenya and Tanzania; there is evidence that several populations have undergone declines (IUCN SSC Antelope Specialist Group, 2008)	Unlikely
Gerbillus cosensis	Cosens's Gerbil	-	-	DD	-	-	-	· Occurs in Kenya and northeastern Uganda, especially around Lake Turkana (Gerrie & Kennerley, 2016)	Probable
								· Very little is known about its status and habitat requirements. This is a semi-desert species found in areas of open, sandy, gravel plains with sparse vegetation	
								· This species has not been recorded in the AOI to date (GBIF 2017).	
Giraffa camelopardalis rothschild	Rothschild's Giraffe	EN	Y	VU	-	-		Occur in Uganda and introduced to central and southwest Kenya. The sub-species was categorized by the IUCN Red List as Endangered (Fennessy and Brenneman 2010); now the IUCN considers all sub-species under Giraffa camelopardalis as VU (Muller et al., 2016)	Unlikely
Hippopotamus amphibius	Hippopotamus	VU	-	VU	-	II	-	· Several thousand occur in Kenya, in most of the many suitable habitats throughout the country (Lewison & Oliver, 2008).	Probable
								· Within the AOI, it is present in Lake Turkana, and has also been recorded in Nairobi National park and the Athi River (GBIF, 2017)	
Hyaena hyaena	Striped Hyaena	EN	Y	NT		III	-	· Very large, albeit patchy distribution, extending from Africa, north of and including the Sahel, and including much of East and North-east Africa south to about central Tanzania, through the Middle East and Arabian Peninsula, Turkey, the Caucasus, Central Asia, and the Indian subcontinent.	Probable
								· Global population size is estimated to be below 10,000 mature individuals, and experiences ongoing deliberate and incidental persecution (Arumugam et al., 2008)	
								· Has been recorded within the AOI (NMK, 2015).	
Litocranius walleri	Gerenuk	-	-	NT	-	-	-	· Still widespread throughout its range, except in parts of Somalia where it has been severely reduced. Inhabits bushland, thickets, semi-arid and arid thornbush (below 1,600 m), avoiding dense woodlands and very open grass-dominated habitats. One of the most exclusive browsers, Gerenuk are largely independent of water (IUCN SSC Antelope Specialist Group 2008)	Unlikely
								· This species has not been recorded in the AOI (GBIF 2017)	
Loxodonta africana	African Elephant	EN	Y	VU	II	I/II	-	· Present in Nasolot and South Turkana reserves (Blanc, 2008) within the AOI.	Probable
								· Found in a wide variety of habitats ranging from dense forest, open and closed savanna, and grassland, to arid deserts mountain slopes and oceanic beaches (Blanc, 2008).	
Lycaon pictus	African Wild Dog	EN	Y	EN	-	-	-	· In 2003, the minimum estimated population size was 150 wild dogs in 11 packs in northern Kenya (Woodroffe, 2012).	Possible
								· This species has been recorded in the AOI in South Turkana Reserve	
Madoqua kirkii	Dik-dik	-	-	LC	-	-	-	· Molecular evidence suggests that Madoqua kirkii is a complex of species, comprising what may effectively represent four distinct species – once recognised as separate species, IUCN reassessment may reassign status of this species (IUCN SSC Antelope Specialist Group, 2008)	Possible
								· This species has been recorded in the AOI (NMK, 2015; GBIF, 2017)	
Miniopterus sp.	Bent-wing Bat	-	-	LC - NT	App. II	-	Congregatory	Bent-wing, or long-fingered bats are obligate cave roosters, and they can form enormous colonies (Dietz et al. 2009, Happold 2013b) (for example, *M. natalensis* is known to form roosting colonies of upwards of 260,000 individuals in de Hoop Guano cave (Monadjem et al. 2010)).	Possible
								These bats are also known migratory species, with species migrating from winter hibernacula to maternity roosts, which may be separated by up to 150 km (Monadjem et al. 2010).	
								Lesser Long-fingered Bat (M. fraterculus), Greater Long-fingered Bat (M. inflatus), African Long-fingered bat (M. africanus), Natal Long-fingered Bat (M. natalensis) and Schreiber's Bent-winged Bat (M. schreibersii - NT) have been recorded within the AOI (GBIF, 2017)	
Neoromicia helios	Samburu Pipistrelle bat	-	-	DD	-	-	-	· Recorded from Djibouti, southern Somalia, southern Sudan, northeastern Uganda, Kenya and northern Tanzania. There is little information about the natural history of this bat, in part because it has often been confused with *Neoromicia nana* (Jacobs et al., 2014)	Unlikely
Oryx beisa	Beisa Oryx	-	-	NT	-	-	-	· Occurs quite widely in areas of Ethiopia, northern and eastern Kenya and north-eastern Tanzania where human and livestock densities are low, with most remaining populations occurring outside protected areas.	Probable
								· GBIF (2017) holds a single record of this species occurring in Tsavo West National Park within the AOI	
								· It is also present in the unprotected northern rangelands of Kenya (IUCN SSC Antelope Specialist Group 2008).	
Otomops martiensseni	Large-eared Free-tailed Bat	VU	-	NT	-	-	Congregatory	· Although this bat was once considered to be rare, with gaps in distribution, additional collecting has demonstrated local abundance in several areas; for example, it is common around Durban in KwaZulu Natal Province of South Africa (Fenton et al. 2002).	Unlikely
								· However, major colonies of this species (consisting of hundreds of bats) from caves in East Africa have declined severely and now have few or no bats (Hutson et al. 2001).	
Otomys barbouri	Barbour's Vlei Rat	EN	Y	EN	-	-	Restricted range	· Extent of occurrence less than 5,000 km²	Unlikely
								· Restricted to high elevations of Mount Elgon , and the burning of the species' habitat causes large fluctuations in the species' area of occupancy and the number of mature individuals.	
								· Inhabits stony hillsides with sparse grass and shrub cover, and wooded grasslands at 600-1,800 m (Taylor & Maree, 2008)	
								· This species has not been recorded in the AOI (GBIF 2017).	
Panthera leo	African Lion	EN	Y	VU	-	II	-	This species has a high habitat tolerance, and can survive in very arid environments as they can obtain their water requirements from prey and even plants (Bauer et al., 2016)	Probable
								· GBIF (2017) holds records of this species of its occurrence in South Turkana Reserve and it is known to occur in Nasolot National Reserve	

Potential Species of Conservation Concern

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10
Panthera pardus	Leopard	EN	Y	NT	-	II	-	· Has the widest habitat tolerance of any Old World felid, ranging from rainforest to desert.	Probable
								· In Africa, they are most successful in woodland, grassland savanna and forest but also occur widely in mountain habitats, coastal scrub, swampy areas, shrubland, semi-desert and desert.	
								· They range from sea level to as much as 4,600 m on Mt Kenya (Henschel et al., 2008)	
Papio anubis	Olive baboon	-	-	LC	-	II	-	· The most extensively distributed baboon in Africa	Probable
								· Very widespread and abundant, no major threats resulting in population declines have been observed to date (Kingdon *et al.,* 2008)	
								· Has been recorded within the AOI (NMK, 2015; GBIF, 2017).	
Scotoecus albofuscus	Light-winged Lesser House Bat	-	-	DD	-	-	Congregatory	· Patchily recorded over much of West Africa and East Africa, with some records from Central Africa; occurs in woodlands and dry savannah (Jacobs, 2008)	Unlikely
								· This species has not been recorded in the AOI (GBIF 2017).	
Smutsia temminckii	Temminck's Ground Pangolin			VU		I		The most widespread pangolin species in Africa, inhabiting mainly savanna woodland in low-lying regions with moderate to dense scrub (Pietersen et al., 2014)	Possible
								· This species has not been recorded in the AOI (GBIF 2017).	
Tadarida ventralis	African Giant Free-tailed Bat	-	-	DD	-	-	Congregatory	· Widely distributed in East and Southern Africa. Typically associated with savanna areas containing rocky crevices and gorges; however Cotterill (1996) reports that a specimen was collected in 1964 from a high rise building in Harare, Zimbabwe (Mickleburgh et al., 2008).	Possible
								· This species has been recorded in the Upstream AOI (GBIF 2017).	
Taphozous hamiltoni	Hamilton's Tomb Bat	VU	-	DD	-	-	Congregatory	· Known mainly from east African savanna, and from mountainous areas, but very little is known. It might be be a cave-dependent species (Mickleburgh et al., 2008)	Possible
Tragelaphus imberbis	Lesser Kudu	VU	-	NT	-	-	-	· Occupies semi-arid areas of north-eastern Africa, commonly known as the Somali-Masai Arid Zone of Ethiopia, Somalia, Kenya and Tanzania.	Probable
								· Closely associated with *Acacia-Commiphora* thornbush in semi-arid areas of north-eastern Africa; it generally avoids open spaces and long grass.	
								· About one-third of the estimated total population occurs in protected areas, but it occurs in larger numbers outside protected areas (IUCN SSC Antelope Specialist Group 2008).	
								· It has been recorded within Tsavo West National park within the AOI (GBIF, 2017)	

Plant Species per Vegetation Community

Plant species recorded during the Baseline surveys conducted during wet and dry seasons in Acacia / commiphora bushland and thicket (ACB), *Acacia tortilis* riparian woodland (ARW), Ephemeral stream woodland (ESW), *Acacia reficiens* low woodland / bushland on plains (ALW), Faidherbia / celtis riparian forest (FCR), Acacia / sansevieria bushland / thicket mosaic (ASB) and Acacia / boswellia shrubland on steep rocky hillslopes (ABS) vegetation communities

Family	Taxon	ACB	ESW	ARW	ALW	FCR	ASB	ABS
Acanthaceae	*Neuracanthus keniensis*	x						
Acanthaceae	*Blepharis turkanae*	x						
Acanthaceae	*Barleria acanthoides*	x						
Acanthaceae	*Blepharis edulis*	x						
Acanthaceae	*Justicia calyculata*	x	x					
Acanthaceae	*Justicia caerulea*	x	x	x				
Acanthaceae	*Megalochlamys revoluta ssp. revolute*			x				
Acanthaceae	*Ruellia patula*	x						
Acanthaceae	*Barleria sp.*	x			x			
Acanthaceae	*Blepharis sp.*				x			
Acanthaceae	*Dicliptera paniculata*					x		
Acanthaceae	*Dicliptera spinulosa*					x		
Acanthaceae	*Duosperma longicalyx*				x			
Acanthaceae	*Justicia flava*			x		x		
Acanthaceae	*Justicia odora*	x						
Actiniopteridaceae	*Actiniopteris radiata*	x						
Agavaceae	*Agave americana **				x		x	
Aizoaceae	*Corbichonia decumbens*	x	x					
Aizoaceae	*Gisekia pharnaceoides* var. *pseudoponiculata*	x	x					
Aizoaceae	*Limeum viscosum*		x	x				
Aizoaceae	*Zaleya pentandra*		x	x				
Aloaceae	*Aloe sp.*	x						
Aloaceae	*Aloe deserti*	x						
Amaranthaceae	*Achyranthes aspera*		x	x				
Amaranthaceae	*Aerva lanata*	x						
Amaranthaceae	*Amaranthus sp.*	x	x	x				
Amaranthaceae	*Dasysphaera prostrate*		x	x				
Amaranthaceae	*Digera muricata*		x	x				
Amaranthaceae	*Pupalia lappacea*	x	x	x				
Amaranthaceae	*Sericocomopsis hildebrandtii*	x	x	x				
Amaranthaceae	*Achyranthes aspera*					x		
Amaranthaceae	*Sericocomopsis hildebrandtii*				x			
Amaryllidaceae	*Crinum macowanii*	x						
Anacardiaceae	*Searsia natalensis*			x				
Apocynaceae	*Blyttia fruticulosum*	x	x					
Apocynaceae	*Calotropis procera*		x	x				
Apocynaceae	*Caralluma acutangula*	x		x				
Apocynaceae	*Leptadenia hastata*	x						
Apocynaceae	*Pentatropis nivalis*			x				
Apocynaceae	*Pergularia daemia*		x					
Apocynaceae	*Adenium obesum*	x						
Apocynaceae	*Calotropis procera **			x	x		x	
Apocynaceae	*Caralluma dicapuae*	x						
Apocynaceae	*Cynanchum viminale*	x			x			
Apocynaceae	*Desmidorchis retrospiciens*	x			x			
Apocynaceae	*Leptadenia hastata*				x			
Arecaceae	*Hyphaene compressa*			x		x		
Arecaceae	*Hyphaene compressa*			x		x		
Aristolochiaceae	*Aristolochia bracteolata*			x				
Asparagaceae	*Asparagus buchananii*	x						
Asparagaceae	*Asparagus sp.*						x	
Asparagaceae	*Sansevieria ehrenbergii*						x	
Asparagaceae	*Sansevieria frequens*					x	x	
Asphodelaceae	*Aloe secundiflora*							x
Asphodelaceae	*Aloe sp.*						x	
Asphodelaceae	*Aloe turkanensis*	x			x			
Asteraceae	*Emilia discifolia*		x	x				
Asteraceae	*Geigeria acaulis*	x						
Asteraceae	*Geigeria alata*	x						

Plant Species per Vegetation Community

Family	Taxon	ACB	ESW	ARW	ALW	FCR	ASB	ABS
Asteraceae	*Helichrysum glumaceum*	x						
Asteraceae	*Kleinia squarrosa*						x	
Asteraceae	*Xanthium strumarium* *			x				
Balanitaceae	*Balanites aegyptiaca*	x		x	x		x	
Balanitaceae	*Balanites rotundifolia*				x			
Boraginaceae	*Cordia sinensis Lam.*		x	x				
Boraginaceae	*Heliotropium simile*	x	x					
Boraginaceae	*Heliotropium strigosum*	x						
Boraginaceae	*Heliotropium rariflorum*		x					
Boraginaceae	*Cordia sinensis*					x		
Burseraceae	*Boswellia neglecta*	x						
Burseraceae	*Commiphora edulis*	x						
Burseraceae	*Commiphora kataf*	x						
Burseraceae	*Commiphora kua*	x						
Burseraceae	*Commiphora africana*	x						
Burseraceae	*Boswellia neglecta*	x						x
Burseraceae	*Commiphora africana*	x			x		x	x
Burseraceae	*Commiphora edulis subsp. boiviniana*							x
Burseraceae	*Commiphora kataf*	x			x			x
Cactaceae	*Opuntia sp.*	x						
Cactaceae	*Opuntia ficus-indica* *				x			x
Capparaceae	*Boscia coriacea*	x	x	x	x		x	x
Capparaceae	*Boscia angustifolia*	x						x
Capparaceae	*Cadaba gynandra*	x	x					
Capparaceae	*Cadaba rotundifolia*	x						
Capparaceae	*Cadaba ruspolii*	x						
Capparaceae	*Cadaba scaposa*	x		x				
Capparaceae	*Cadaba tenella*	x	x	x				
Capparaceae	*Cadaba farinosa*	x			x		x	
Capparaceae	*Cleome allamani*	x	x					
Capparaceae	*Capparis tomentosa*					x	x	
Capparaceae	*Maerua crassifolia*	x			x		x	
Capparaceae	*Maerua triphylla*					x		
Celastraceae	*Gymnosporia senegalensis*					x	x	
Colchicaceae	*Gloriosa superba* var. *graminifolia*	x						
Combretaceae	*Combretum aculeatum*	x		x		x		
Combretaceae	*Combretum hereroense*	x						
Combretaceae	*Terminilia spinosa*	x						
Commelinaceae	*Commelina sp.*	x						
Convolvulaceae	*Cuscuta hyalina*		x	x				
Convolvulaceae	*Hildebrandtia sepalosa*	x						
Convolvulaceae	*Ipomoea mombassana*		x	x				
Convolvulaceae	*Merremia ampelophylla*		x					
Convolvulaceae	*Seddera hirsuta*	x						
Convolvulaceae	*Ipomoea sp.*			x				
Cucurbitaceae	*Citrullus colocynthis*		x	x				
Cucurbitaceae	*Coccinia grandis*		x	x				
Cucurbitaceae	*Cucumis dipsaceus*	x	x	x				
Cucurbitaceae	*Zehneria sp.*		x					
Cucurbitaceae	*Cucumis metuliferus*						x	
Cyperaceae	*Kyllinga microstyla*	x						
Cyperaceae	*Kyllinga alba*	x						
Ebenaceae	*Diospyros scabra*	x						x
Euphorbiaceae	*Acalypha indica*		x	x				
Euphorbiaceae	*Euphorbia inaequilatera* var. *dentata*	x						
Euphorbiaceae	*Euphorbia prostrata*	x						
Euphorbiaceae	*Euphorbia tescorum*	x						
Euphorbiaceae	*Euphorbia turkanae*	x			x			
Euphorbiaceae	*Euphorbia cuneata*	x			x			
Euphorbiaceae	*Jatropha pelargoniifolia*	x			x			
Euphorbiaceae	*Jatropha ellenbeckii*	x						
Euphorbiaceae	*Phyllanthus maderaspatensis*		x					
Euphorbiaceae	*Acalypha fruticosa*					x		
Euphorbiaceae	*Euphorbia gossypina*				x			
Euphorbiaceae	*Euphorbia sp.*						x	
Euphorbiaceae	*Ricinis communis* *			x				

Plant Species per Vegetation Community

Family	Taxon	ACB	ESW	ARW	ALW	FCR	ASB	ABS
Fabaceae (Caesalpinioideae)	*Delonix elata*	x	x	x		x		
Fabaceae (Caesalpinioideae)	*Senna longiracemosa*		x					
Fabaceae (Caesalpinioideae)	*Senna obtusifolia **			x		x		
Fabaceae (Caesalpinioideae)	*Senna sp. (photos)*			x				
Fabaceae (Faboideae)	*Crotalaria saltiana*	x						
Fabaceae (Faboideae)	*Indigofera spinosa*	x						
Fabaceae (Faboideae)	*Indigofera arrecta*		x					
Fabaceae (Faboideae)	*Indigofera schimperi*	x	x					
Fabaceae (Faboideae)	*Vatovaea pseudolablab*	x						
Fabaceae (Mimosoideae)	*Acacia horrida*	x						
Fabaceae (Mimosoideae)	*Acacia mellifera*	x						x
Fabaceae (Mimosoideae)	*Acacia reficiens*	x			x		x	x
Fabaceae (Mimosoideae)	*Acacia senegal*	x						
Fabaceae (Mimosoideae)	*Acacia tortilis*	x	x	x				
Fabaceae (Mimosoideae)	*Acacia elatior*	x	x	x		x		
Fabaceae (Mimosoideae)	*Prosopis procera*	x						
Fabaceae (Mimosoideae)	*Acacia etbaica*				x			
Fabaceae (Mimosoideae)	*Acacia nilotica*							
Fabaceae (Mimosoideae)	*Acacia paolii*				x			
Fabaceae (Mimosoideae)	*Acacia senegal* var. *kerensis*	x			x		x	
Fabaceae (Mimosoideae)	*Acacia tortilis* subsp. *spirocarpa*			x	x	x		x
Fabaceae (Mimosoideae)	*Prosopis juliflora **			x		x		
Fabaceae (Papilionoideae)	*Indigofera spinosa*	x			x		x	
Hyacinthaceae	*Albuca abyssinica*	x						
Labiatae	*Leucas tomentosa*	x						
Labiatae	*Leucas glabrata*		x					
Lamiaceae	*Leucas cf. glabrata*	x						
Lamiaceae	*Plectranthus sp.*							x
Loranthaceae	*Plicosepalus sagittifolius*	x	x	x				
Lythraceae	*Lawsonia inermis*							x
Malvaceae	*Abutilon figarianum*	x						
Malvaceae	*Hermannia rhabdotospermus*		x					
Malvaceae	*Hermannia kirkii*	x						
Malvaceae	*Hibiscus micranthus*	x						
Malvaceae	*Pavonia patens*	x						
Malvaceae	*Abutilon cf. angulatum*			x		x		
Malvaceae	*Grewia cf. similis*				x		x	
Malvaceae	*Grewia fallax*	x			x		x	
Malvaceae	*Grewia tenax*	x					x	x
Malvaceae	*Grewia villosa*						x	
Malvaceae	*Sterculia stenocarpa*	x						x
Meliaceae	*Azadirachta indica **					x		
Menispermaceae	*Cocculus pendulus*	x	x	x				
Moraceae	*Ficus cordata*							x
Moraceae	*Ficus sycomorus*					x		
Myrtaceae	*Psidium guajava **					x		
Nyctaginaceae	*Boerhavia repens*	x	x	x				
Nyctaginaceae	*Commicarpus helenae*			x				
Olacaceae	*Ximenia americana*					x	x	
Orobanchaceae	*Cistanche tubulosa*		x					
Passifloraceae	*Adenia venenata*	x						x
Passifloraceae	*Adenia volkensii*		x	x				
Passifloraceae	*Basananthe hanningtoniana*		x					
Pedaliaceae	*Pterodiscus ruspolii*	x	x					
Pedaliaceae	*Sesamothamnus busseanus*	x	x					
Pedaliaceae	*Sesamum alatum*	x						
Pedaliaceae	*Sesamothamnus rivae*	x						
Poaceae	*Aristida kenyensis*	x						
Poaceae	*Aristida mutabilis*	x			x		x	
Poaceae	*Aristida adscensionsis*	x		x				
Poaceae	*Brachiaria leersioides*	x						
Poaceae	*Cenchrus ciliaris*			x				
Poaceae	*Dactyloctenium aegyptium*	x	x					
Poaceae	*Digitaria velutina*		x	x				
Poaceae	*Enneapogon cenchroides*	x						
Poaceae	*Eragrostis aethiopica*		x	x				

Plant Species per Vegetation Community

Family	Taxon	ACB	ESW	ARW	ALW	FCR	ASB	ABS
Poaceae	*Eragrostis cilianensis*		x	x				
Poaceae	*Eragrostis ciliaris*		x	x				
Poaceae	*Leptochloa obtusiflora*	x						
Poaceae	*Leptothrium senegalense*	x						
Poaceae	*Oropetium minimum*	x						
Poaceae	*Panicum sp.*		x	x				
Poaceae	*Setaria spicatus*		x	x				
Poaceae	*Setaria verticillata*		x	x		x		
Poaceae	*Sporobolus rangei*			x				
Poaceae	*Stipagrostis hirtigluma*	x						
Poaceae	*Tetrapogon cenchriformis*	x						
Poaceae	*Tragus berteronianus Schult.*	x						
Poaceae	*Tricholaena teneriffae*	x	x	x				
Poaceae	*Aristida cf. congesta*				x		x	
Poaceae	*Eragrostis sp.*	x						x
Poaceae	*Heteropogon contortus*						x	x
Poaceae	*Panicum maximum*			x		x		
Poaceae	*Setaria sulcata*					x		
Polygalaceae	*Polygala erioptera*	x						
Portulacaceae	*Portulaca oleracea*	x						
Rhamnaceae	*Ziziphus mauritiana*		x	x		x		
Rhamnaceae	*Ziziphus mucronata*					x		
Rubiaceae	*Kohautia sp.*		x					
Rubiaceae	*Vangueria cf. apiculata*					x		
Salvadoraceae	*Dobera glabra*		x					
Salvadoraceae	*Salvadora persica*	x	x	x	x		x	
Sapindaceae	*Allophylus rubifolius*					x		
Sapindaceae	*Cardiospermum grandiflorum* *					x		
Scrophulariaceae	*Striga gesnerioides*		x					
Selaginellaceae	*Selaginella sp.*							x
Solanaceae	*Datura inoxia*			x				
Solanaceae	*Lycium europaeum*	x	x					
Solanaceae	*Solanum somalense*	x	x	x				
Solanaceae	*Solanum coagulans*							
Solanaceae	*Physalis peruviana* *			x				
Solanaceae	*Solanum campylacanthum*			x				
Solanaceae	*Withania somnifera*			x				
Sterculiaceae	*Hermannia kirkii*	x	x	x				
Tiliaceae	*Corchorus tridens*		x	x				
Tiliaceae	*Grewia villosa*	x						
Tiliaceae	*Grewia tenax*	x						
Velloziaceae	*Xerophyta schnizleinia*	x						
Verbenaceae	*Premna resinosa*	x						
Verbenaceae	*Lantana camara* *					x		
Vitaceae	*Cissus rotundifolia*	x	x	x	x		x	x
Vitaceae	*Cissus quadrangularis*		x	x	x		x	x
Zygophyllaceae	*Balanites rotundifolia*	x						
Zygophyllaceae	*Tribulus terrestris*	x	x	x	x		x	

*** Alien invasive species**

Invertebrate Baseline Data

Taxa	*Acacia tortilis* Riparian Forest	Acacia/ Commiphora deciduous bushland and thicket	Acacia/ Commiphora/ Euphorbia stunted bushland/ thicket	Acacia/ Commiphora/ Indigofera stunted bushland	Mixed Acacia/ Hyphaene Riparian Forest	Semi-desert shrubland	Wooded Ephemeral Streams	Total
Araneae	**26**	**3**					**19**	**48**
(blank)	26	3					19	48
Blattodea	**1**				**1**		**1**	**3**
Blatellidae							1	1
Blattidae	1				1			2
Chilopoda	**4**						**2**	**6**
Lithobiidae	3							3
Scolopendridae							1	1
(blank)	1						1	2
Coleoptera	**1337**	**3**	**26**	**7**	**1238**	**4**	**562**	**3177**
Bostrychidae							1	1
Buprestidae	1		1			1	1	4
Carabidae	6		1		13		24	44
Cerambycidae			1	2	12		19	34
Chrysomelidae					2			2
Cicindelidae					2		1	3
Cleridae					1		1	2
Coccinelidae						1		1
Curculionidae	1				2		1	4
Dascilidae							2	2
Dryopidae					2			2
Elateridae	2		1		13		8	24
Erotylidae							1	1
Hybosoridae	2				67		17	86
Meloidae	1						3	4
Scarabaeidae	9		1	1	614		143	768
Staphylinidae					341		3	344
Tenebrionidae	1313	3	21	4	109	2	322	1774
Trogidae	2							2
(blank)					60		15	75
Diplopoda	**1**		**1**					**2**
(blank)	1		1					2

Invertebrate Baseline Data

Taxa	***Acacia tortilis* Riparian Forest**	**Acacia/ Commiphora deciduous bushland and thicket**	**Acacia/ Commiphora/ Euphorbia stunted bushland/ thicket**	**Acacia/ Commiphora/ Indigofera stunted bushland**	**Mixed Acacia/ Hyphaene Riparian Forest**	**Semi-desert shrubland**	**Wooded Ephemeral Streams**	**Total**
Diptera	**49**		**5**		**5**		**133**	**192**
Asilidae					1		8	9
Bombylidae							1	1
Diopsidae					1			1
Dolichopodidae							1	1
Drosophilidae	5						25	30
Muscidae	39		5		3		97	144
Sarcophagidae							1	1
Tachinidae	5							5
Hemiptera	**15**		**19**		**25**	**2**	**26**	**87**
Cicadellidae							15	15
Cicadidae					1			1
Cydnidae							1	1
Lygaeidae	8				1		5	14
Notonectidae					18			18
Pentatomidae					5		3	8
Pyrrhocoridae	7		18			2	1	28
Reduviidae							1	1
Scutelleriidae			1					1
Hymenoptera	**348**	**21**	**106**	**21**	**7**	**1**	**573**	**1077**
Anthophoridae	1				2		2	5
Anthoporidae							2	2
Apidae			94				33	127
Braconidae			3	1				4
Chalcididae	29					1	175	205
Eumenidae							1	1
Formicidae	315	1	8	20			355	699
Halictidae	1				2		4	7
Ichneumonidae					1			1
Mutilidae			1					1
Mutiliidae	2							2
Scoliidae					1		1	2

Invertebrate Baseline Data

Taxa	*Acacia tortilis* Riparian Forest	Acacia/ Commiphora deciduous bushland and thicket	Acacia/ Commiphora/ Euphorbia stunted bushland/ thicket	Acacia/ Commiphora/ Indigofera stunted bushland	Mixed Acacia/ Hyphaene Riparian Forest	Semi-desert shrubland	Wooded Ephemeral Streams	Total
Sphecidae					1			1
Tetramorium		20						20
Isopoda							**1**	**1**
Cylistidae							1	1
Isoptera	**1**	**0**	**6**				**0**	**7**
Termitidae	1	0	6				0	7
Lepidoptera	**182**	**15**	**81**	**118**	**40**	**44**	**269**	**749**
Hesperiidae	3						9	12
Lycaenidae	121			4			2	127
Nymphalidae	1				2	3		6
Pieridae	57	15	81	114	4	41	258	570
(blank)					34			34
Mantodea		**1**					**2**	**3**
Tarachodidae							1	1
(blank)		1					1	2
Mecoptera						**2**		**2**
(blank)						2		2
Neuroptera			**5**					**5**
(blank)			5					5
Odonata			**1**				**2**	**3**
Coenagridae							1	1
Libellulidae			1				1	2
Orthoptera	**9**			**1**	**14**	**5**	**19**	**48**
Acridiidae	4			1	8	5	5	23
Gryllidae	4				4		14	22
Tettigonidae	1							1
Tridactylidae					2			2
Scorpiones	**10**		**7**	**2**	**18**	**5**	**14**	**56**
(blank)	10		7	2	18	5	14	56
Solfugida	**4**						**12**	**16**
Solfugae	1						6	7
(blank)	3						6	9

Invertebrate Baseline Data

Taxa	*Acacia tortilis* Riparian Forest	Acacia/ Commiphora deciduous bushland and thicket	Acacia/ Commiphora/ Euphorbia stunted bushland/ thicket	Acacia/ Commiphora/ Indigofera stunted bushland	Mixed Acacia/ Hyphaene Riparian Forest	Semi-desert shrubland	Wooded Ephemeral Streams	Total
Thysanura		**2**		**5**				**7**
Lepismatidae		2		5				7
Grand Total	**1987**	**45**	**257**	**154**	**1348**	**63**	**1635**	**5489**

Baseline Herpetofauna Data

Region	Sampling Location	Common Name	*Genus*	*Species*	IUCN Status	Observation type	Vegetation Type
Ngamia	n/a	Hook-snouted worm snake	*Afrotyphlops*	*brevis*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Nakukulas	TKLA_08	Rupell's agama	*Agama*	*ruepelli*	Not yet assessed	Found in rocky area	Acacia/Commiphora deciduous bushland and thicket
Amosing	TKLA_07	Turkana toad	*Amietophrynus*	*turkanae*	Data Deficient	Caught in pitfall trap	Acacia tortillis Riparian Forest
Ngamia	n/a	Puff adder	*Bitis*	*arietans*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Katamanak	TKLA_11	North-East African carpet viper	*Echis*	*pyramidum*	Least Concern	Found under fallen, rotting vegetation	Semi-desert shrubland
Amosing	n/a	North-East African carpet viper	*Echis*	*pyramidum*	Least Concern	Tullow Snake Callout Record	Not recorded
Ngamia	n/a	North-East African carpet viper	*Echis*	*pyramidum*	Least Concern	Tullow Snake Callout Record	Not recorded
Amosing	n/a	Kenya Sand Boa	*Eryx*	*colubrinus*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Ngamia	TKLA_06	Speke's sand lizard	*Heliobolus*	*spekii*	Not yet assessed	Mostly seen by day moving on the ground	Wooded Ephemeral Streams
Amosing	TKLA_07	Speke's sand lizard	*Heliobolus*	*spekii*	Not yet assessed	Mostly seen by day moving on the ground	Acacia tortillis Riparian Forest
Nakukulas	TKLA_08	Uniform-scaled gecko	*Hemidactylus*	*isolepis*	Not yet assessed	Found under rock	Acacia/Commiphora deciduous bushland and thicket
Ngamia	TKLA_06	Brook's gecko	*Hemidactylus*	*brookii*	Not yet assessed	Mostly seen on tree trunks at night	Wooded Ephemeral Streams
Amosing	TKLA_07	Brook's gecko	*Hemidactylus*	*brookii*	Not yet assessed	Mostly seen on tree trunks at night	Acacia tortillis Riparian Forest
Leporot	TKLA_01	Somali-Masai clawed gecko	*Holodactylus*	*africanus*	Not yet assessed	Found at night under thorn bush	Mixed Acacia/Hyphaene Riparian Forest
Ngamia	TKLA_06	Somali-Masai clawed gecko	*Holodactylus*	*africanus*	Not yet assessed	Nocturnal; caught in pitfall trap	Wooded Ephemeral Streams
Amosing	TKLA_07	Long-tailed sand lizard	*Latastia*	*longicaudata*	Not yet assessed	Mostly seen by day moving on the ground	Acacia tortillis Riparian Forest
Amosing	TKLA_07	Kenya dwarf gecko	*Lygodactylus*	*keniensis*	Least Concern		Acacia tortillis Riparian Forest
Leporot	TKLA_01	Kenya dwarf gecko	*Lygodactylus*	*keniensis*	Least Concern	Mostly seen on tree trunks by day	Mixed Acacia/Hyphaene Riparian Forest
Katamanak	TKLA_11	Kenya dwarf gecko	*Lygodactylus*	*keniensis*	Least Concern	Mostly seen on tree trunks by day	Semi-desert shrubland
Leporot	TKLA_01	Sundevall's writhing skink	*Mochlus*	*sundevalli*	Least Concern		Mixed Acacia/Hyphaene Riparian Forest
Ngamia	TKLA_06	Sundevall's writhing skink	*Mochlus*	*sundevalli*	Least Concern	Caught in pitfall trap	Wooded Ephemeral Streams
Amosing	TKLA_07	Sundevall's writhing skink	*Mochlus*	*sundevalli*	Least Concern	Caught in pitfall trap	Acacia tortillis Riparian Forest
Ngamia	n/a	Red spitting cobra	*Naja*	*pallida*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Ngamia	TKLA_06	Turkana shield-backed ground lizard	*Philochortus*	*rudolfensis*	Least Concern	Caught in pitfall trap	Wooded Ephemeral Streams
Leporot	TKLA_01	Link-marked sand snake	*Psammophis*	*biseriatus*	Not yet assessed		Mixed Acacia/Hyphaene Riparian Forest
Ngamia	TKLA_06	Link-marked sand snake	*Psammophis*	*biseriatus*	Not yet assessed	Found basking on low bush	Wooded Ephemeral Streams
Ngamia	n/a	Speckled sand snake	*Psammophis*	*punctatus*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Amosing	n/a	Rufous Beaked Snake	*Rhamphiophis*	*rostratus*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Ngamia	n/a	Rufous Beaked Snake	*Rhamphiophis*	*rostratus*	Not yet assessed	Tullow Snake Callout Record	Not recorded
Ngamia	n/a	Black tiger snake/Large-eyed snake	*Telescopus*	*dhara*	Not yet assessed	Tullow Snake Callout Record	Not recorded

Avifauna Baseline Data

Bird species recorded during the Baseline assessment in the following vegetation communities: Acacia / Commiphora Bushland and thicket (ACB), Ephemeral Stream Woodland (ESW), Acacia tortilis riparian woodland (ARW), Acacia reficiens low woodland (ALW), Faidherbia – Celtis Riparian Forest (FCR), Acacia – Sanseviera Bushland (ASB), Acacia Boswellia Shrubland (ABS), Open water (OW) and Towns and villages (TWV)

Common name	ARW	ACB	ESW	FCR	ALW	ASB	OW	TWV
Abdim's stork	X	X	X	X				
Abyssinian Roller	X	X	X	X	X			X
Abyssinian Scimitarbill	X	X	X					
Abyssinian Wheatear	X	X	X	X				
African Cuckoo	X			X				
African Darter							X	
African Dusky Flycatcher		X						
African Firefinch		X	X					
African Fish-eagle							X	
African Goshawk	X	X	X					
African Grey Flycatcher	X	X	X		X			
African Grey Hornbill	X	X		X	X			
African Harrier-hawk	X		X	X				
African Hawk-Eagle			X					
African Mourning Dove			X					
African Palm-Swift	X	X	X					
African Paradise-flycatcher	X			X				
African Pied Wagtail							X	
African Pygmy-kingfisher	X			X				
African Silverbill		X						
African Thrush				X				
Augur Buzzard		X						
Barn Swallow		X		X	X		X	X
Bateleur		X		X	X			
Bearded Woodpecker	X			X	X			
Beautiful Sunbird	X	X	X	X	X			
Black Crake							X	
Black Cuckoo				X				
Black Kite		X		X				
Black-backed Puffback				X				
Black-bellied Bustard	X	X						
Black-bellied Sunbird	X							
Black-cheeked Waxbill	X							
Black-chested Snake-eagle					X			
Black-crowned Night Heron				X				
Black-crowned Tchagra		X	X					
Black-faced Sandgrouse	X	X	X					
Black-headed Gonolek				X				
Black-headed Heron		X						
Black-headed Oriole		X	X	X				
Black-headed Plover	X							
Black-shouldered Kite				X				
Black-throated Barbet	X	X	X	X	X			

Avifauna Baseline Data

Common name	ARW	ACB	ESW	FCR	ALW	ASB	OW	TWV
Black-winged Kite					X			X
Bleating Camaroptera	X			X				
Blue-capped Cordon-bleu	X	X			X			
Blue-naped Mousebird	X	X	X		X			
Blue-spotted Wood-dove				X				
Bristle-crowned Starling		X						
Broad-billed Roller				X				
Brown Parrot	X	X	X	X	X			
Brown Snake eagle		X		X	X			
Brown-crowned Tchagra	X	X	X					
Brown-headed Kingfisher					X			
Brubru	X	X	X	X	X			
Buff-bellied Warbler				X				
Cardinal Woodpecker	X	X		X				
Cattle Egret		X						
Chestnut Sparrow		X						
Chestnut Weaver	X	X	X		X			
Chestnut-bellied Sandgrouse					X			
Chestnut-headed Sparrow-Lark					X			
Chin-spot Batis	X	X	X					
Cinnamon-chested Bee-eater		X	X					
Common Bulbul	X	X	X	X	X			
Common Drongo	X	X		X				
Common Fiscal	X	X						
Common Hoopoe					X			
Common Kestrel		X			X			
Common Quail		X	X					
Common Waxbill			X					
Crested Francolin		X		X	X			
Crested Lark		X			X			
Cut-throat Finch			X		X			
Dark Chanting-goshawk	X			X	X			
D'Arnaud's Barbet		X	X		X			
Dickinson's Kestrel			X					
Diederik Cuckoo		X	X					
Dwarf Raven	X							
Eastern Black-headed Oriole	X			X				
Eastern Chanting Goshawk		X	X					
Eastern Violet-backed Sunbird	X	X	X		X			
Eastern Yellow-billed Hornbill					X			
Emerald-spotted Wood-dove	X		X	X	X			
Ethiopian Swallow					X			
Eurasian Hobby			X					
European Bee-eater		X			X			
Fan-tailed Raven	X	X	X					
Fawn-coloured Lark		X						
Fischer's Sparrow Lark		X						
Fischer's Starling		X	X					
Fork-tailed Drongo	X	X	X	X	X			

Avifauna Baseline Data

Common name	ARW	ACB	ESW	FCR	ALW	ASB	OW	TWV
Four-banded Sandgrouse		X	X		X			
Fox Kestrel		X			X			
Foxy Lark					X			
Gabar Goshawk	X	X	X	X				
Giant Kingfisher							X	
Golden-backed Weaver				X				
Golden-breasted Bunting	X	X	X					
Grasshopper Buzzard					X			
Great Spotted Cuckoo	X	X	X					
Greater Blue-eared Starling				X				
Greater Honeyguide	X			X	X			
Green Woodhoopoe		X	X		X			
Green-backed Heron							X	
Green-winged Pytilia		X	X		X			
Grey Woodpecker	X			X				
Grey Wren-warbler	X		X		X			
Grey-backed Camaroptera				X				
Grey-backed Fiscal			X	X				
Grey-headed Bush-shrike	X			X				
Grey-headed Kingfisher				X	X			
Grey-headed Kingfisher	X			X				
Grey-headed Sparrow		X	X					
Hadeda Ibis	X			X				
Hamerkop							X	
Harlequin Quail	X							
Helmeted Guineafowl				X	X			
Hemprich's Hornbill		X						
Heuglin's Wheatear					X			X
Hoopoe	X	X	X					
House Sparrow								X
Hunter's Sunbird		X						
Isabelline Wheatear	X	X		X				
Jackson's Hornbill	X	X		X	X			
Jacobin Cuckoo		X	X	X				
Kenya (Eastern) Violet-backed Sunbird	X	X	X					
Kenya Rufous-Sparrow		X						
Klaas's Cuckoo	X	X	X	X				
Kori Bustard		X	X					
Lanner Falcon	X	X			X			
Lappet-faced Vulture		X						
Laughing Dove	X	X	X	X	X			X
Lesser Honeyguide	X			X				
Lesser Kestrel	X	X						
Lesser Striped Swallow	X						X	
Levaillant's Cuckoo		X						
Lilac-breasted Roller				X	X			
Little Bee-eater	X	X	X	X	X			
Little Sparrowhawk	X	X						

Avifauna Baseline Data

Common name	ARW	ACB	ESW	FCR	ALW	ASB	OW	TWV
Little Swift		X					X	X
Little Weaver	X	X	X					
Long-crested Eagle				X				
Long-tailed Cormorant							X	
Long-tailed Paradise-whydah					X			
Magpie Starling	X	X		X	X			
Marico Sunbird	X			X				
Meyer's Parrot			X	X				
Mottled Swift				X				
Mourning Collared-dove	X			X	X			
Mouse-coloured Penduline-Tit		X			X			
Namaqua Dove	X	X	X	X	X			X
Northern Brownbul	X			X				
Northern Crombec		X	X		X			
Northern Grey-headed Sparrow	X							
Northern Puffback					X			
Northern Red-billed Hornbill	X			X	X			
Northern Wheatear		X	X		X			X
Northern White-crowned Shrike	X			X				
Nothern White-crowned Shrike	X	X	X	X	X			X
Nubian Woodpecker	X	X	X	X	X			
Olive Bee-eater	X							
Orange-breasted Bush-shrike	X			X	X			
Orange-winged Pytilia		X						
Pale Flycatcher	X	X		X	X			
Pale Prinia	X	X	X		X			
Pallid Harrier	X							
Pallid Honeyguide	X	X						
Palm-nut Vulture				X				
Parrot-billed Sparrow	X			X	X			X
Pearl-spotted Owlet					X			
Pied Crow	X		X					X
Pied Kingfisher							X	
Pink-breasted Lark					X			
Pin-tailed Whydah			X					
Plain Nightjar		X						
Plain-backed Pipit		X						
Pringle's Puffback			X					
Purple Grenadier	X	X	X	X	X			
Purple Roller		X						
Pygmy Batis		X			X			
Pygmy Falcon	X	X	X					
Pygmy falcon		X	X		X			
Quail Plover		X						
Rattling Cisticola	X							
Red-and-yellow Barbet	X	X	X	X	X			
Red-billed Firefinch				X				
Red-billed Hornbill	X	X	X	X				

Avifauna Baseline Data

Common name	ARW	ACB	ESW	FCR	ALW	ASB	OW	TWV
Red-billed Oxpecker					X			
Red-billed Quelea				X	X			
Red-cheeked cordon-bleu				X				
Red-chested Cuckoo	X			X				
Red-chested Sunbird		X						
Red-eyed Dove				X				
Red-fronted Barbet				X				
Red-fronted Prinia					X			
Red-fronted Tinkerbird	X	X		X	X			
Red-fronted Warbler			X					
Red-rumped Swallow	X							
Red-throated Rock Martin		X						
Red-winged Lark	X							
Red-winged Starling		X						
Ring-necked Dove	X	X	X	X	X			X
Rock Dove (Feral Pigeon)								X
Rosy-patched Bushshrike	X	X	X					
Rufous Chatterer	X	X	X	X	X			
Rufous-tailed Scrub Robin					X			
Rüppell's Starling	X	X		X	X			X
Scarlet-chested Sunbird	X	X	X	X				
Scissor-tailed Kite					X			
Shikra	X			X	X			
Singing Bush Lark		X						
Slate-coloured Boubou	X	X	X	X	X			
Somali Bunting		X			X			
Somali Courser	X	X						
Somali Crow					X			X
Somali Fiscal		X			X			X
Somali Golden-breasted Bunting			X					
Somali Sparrow		X	X					X
Somali Tit					X			
Speckled Mousebird	X			X	X			
Speckled Pigeon	X	X						X
Speckle-fronted Weaver	X	X	X		X			
Spotted Eagle-Owl		X						
Spotted Flycatcher	X	X	X					
Spotted Morning Thrush			X					
Spotted Palm-thrush	X	X	X	X				
Spotted Thick-knee	X	X						
Spur-winged Plover	X	X	X					
Steel-blue Whydah		X	X					
Steppe Buzzard		X	X					
Steppe Eagle	X	X		X				
Stone Partridge		X						
Striped Kingfisher	X			X	X			
Striped Pipit		X						
Sulphur-breasted Bushshrike			X					

Avifauna Baseline Data

Common name	ARW	ACB	ESW	FCR	ALW	ASB	OW	TWV
Superb Starling	X	X	X	X	X			X
Tambourine Dove				X				
Tawny Eagle		X	X	X				
Tawny-flanked Prinia	X	X	X					
Thick-billed Weaver							X	
Three-streaked Tchagra		X						
Variable Sunbird	X	X	X	X	X			
Village Indigobird	X							
Village Weaver	X			X				
Violet-backed Starling	X	X	X					
Vitelline Masked Weaver	X	X	X	X				
Wahlberg's Eagle		X						
Wattled Starling	X	X	X		X			
Western Banded Snake-eagle				X				
White-backed Vulture		X						
White-bellied Bustard		X						
White-bellied Canary					X			
White-bellied Go-away-bird	X	X	X	X	X			
White-billed Buffalo-weaver	X	X	X	X	X			X
White-breasted Cormorant							X	
White-browed Coucal	X			X				
White-browed Robin-chat	X			X				
White-browed Scrub Robin	X	X	X	X	X			
White-browed Sparrow-weaver	X	X	X	X	X			X
White-crested Helmetshrike	X	X	X	X				
White-crowned Shrike				X				
White-headed Buffalo-weaver	X	X	X	X	X			X
White-headed Mouse-bird		X	X					
White-rumped Swift	X							
White-throated Bee-eater	X	X	X					
Willow Warbler	X		X	X	X			
Wire-tailed Swallow							X	
Woodland Kingfisher				X				
Yellow-bellied Eremomela	X	X			X			
Yellow-billed Kite					X			X
Yellow-breasted Apalis	X			X				
Yellow-spotted Bush-sparrow					X			
Yellow-spotted Petronia	X	X	X					
Yellow-vented Eremomela		X			X			
Zebra Waxbill			X					

Mammal Baseline Data

Method / Species	Acacia/ Commiphora deciduous bushland/ thicket	Acacia/ Commiphora/ Euphorbia stunted bushland/ thicket	Acacia/ Commiphora/ Indigofera stunted bushland	Mixed Acacia/ Hyphaene Riparian Forest	Ephemeral Stream Woodland	Total
Camera trap						
Hyaena hyaena					1	1
Otocyon megalotis		2				2
Foraging evidence						
Hystrix sp.		1				1
Orycteropus afer					1	1
Harp trap						
Lavia frons					2	2
Incidental						
Canis mesomelas		1				1
Hyaena hyaena		1				1
Lavia frons					6	6
Lepus capensis			1			1
Madoqua guentheri					1	1
Orycteropus afer		1				1
Xerus rutilans		12	3	1	7	23
Xerus rutilus		3			3	6
Roost search						
Nycticeinops schlieffeni		1				1
Sherman trap						
Acomys percivali		1			1	2
Acomys wilsoni					1	1
Arvicanthis niloticus					2	2
Atelerix albiventris		1				1
Elephantalus rufescens					1	1
Gerbilliscus nigricaudus					1	1
Gerbillus sp.		2			1	3
Taterillus sp.		1	2			3
Xerus rutilus		1				1
Track						
Hyaena hyaena		2				2
Track pad						
Civet/Mongoose		1			1	2
Canis sp.		1				1
Crocuta crocuta					2	2
Crocuta/Hyena		2				2
Mellivora capensis					1	1
Transect						
Atelerix sclateri		2	2			4
Canis aureus		1				1
Civettictis civetta	1					1
Crocuta crocuta		1				1
Galago senegalensis		4	2		4	10
Genetta maculata					2	2
Genetta sp.		1				1
Gerbillius sp.		1				1
Ictonyx striatus		1	4			5
Leptailurus servalis					2	2
Lepus capensis		19	7		2	28
Madoqua guentheri			4			4
Orycteropus afer	1				1	2
Xerus rutilans		4	2		3	9
Total	**2**	**68**	**27**	**1**	**46**	**144**

Ecosystem Services

C6

Turkana plant name	Species	Use	Description of Use	Reference
Amuroekile		Medicinal	Treating stomach diseases including diarrhea, vomiting	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ebei	*Balanites rotundifolia*	Food	Poisonous ebei fruits are boiled like edung to provide food for people	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ebei	*Balanites rotundifolia*	Forage	Leaves are eaten by livestock	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ebucharatet		Constructio n materials	Serves as a house construction material, in conjunction with edung	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Echokokile	*Commiphora cuneata*	Medicinal	Acts in the same way as echuchuka inducing vomit and treating stomach ailments	name reference: Mwaura & Kaburu, 2008
Echuchuka	*Euphorbia cuneata*	Medicinal	Fluid is used as an effective remedy for stomach problems (acidity and ulcers). It induces vomit through which the sickness fluids are removed from the body	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Edapal	*Dobera glabra*			Juma (2009)
Edome	*Cordia sinensis*	Utensils	Used for making traditional carved sticks with curved heads, and *Ekicholong* (Turkana seat/head rest).	
Edung	*Boscia coricea*	Forage	Fresh edung leaves are consumed by camels and they are dry and fall down are important feed for goats and donkeys. Donkeys feed on the bark	name reference: Mwaura & Kaburu, 2008

Turkana plant name	Species	Use	Description of Use	Reference
Edung	*Boscia coricea*	Food	Edung fruits are gathered by women and boiled for long hours to supply food for the family. Being poisonous the fruits are usually boiled from seven o'clock in the morning to three o'clock in the afternoon to be ready for human consumption. Around October, edung becomes plentiful. It is collected and cooked in large sufurias for sharing with everyone. All Turkana foods are shared, but some foods are restricted especially entrails are never eaten by pregnant women as it is believed to bring bad omen and deformities	name reference: Mwaura & Kaburu, 2008
Edweite		Utensils	Used to make all the traditional Turkana stools, utensils (plates, cups and spoons).	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Eengol	*Hyphaene*	Utensils	leaves are used for weaving baskets and mats, and making rope; and trunks are used as poles for construction (Booth et al., 2015).	Booth et al., 2015; name reference from Mwaura & Kaburu
Eengol	*Hyphaene*	Constructio n materials	leaves are used for weaving baskets and mats, and making rope; and trunks are used as poles for construction (Booth et al., 2015).	Booth et al., 2015; name reference from Mwaura & Kaburu
Egis		Medicinal	Used to treat livestock diseases, which include loukoi, emany, lojaa, lokot, lotomee, lomoo, ngiboruok (foot and mouth disease), amil, lonyang, lokot, loidiit.	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Eipa	*Maerua oblongifolia*	Medicinal	Toothbrushes, superior to those from esekon; believed to contain germ-killing chemicals	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008

Turkana plant name	Species	Use	Description of Use	Reference
Eipa	*Maerua oblongifolia*	Forage	Eipa which needs support from other trees to grow (always existing near acacia trees) is eaten by camels and goats (which consume the leaves).	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Ekabekebeke	*Lycium europaeum*	Medicinal	A very effective treatment for snakebites (fluid from the leaves are smeared in the bitten place to remove the poison and fangs stuck in the body).	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Ekabekebeke	*Lycium europaeum*	Forage	Camel feed	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Ekabekebeke	*Lycium europaeum*	Utensils	Used to produce transport trays used during migrations to carry luggage	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Ekabonyo		Medicinal	Acts in the same way as echuchuka inducing vomit and treating stomach ailments	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekadel	*Commiphora africana*			Juma (2009)
Ekalale	*Ziziphus mauritiana*	Forage	Leaves and flowers are feed for livestock, as are its fruits	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016

Turkana plant name	Species	Use	Description of Use	Reference
Ekalale	*Ziziphus mauritiana*	Food	Fruits used by people. Ekalale is pound with stone and to is added milk, blood, fat and flour to make a firm paste which is very delicious and keeps one satisfied for long	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekalale	*Ziziphus mauritiana*	Utensils	Branches are used for making bows, fencing, and the making of stools	(Booth et al., 2015)
Ekaliko		Food	People consume this	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekalio		Food	People consume this	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekamongo	*Leptadenia hastata*	Medicinal	treats wounds and is considered the most important antiseptic, but it is usually very painful	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Watkins, 2010
Ekunoit	*Acacia senegal*	Food	Fluid is tapped and chewed as sweets	name reference: Mwaura & Kaburu, 2008
Ekurichanait	*Delonix elata*	Forage	Pods, leaves and flowers are feed for livestock	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekurichanait	*Delonix elata*	Food	Roots and pods are eaten by people	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016

Turkana plant name	Species	Use	Description of Use	Reference
Ekurichanait	*Delonix elata*	Utensils	Used to make all the traditional Turkana stools, utensils (plates, cups and spoons).	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekurichanait	*Delonix elata*	Medicinal	The roots and pods are used as medicine	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekurichanait	*Delonix elata*	Construction materials	Used in the construction of houses	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ekwangorong	*Commiphora schimperi*	Forage	Eaten by livestock only	name reference: Mwaura & Kaburu, 2008
Elamach	*Balanites pedicellaris*	Food	Fruits are also boiled for hours to make them edible, and provide food for people	name reference: Mwaura & Kaburu, 2008
Elamach	*Balanites pedicellaris*	Forage	Leaves are browsed by livestock	name reference: Mwaura & Kaburu, 2008
Elamach	*Balanites pedicellaris*	Food	People consume this	name reference: Mwaura & Kaburu, 2008
Elap		Food	People consume this	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Elemach	*Balanites sp.*			Juma (2009)

Turkana plant name	Species	Use	Description of Use	Reference
Eligoi		Medicinal	Used to treat livestock diseases, which include loukoi, emany, lojaa, lokot, lotomee, lomoo, ngiboruok (foot and mouth disease), amil, lonyang, lokot, loidiit.	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Elim	*Diospyros scabra*	Medicinal	Pounded and used to treat stomach complaints such as diarrhoea, vomiting and constipation	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Elim	*Diospyros scabra*	Construction materials	Supplies the materials for construction of various structures	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Elim	*Diospyros scabra*	Forage	Leaves are eaten by livestock	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Emekwi	*Indigofera spinosa*	Food	A staple food of Turkana people	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Emekwi	*Indigofera spinosa*	Forage	Main food item for camels and donkeys.	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Emus		Medicinal	act in the same way as echuchuka inducing vomit and treating stomach ailments	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016

Turkana plant name	Species	Use	Description of Use	Reference
Emus		Medicinal	(The thorny plants) are first roasted over the fire to remove the thorns. It is then pounded with stone and put in water to boil and mixed with milk and drunk- only one cup helps one to remain healthy for up to two years! It induces diarrhoea which then relives the individual of the trouble causing fluids	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Emus		Medicinal		South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Engiminae		Food	People consume this	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Engomo	*Grewia tenax*	Food	People consume this	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Epat	*Grewia mollis*	Food	People consume this	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Watkins, 2010
Epetet	*Acacia nubica*	Medicinal	Eye ailments	name reference: Mwaura & Kaburu, 2008
Epetet	*Acacia nubica*	Forage	Pods, leaves and flowers are important livestock feed.	name reference: Mwaura & Kaburu, 2008
Epetet	*Acacia nubica*	Food	Fluid serves as sweets to children	name reference: Mwaura & Kaburu, 2008

Turkana plant name	Species	Use	Description of Use	Reference
Epetet	*Acacia nubica*	Medicinal	Used for treating eye diseases and stomach ailments.	name reference: Mwaura & Kaburu, 2008
Epong		Medicinal	Found only in the hills, and is useful for curing worms (minyoo) and stomach problems. It also heals joint pains and eases delivery in camels but it is highly poisonous and must be taken with great caution; it must be boiled and the top cream removed and thrown away. The sieved clear solution is drunk.	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Eregai	*Acacia reficiens*	Food	a main food of Turkana people	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Eregai / eregae	*Acacia reficiens*	Forage	Feed for livestock	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Eregai / eregae	*Acacia reficiens*	Constructio n materials	fencing material for livestock structures	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Eregai / eregae	*Acacia reficiens*	Food	ngiminai (used as sweets just like ekunoit whose fluid is tapped and chewed as sweets) for children	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ereng	*Cadaba farinosa / Maerua crassifolia*	Medicinal	Toothbrushes	name reference: Mwaura & Kaburu, 2008

Turkana plant name	Species	Use	Description of Use	Reference
Ereng	*Cadaba farinosa / Maerua crassifolia*	Food	people consume pods	name reference: Mwaura & Kaburu, 2008
Ereng	*Cadaba farinosa / Maerua crassifolia*	Forage	livestock consume leaves	name reference: Mwaura & Kaburu, 2008
Ereng	*Cadaba farinosa / Maerua crassifolia*	Construction materials	houses and livestock structures	name reference: Mwaura & Kaburu, 2008
Erodo		Medicinal	act in the same way as echuchuka inducing vomit and treating stomach ailments	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Esanyanait	*Acacia elatior*	Construction materials	provide shed for both people and livestock	name reference: Mwaura & Kaburu, 2008
Esanyanait	*Acacia elatior*	Forage	pods, leaves and flowers are consumed by livestock during dry season	name reference: Mwaura & Kaburu, 2008
Esanyanait	*Acacia elatior*	Cultural	Whenever there is an issue facing the community such as sickness, drought, the elders come together under the tree (ewoi and esanyanait) and slaughter a camel, goat or sheep and share the meat with God and amongst themselves	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016

Turkana plant name	Species	Use	Description of Use	Reference
Esekon	*Salvadora persica*	Medicinal	toothbrushes; roots are used to treat stomach ailments (acids, ulcers); they are pounded and put in water and drunk only once to induce vomiting. But the esokon drink also serves as an apetizer (giving one an urge to eat). The tubers are dug from the soil, smashed and put in water, allowed to rest for sometime before being administered on the sick. It is then drink as prescribed - half two hundred and fifty grammes container for children and the full tin cup for adults.	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Esekon	*Salvadora persica*	Food	fruits are eaten by livestock and people	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Esekon	*Salvadora persica*	Forage	fruits are eaten by livestock, fresh esekon leaves are good feed for camels while the dry leaves are eaten by goats and donkeys.	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Esekon	*Salvadora persica*	Food	a main food of Turkana people	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Mwaura & Kaburu, 2008
Etesiro	*Calotropis procera*	Medicinal	when someone is pricked by a thorn which breaks in the body. You break etesro and drop its milk in the place	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016

Turkana plant name	Species	Use	Description of Use	Reference
			pricked by the thorn. The thorn would come out two days later.	
Etesiro	*Calotropis procera*	Medicinal	Also serves as a purgative to remove stuck placenta when a camel delivers	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Etesiro	*Calotropis procera*	Recreational	Leaves are used while chewing tobacco to retain the taste for longer	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Etesiro	*Calotropis procera*	Medicinal	Leaves also serve as a curative for wounds - milky sap from leaves serves this purpose	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ewoi	*Acacia tortilis*	Forage	leaves, flowers and pods are used as livestock feed - its leaves and flowers are essential livestock feed	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ewoi	*Acacia tortilis*	Food	Pods are consumed by people. Ewoi is pounded and added with milk and eaten. it is believed to satisfy hunger and keeps one satisfied for long. Black discharge is used for drinks (put in water and boiled as sugar and milk are added to it)	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Ewoi	*Acacia tortilis*	Wood	When an ewoi tree dries up it is used to provide firewood and charcoal for domestic use for cooking and for sale	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016

Turkana plant name	Species	Use	Description of Use	Reference
Ewoi	*Acacia tortilis*	Cultural	Whenever there is an issue facing the community such as sickness, drought, the elders come together under the tree (ewoi and esanyanait) and slaughter a camel, goat or sheep and share the meat with God and amongst themselves	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Kayep		Medicinal	Leaves provide treatment for certain ailments in both people and livestock	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Kayep		Forage	used as feed for livestock	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Locham		Medicinal	used for treating coughs	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016
Lorodo	*Cissus rotundifolia*	Medicinal	Used to treat lobute' or swellings, 'egong' or diarrea, and chest problems - the tubers and roots are pounded and its liquid drunk while the res put in water for bathing. The medicine is very sharp in taste	South Turkana Cultural Heritage Baseline Survey Phase 2 July-Aug 2016; name ref from Watkins, 2010
	Commiphora sp.	Utensils	used for making local cups and bowls for drinking, and Ekicholong	Booth et al., 2015
	Euphorbia tirucalli	Medicinal	Used to induce abortion	Tullow driver pers. comm. during biodiversity surveys (2016)

PRIORITISATION OF ES ACCORDING TO PROJECT IMPACT

Priority ecosystem services are those services for which the answers to questions 1 and 2 are “Yes” or “Unknown”, **and** “No” or “Unknown” to question 3. If the answer to either question 1 or 2 is no, then the ecosystem service is non-priority

Impact prioritisation spreadsheet

Ecosystem Service	Supplying Ecosystem	Potentially affected beneficiaries/locations	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries’ livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Provisioning							
Food – Cultivated foods	Ephemeral stream woodland Riparian forest	Locations in West Pokot and Turkana County adjacent to the water pipeline	Income, livelihoods, food intake – seasonal sorghum gardens and beekeeping enterprises	Y	Y	N	1
Food – Grazing/browsing resources for Livestock	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Reduced grazing area due to Project land-take and increased pressure from population influx will reduce grazing availability, which may limit the ability of people to raise livestock for subsistence, livelihood and cultural purposes	?	Y	N	1
Food – Capture fisheries	Turkwel Dam	Locations in West Pokot County adjacent to the Turkwel Dam	Income, livelihoods, food intake	N	n/a	n/a	0
Food – wild foods	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Reduced wild food plant and/or bush meat availability due to reductions in woodland/bush land cover that supports food plant/animal species Reduced vegetation cover may limit bee’s ability to produce honey and honey production	Y	Y	?	1
Medicinal plants	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Reduced availability of traditional medicines due to reduction in woodland/bush vegetation cover that supports plant species used for traditional medicine	Y	Y	?	1

Ecosystem Service	Supplying Ecosystem	Potentially affected beneficiaries/locations	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Biomass fuel – wood and charcoal	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Freely-accessible energy sources for cooking, heating – reduced availability due to reduction in vegetation cover supplying the ES	Y	Y	N – most people in AoI do not have the ability to purchase alternatives	1
		Residents in Kochodin and Lokichar Locations	Reduced supply of wood/charcoal for purchase	Y	Y	Y	0
Biological raw materials – construction of traditional houses	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Ability to construct homes and animal shelters, traditional utensils	Y	Y	?	1
Biological raw materials – Animal skins	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Project land take could reduce ability of beneficiaries to raise livestock with subsequent effects on the availability of animal skin/hide for sale or use	N	n/a	n/a	0
Fresh water	Turkwel Dam Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Availability and quality of fresh water for drinking may be compromised by abstraction from groundwater, reliance on TKBV for supply to water points	Y	Y	Y	1
		Locations in West Pokot County adjacent to the Turkwel Dam	Availability and quality of fresh water for drinking may be compromised by abstraction from Turkwel Dam	N	n/a	n/a	0

Ecosystem Service	Supplying Ecosystem	Potentially affected beneficiaries/locations	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Regulating							
Air quality	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Project effects on ecosystems that provide this ecosystem service (reduction in extent) are negligible in the context of available unaffected areas in AoI	N	n/a	n/a	0
Water flows and timing	Ephemeral stream woodland Riparian forest	Locations in West Pokot and Turkana County adjacent to the water pipeline	Abstraction of water from the Turkwel Dam could result in disturbance/interruption of flows to downstream beneficiaries	N	n/a	n/a	0
		Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Reduction in extent of riparian vegetation and lugga habitat in AoI due to Project land take could limit the ability of ecosystems to supply this service	N	n/a	n/a	0
Soil stability & erosion control	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Vegetation clearance for construction may reduce the ability of the surrounding soils to withstand erosive forces of wind and floods	N	n/a	n/a	0
Water purification and waste treatment	Turkwel Dam Ephemeral stream woodland Riparian forest	Locations in West Pokot and Turkana County adjacent to the water pipeline Locations in West Pokot County adjacent to the Turkwel Dam	Abstraction of water from the Turkwel Dam may reduce its capacity to assimilate organic pollutants due to reduction in water quantities.	N	n/a	n/a	0

Ecosystem Service	Supplying Ecosystem	Potentially affected beneficiaries/locations	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Cultural							
Ethical and spiritual values	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	Sacred sites and intangible cultural heritage are intrinsically linked with natural ecosystems such as riparian forest, luggas, arid grasslands and rocky mountains and substantially contribute to beneficiaries' sense of identity. Construction activity, and presence of the Project in the landscape are likely to affect indigenous sense of place and belonging.	Y	Y	N	1
Educational and inspirational	Acacia-commiphora bushland/ thicket Ephemeral stream woodland Riparian forest	Mobile pastoralists; Residents in Kochodin and Lokichar Locations	The Turkana landscape inspires folklore and contributes to beneficiaries' sense of heritage and identity. Construction activity, and presence of the Project in the landscape are likely to affect beneficiaries' sense of heritage and identity	Y	Y	N	1
Recreation	Turkwel River	Locations in West Pokot County adjacent to the Turkwel Dam	Children swim and play in the river; men and probably women use it for bathing.	N	n/a	n/a	0

PRIORITISATION OF ES ACCORDING TO PROJECT DEPENDENCE

Priority ES are those services for which the answers to question 1 is "Yes" or "Unknown", **and** "No" or "Unknown" to question 2. If the answer to question 1 is no, it is automatically a non-priority ecosystem service. Changes in an ecosystem service can be driven both by causes of ecosystem change external to the Project and by the Project's own impacts.

Priority ecosystem services according to the extent of Project Demand

Ecosystem Service	1. Could this ES change in ways that will affect operational performance (Y/N/?)	2. Does the Project have viable alternatives to this ES (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Provisioning			
Fresh water	Y – stakeholders perceive that the Project may impact the quantity of water (in Turkwel Dam in particular). The drawdown of groundwater as a result of pumping from boreholes before the pipeline is commissioned could affect groundwater supply for nearby communities (e.g. Nakukulas, Lokicheda), therefore the Project is reliant on the quantity of freshwater remaining constant throughout its lifetime in order to maintain its social license to operate Cumulative impact of abstraction from Turkwel by other projects unknown	N	1
Regulating			
Air quality	Project effects on ecosystems that provide this ecosystem service (reduction in extent) are negligible in the context of available unaffected areas in AoI. Given the Project setting in a non-urban/industrialised landscape, no changes in this ES are expected during operational lifetime of the Project	N	0
Water flows and timing	Y – The Project will affect luggas and ephemeral streams which may cause flooding which could affect operational performance	Y – engineering mitigation measures to manage surface and sub-surface flows in the construction and operation phases of the Project are considered sufficient to reduce potential impacts to negligible significance	0
Soil stability & erosion control	Y – Vegetation clearance for construction may reduce the ability of the surrounding soils to withstand erosive forces of wind and floods	N – Engineered measures for the control of erosion arising from vegetation removal are considered sufficient to minimise the impacts of vegetation clearance.	0
Cultural			
Ethical and spiritual values (sacred trees)	Y – the Project is reliant on the availability of this ES remaining constant throughout its lifetime in order to maintain its social license to operate	N – there are no alternatives to the presence of the Project in the landscape	1
Educational and inspirational	? – the Project could be reliant on the availability of this ES remaining constant throughout its lifetime in order to maintain its social license to operate	N – there are no alternatives to the presence of the Project in the landscape	1

Cultural Heritage

C7

1.0 CULTURAL HERITAGE GAZETTEER

All Universal Transverse Mercator (UTM) coordinates are presented UTM 36N. Under ‘Materials Recorded’, a “1” indicates a material is present, whilst “0” indicates it is not present.

Table 1: Gazetteer - Archaeological Assets

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded									
			Pottery - Rim/Neck	Pottery - Decorated	Pottery - Undecorated	Lithic - Quartz	Lithic - Chert	Lithic - Obsidian	Lithic - Rhyolite	Lithic - Other	Palaeontological	Jewellery
AR-001	800384	282428	0	0	0	1	1	0	0	1	0	0
AR-002	800352	282426	0	0	0	1	1	0	0	0	0	0
AR-003	800202	282395	0	0	0	1	0	0	0	0	0	0
AR-004	800166	282387	0	0	0	1	0	0	0	1	0	0
AR-005	800461	282380	0	0	1	0	0	0	0	1	0	0
AR-006	799233	282368	0	0	0	1	0	0	0	1	0	0
AR-007	800187	282339	0	0	0	1	0	0	0	1	0	0
AR-008	800163	282327	0	0	0	1	0	0	1	1	0	0
AR-009	800033	282315	0	0	0	1	0	0	0	0	0	0
AR-010	799189	282314	0	0	0	0	0	1	0	0	0	0
AR-011	799014	282295	0	0	0	0	1	0	0	0	0	0
AR-012	799025	282269	0	0	0	1	0	0	0	0	0	0
AR-013	799457	282232	0	0	1	1	0	0	0	0	0	0
AR-014	798983	282213	0	0	0	0	0	0	1	0	0	0
AR-015	799332	282194	0	0	1	0	0	0	0	0	0	0
AR-016	798972	282146	0	0	0	0	1	0	0	0	0	0
AR-017	800174	282087	0	0	1	0	0	0	0	0	0	0
AR-018	800306	281462	0	0	1	0	1	0	0	0	0	0
AR-019	799968	281260	0	0	0	1	0	0	0	0	0	0
AR-020	797876	281004	0	0	1	0	0	0	0	0	0	0
AR-021	797840	280961	0	0	1	0	0	0	0	0	0	0
AR-022	797948	280929	0	0	1	0	0	0	0	0	0	0
AR-023	797975	280693	0	1	0	0	0	0	0	0	0	0
AR-024	797988	280682	0	0	1	0	0	0	0	0	0	0
AR-025	797620	280496	0	0	0	1	0	0	0	0	0	0
AR-026	801511	280349	0	0	1	0	0	0	0	0	0	0
AR-027	801934	280194	0	0	1	1	0	0	0	1	0	0
AR-028	801862	280152	0	0	0	1	0	0	0	0	0	0
AR-029	799798	279941	0	0	0	1	0	0	0	0	0	0
AR-030	799825	279924	0	0	0	1	1	0	1	1	0	0
AR-031	799636	279893	0	0	0	1	0	0	0	1	0	0
AR-032	799911	279854	0	0	0	1	0	0	1	1	0	0
AR-033	799693	279829	0	0	0	1	0	1	0	0	0	0
AR-034	799734	279822	0	0	0	1	0	0	0	1	0	0
AR-035	799996	279753	0	0	0	1	0	0	0	0	0	0
AR-036	799945	279723	0	0	1	1	1	0	0	0	0	0
AR-037	799819	279720	0	0	1	1	1	0	0	0	0	0
AR-038	799851	279718	0	0	0	1	1	1	0	0	0	0
AR-039	799889	279705	0	0	0	0	1	0	0	0	0	0
AR-040	799657	279624	0	0	0	1	0	0	0	0	0	0
AR-041	799594	279509	0	0	0	1	0	0	0	0	0	0
AR-042	800497	279289	0	0	0	1	0	0	0	0	0	0
AR-043	800491	279132	0	0	0	1	0	0	0	0	0	0
AR-044	798963	273347	0	0	0	0	0	1	0	0	0	0
AR-045	799434	273310	1	0	0	0	0	0	0	0	0	0
AR-046	799259	273276	0	0	1	0	0	0	0	0	0	0
AR-047	798494	273257	0	0	0	0	0	0	1	0	0	0
AR-048	798505	273205	0	0	0	0	1	0	0	1	0	0
AR-049	798524	273169	0	0	0	0	1	0	0	0	0	0
AR-050	798289	273152	0	0	0	0	0	0	1	1	0	0
AR-051	798326	273152	0	0	0	1	1	0	0	0	0	0
AR-052	798130	273099	0	0	0	1	0	0	0	0	0	0
AR-053	799480	273043	0	0	0	1	0	0	0	1	0	0
AR-054	799611	272435	1	0	1	0	0	0	0	0	0	0
AR-055	800536	272106	0	0	1	0	0	0	0	0	0	0
AR-056	800738	272000	0	0	1	0	0	0	0	0	0	0
AR-057	800738	271989	0	0	1	0	0	0	0	0	0	0
AR-058	800868	271796	0	0	1	0	0	0	0	0	0	0
AR-059	801000	271776	0	0	0	0	0	1	0	0	0	0
AR-060	800535	271587	0	0	0	0	0	0	0	1	0	0
AR-061	801501	271318	0	0	0	0	1	0	0	0	0	0
AR-062	801871	271163	0	0	1	0	0	0	0	0	0	0
AR-063	801862	271012	0	0	1	1	0	0	1	0	0	0
AR-064	801907	271005	0	0	0	0	0	1	0	0	0	0
AR-065	801686	270998	0	0	1	1	0	0	0	1	0	0
AR-066	801008	267361	0	0	1	0	0	0	0	0	0	0
AR-067	800512	267221	0	0	1	1	0	0	0	0	0	0
AR-068	803279	267135	0	0	1	0	0	0	0	0	0	0
AR-069	799872	266907	0	0	1	0	0	0	0	0	0	0
AR-070	799892	266832	1	0	1	0	0	0	0	0	0	0
AR-071	799969	266804	0	0	1	0	0	0	0	0	0	0
AR-072	799765	266766	0	1	1	0	0	0	0	0	0	0
AR-073	801983	266748	0	0	0	0	0	1	0	0	0	0
AR-074	799901	266745	0	0	1	0	0	0	0	0	0	0
AR-075	799898	266711	0	0	1	0	0	0	0	0	0	0
AR-076	799717	266689	0	0	1	0	0	0	0	0	0	0
AR-077	801438	266548	0	0	0	1	0	0	0	0	0	0
AR-078	801459	266393	0	0	0	1	1	1	0	0	0	0
AR-079	801458	266392	1	0	1	0	0	0	0	0	0	0
AR-080	803962	266377	0	0	1	0	0	0	0	0	0	0
AR-081	801396	266372	0	0	0	1	1	0	1	0	0	0
AR-082	801354	266346	0	0	0	1	1	0	1	0	0	0
AR-083	803505	266245	0	0	0	0	1	0	0	0	0	0
AR-084	801105	266212	0	0	0	1	0	0	0	0	0	0
AR-085	800894	266207	0	0	0	1	1	1	0	0	0	0

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded									
			Pottery - Rim/Neck	Pottery - Decorated	Pottery - Undecorated	Lithic - Quartz	Lithic - Chert	Lithic - Obsidian	Lithic - Rhyolite	Lithic - Other	Palaeontological	Jewellery
AR-086	800944	266138	0	0	1	0	0	0	0	0	0	0
AR-087	800941	266121	0	0	0	0	1	0	0	0	0	0
AR-088	800781	266075	0	0	0	0	0	1	0	0	0	0
AR-089	801130	266068	0	0	0	1	0	0	0	0	0	0
AR-090	801102	266052	0	0	0	1	0	0	0	0	0	0
AR-091	800751	265992	0	0	1	1	0	1	1	0	0	0
AR-092	800778	265976	0	0	0	1	1	1	0	0	0	0
AR-093	800773	265928	0	0	0	1	0	0	0	0	0	0
AR-094	799997	265865	0	0	0	1	0	0	0	0	0	0
AR-095	799551	265734	0	0	1	0	0	0	0	0	0	0
AR-096	799999	265632	0	0	0	1	0	0	0	0	0	0
AR-097	799848	265592	0	0	0	1	1	0	1	0	0	0
AR-098	799813	265555	0	0	0	0	0	1	1	0	0	0
AR-099	799792	265540	0	0	0	0	0	1	0	0	0	0
AR-100	799779	265514	0	0	1	0	1	1	1	1	0	0
AR-101	800902	265496	0	0	1	0	0	0	0	0	0	0
AR-102	799504	265495	0	0	0	0	0	1	0	0	0	0
AR-103	800845	265279	0	0	1	0	0	0	0	0	0	0
AR-104	796707	260877	0	0	0	1	0	1	0	0	0	0
AR-105	796570	260876	0	0	1	0	1	0	0	0	0	0
AR-106	796676	260874	0	0	0	0	1	0	1	0	0	0
AR-107	796651	260868	0	0	0	1	0	0	0	0	0	0
AR-108	796224	260820	0	0	0	1	0	0	1	0	0	0
AR-109	796130	260811	0	0	0	1	0	0	1	0	0	0
AR-110	795853	260764	0	0	0	0	0	0	1	0	0	0
AR-111	801898	257875	0	0	0	0	0	1	0	0	0	0
AR-112	801966	257643	0	0	1	0	1	1	1	0	0	0
AR-113	801699	257628	0	0	0	0	0	0	0	1	0	0
AR-114	801498	257606	0	0	0	0	1	0	0	0	0	0
AR-115	801870	257501	0	0	0	0	0	0	1	1	0	0
AR-116	801483	257495	0	0	0	1	0	0	0	0	0	0
AR-117	801969	257486	0	0	0	1	1	1	0	1	0	0
AR-118	799080	256999	0	0	0	0	0	1	0	0	0	0
AR-119	799001	256995	0	0	0	1	0	0	0	0	0	0
AR-120	799164	256968	0	0	1	0	0	0	0	0	0	0
AR-121	799201	256892	0	0	0	0	1	0	0	0	0	0
AR-122	801074	256873	0	0	1	0	0	0	0	0	0	0
AR-123	801351	256848	0	0	1	0	0	0	0	0	0	0
AR-124	799086	256712	0	0	0	0	0	0	0	1	0	0
AR-125	799163	256585	0	0	0	1	0	1	0	0	0	0
AR-126	799136	256545	0	0	1	0	0	0	0	0	0	0
AR-127	802444	255998	0	0	0	0	0	1	0	0	0	0
AR-128	803423	255998	0	0	0	1	0	0	0	0	0	0
AR-129	802442	255986	0	0	0	0	0	1	0	0	0	0
AR-130	803444	255861	0	0	1	0	0	0	0	0	0	0
AR-131	803020	255850	0	0	1	0	0	0	0	0	0	0
AR-132	803145	255824	0	0	1	0	0	0	0	0	0	0
AR-133	803056	255760	1	1	1	0	0	0	0	0	0	0
AR-134	803429	255734	1	0	1	0	0	0	0	0	0	0
AR-135	802054	255720	0	0	1	0	0	0	0	0	0	0
AR-136	802302	255687	0	0	1	0	0	0	0	0	0	0
AR-137	803065	255638	0	0	1	0	0	0	0	0	0	0
AR-138	802192	255499	0	0	1	0	0	0	0	0	0	0
AR-139	799835	254425	1	0	1	0	0	0	0	0	0	0
AR-140	799958	254376	0	0	1	0	0	0	0	0	0	0
AR-141	799929	254364	1	0	1	0	0	0	0	0	0	0
AR-142	799930	254362	0	0	0	0	0	0	0	0	0	1
AR-143	799641	254351	0	0	0	0	0	1	0	0	0	0
AR-144	799913	254350	0	0	1	0	0	0	0	0	0	0
AR-145	799211	254286	0	0	1	0	0	0	0	0	0	0
AR-146	800418	254263	0	0	0	1	0	0	0	0	0	0
AR-147	800561	254194	0	0	1	1	0	0	1	1	0	0
AR-148	799892	254091	0	0	0	1	0	0	0	0	0	0
AR-149	800037	254072	0	0	1	0	0	0	0	0	0	0
AR-150	800414	253831	0	0	1	0	0	0	0	0	0	0
AR-151	803694	250411	0	0	0	0	0	0	1	0	0	0
AR-152	803913	250085	0	0	0	0	0	0	1	0	0	0
AR-153	808773	248351	0	0	0	0	1	0	0	0	0	0
AR-154	808522	248094	0	0	0	0	0	0	0	1	0	0
AR-155	808507	247991	0	0	0	0	0	0	0	1	0	0
AR-156	808480	247986	0	0	0	0	0	0	0	1	0	0
AR-157	808921	247965	0	0	1	1	1	1	0	1	0	0
AR-158	808845	247931	0	0	0	1	0	0	0	1	0	0
AR-159	808919	247880	0	0	0	0	1	0	1	0	0	0
AR-160	808931	247856	0	0	0	0	0	0	0	1	0	0
AR-161	809222	247830	0	0	0	1	1	0	0	1	0	0
AR-162	809131	247821	0	0	1	0	0	0	0	0	0	0
AR-163	809091	247770	0	0	0	1	1	0	0	1	0	0
AR-164	809270	247764	0	0	0	1	1	0	1	0	0	0
AR-165	808851	247760	1	0	0	0	0	0	0	1	0	0
AR-166	806661	247759	0	0	0	1	0	0	0	0	0	0
AR-167	809197	247755	0	0	0	1	0	0	0	1	0	0
AR-168	808717	247751	0	0	1	0	0	0	1	1	0	0
AR-169	809111	247747	0	0	0	0	0	0	0	1	0	0
AR-170	809155	247739	0	0	1	1	1	0	0	1	0	0
AR-171	806738	247729	0	0	0	0	0	0	1	0	0	0
AR-172	806894	247717	0	0	0	0	0	0	1	0	0	0
AR-173	806784	247716	0	0	0	0	0	0	1	0	0	0
AR-174	806831	247711	0	0	0	0	0	0	1	0	0	0
AR-175	806854	247709	0	0	0	0	0	0	1	0	0	0
AR-176	806843	247709	0	0	0	0	0	0	1	0	0	0
AR-177	808826	247692	0	0	0	0	0	1	0	0	0	0
AR-178	807156	247661	0	0	0	0	0	0	1	0	0	0
AR-179	807149	247657	0	0	1	0	0	0	1	1	0	0
AR-180	807189	247656	0	0	0	0	1	0	1	0	0	0
AR-181	809034	247638	0	0	0	1	1	0	1	1	0	0
AR-182	808672	247625	0	0	0	1	1	0	0	0	0	0
AR-183	807292	247620	0	0	0	0	0	0	1	0	0	0
AR-184	808945	247613	0	0	0	1	1	0	1	1	0	0
AR-185	808263	247613	0	0	0	0	0	0	0	1	0	0

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded									
			Pottery - Rim/Neck	Pottery - Decorated	Pottery - Undecorated	Lithic - Quartz	Lithic - Chert	Lithic - Obsidian	Lithic - Rhyolite	Lithic - Other	Palaeontological	Jewellery
AR-186	808639	247596	0	0	0	0	0	0	0	1	0	0
AR-187	808293	247591	0	0	0	0	0	0	0	1	0	0
AR-188	807521	247584	0	0	1	1	1	0	0	0	0	0
AR-189	808737	247583	0	0	0	1	1	1	1	1	0	0
AR-190	808778	247527	0	0	0	0	0	0	1	0	0	0
AR-191	803582	247511	0	0	0	1	0	0	0	0	0	0
AR-192	808868	247506	0	0	1	0	0	0	0	0	0	0
AR-193	808848	247468	0	0	0	0	0	0	1	0	0	0
AR-194	808129	247462	0	0	0	0	0	0	0	1	0	0
AR-195	808351	247446	0	0	0	0	1	0	0	0	0	0
AR-196	807983	247444	0	0	1	1	1	1	0	1	0	0
AR-197	808453	247430	0	0	0	0	1	1	0	0	0	0
AR-198	808490	247378	0	0	0	0	0	0	0	1	0	0
AR-199	808546	247376	0	0	1	1	1	1	1	0	0	0
AR-200	808658	247371	0	0	1	0	0	0	0	0	0	0
AR-201	803015	247369	0	0	0	1	0	0	0	0	0	0
AR-202	808373	247314	0	0	0	1	0	0	0	1	0	0
AR-203	807881	247292	0	0	0	1	1	1	0	0	0	0
AR-204	808685	247288	0	0	1	0	0	0	0	0	0	0
AR-205	808515	247237	0	0	1	0	0	0	0	0	0	0
AR-206	807748	247207	0	0	1	0	0	0	0	0	0	0
AR-207	808546	247202	0	0	0	0	0	0	1	0	0	0
AR-208	808529	246965	0	0	1	0	0	0	0	0	0	0
AR-209	807285	246844	0	0	0	1	0	1	1	0	0	0
AR-210	807466	246816	0	0	0	1	0	0	0	0	0	0
AR-211	805542	246752	0	0	1	0	0	1	0	0	0	0
AR-212	805137	246625	0	0	0	0	1	0	1	1	0	0
AR-213	805109	246552	0	0	0	0	0	0	1	0	0	0
AR-214	808646	246276	0	0	1	0	0	0	0	0	0	0
AR-215	804272	246212	0	0	0	1	0	0	0	0	0	0
AR-216	804315	246194	0	0	0	0	0	0	1	0	0	0
AR-217	807493	246192	1	0	1	0	0	0	0	0	0	0
AR-218	804387	246189	0	0	0	1	0	0	0	0	0	0
AR-219	804341	246139	0	0	0	1	1	0	1	1	0	0
AR-220	804251	246094	0	0	0	1	1	1	1	0	0	0
AR-221	804247	246072	0	0	0	1	0	0	1	0	0	0
AR-222	804308	246066	0	0	0	1	0	0	1	0	0	0
AR-223	808996	246048	0	0	1	0	0	0	0	0	0	0
AR-224	805383	246045	0	0	1	0	0	0	0	0	0	0
AR-225	805229	246001	0	0	0	0	0	1	0	0	0	0
AR-226	807527	245982	0	0	1	1	0	0	0	0	0	0
AR-227	805111	245897	0	0	0	1	1	0	1	0	0	0
AR-228	805233	245892	0	1	1	0	0	0	0	0	0	0
AR-229	805114	245836	0	0	0	0	0	0	1	0	0	0
AR-230	805066	245822	0	0	0	1	0	0	1	0	0	0
AR-231	805049	245776	0	0	0	0	1	0	1	0	0	0
AR-232	805072	245764	0	0	0	1	0	1	0	0	0	0
AR-233	808501	245600	0	0	0	0	1	0	0	0	0	0
AR-234	807331	245526	0	0	1	0	0	0	0	0	0	0
AR-235	809546	245484	0	0	1	0	0	0	0	0	0	0
AR-236	804541	245421	0	0	0	0	1	0	1	0	0	0
AR-237	804536	245385	0	0	0	0	1	1	0	0	0	0
AR-238	810518	245374	0	0	1	0	0	0	0	0	0	0
AR-239	804584	245367	0	0	0	1	1	0	1	0	0	0
AR-240	804495	245355	0	0	0	0	10	0	1	0	0	0
AR-241	804552	245349	0	0	0	1	0	0	0	0	0	0
AR-242	810642	245202	0	0	0	0	0	0	1	0	0	0
AR-243	807916	245165	1	0	1	0	0	0	0	0	0	0
AR-244	807945	245032	0	0	0	0	1	0	0	0	0	0
AR-245	806005	244958	0	0	0	0	1	0	0	0	0	0
AR-246	807893	244785	0	0	0	1	0	1	1	0	0	0
AR-247	805537	244770	0	0	0	1	0	0	1	0	0	0
AR-248	807872	244755	0	0	0	1	0	1	0	0	0	0
AR-249	808037	244753	0	0	0	1	1	0	1	1	0	0
AR-250	807978	244718	0	0	0	1	1	1	1	1	0	0
AR-251	807964	244698	0	0	0	1	1	1	1	0	0	0
AR-252	807933	244683	0	0	0	1	1	1	1	1	0	0
AR-253	807877	244667	0	0	0	1	0	0	1	1	0	0
AR-254	807895	244657	0	0	0	1	0	1	1	0	0	0
AR-255	810222	244618	0	0	0	0	1	0	1	0	0	0
AR-256	810407	244615	0	0	0	0	0	0	1	0	0	0
AR-257	810323	244614	0	0	0	0	0	0	1	0	0	0
AR-258	806732	244611	0	0	0	1	0	0	0	0	0	0
AR-259	810251	244609	0	0	0	0	0	0	0	1	0	0
AR-260	810208	244605	0	0	0	0	0	0	1	0	0	0
AR-261	806797	244600	0	0	1	0	0	0	0	0	0	0
AR-262	810308	244594	0	0	0	1	0	0	0	0	0	0
AR-263	807738	244590	0	0	0	0	0	0	1	1	0	0
AR-264	810313	244574	0	0	0	0	0	0	1	0	0	0
AR-265	807806	244570	0	0	0	1	0	0	1	1	0	0
AR-266	810379	244565	0	0	0	0	1	1	0	0	0	0
AR-267	807765	244555	0	0	0	1	0	0	0	0	0	0
AR-268	810291	244555	0	0	0	0	0	0	1	0	0	0
AR-269	805508	244550	0	0	0	0	0	0	1	0	0	0
AR-270	810303	244543	0	0	0	1	0	0	0	0	0	0
AR-271	805661	244533	0	0	0	1	0	0	0	0	0	0
AR-272	810277	244517	0	0	0	0	1	0	0	0	0	0
AR-273	810368	244512	0	0	1	0	1	0	0	0	0	0
AR-274	805657	244499	0	0	0	1	0	0	0	0	0	0
AR-275	810295	244494	0	0	0	0	0	0	1	0	0	0
AR-276	808559	244492	1	0	1	0	0	0	0	0	0	0
AR-277	810203	244488	0	0	0	0	0	0	1	0	0	0
AR-278	810206	244462	0	0	0	0	0	0	1	0	0	0
AR-279	805561	244454	0	0	0	1	1	0	1	1	0	0
AR-280	807661	244448	0	0	0	0	0	1	0	0	0	0
AR-281	810208	244432	0	0	0	1	0	0	1	0	0	0
AR-282	810360	244416	0	0	1	0	0	0	0	0	0	0
AR-283	810178	244404	0	0	0	0	1	0	1	0	0	0
AR-284	807486	244384	0	0	0	0	1	0	0	0	0	0
AR-285	807673	244370	0	0	1	0	0	0	0	0	0	0

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded									
			Pottery - Rim/Neck	Pottery - Decorated	Pottery - Undecorated	Lithic - Quartz	Lithic - Chert	Lithic - Obsidian	Lithic - Rhyolite	Lithic - Other	Palaeontological	Jewellery
AR-286	807489	244349	0	0	0	0	0	0	0	1	0	0
AR-287	807519	244314	0	0	0	1	1	1	1	0	0	0
AR-288	807448	244229	0	0	0	0	1	0	1	0	0	0
AR-289	806353	244212	0	0	0	0	0	0	1	0	0	0
AR-290	806383	244190	0	0	0	1	0	1	0	0	0	0
AR-291	808977	244148	0	0	1	0	0	0	0	0	0	0
AR-292	807581	244120	0	0	0	0	1	0	0	0	0	0
AR-293	808848	244059	1	1	0	0	0	0	0	0	0	0
AR-294	807172	244001	0	0	1	0	0	0	0	0	0	0
AR-295	807055	243998	0	0	1	0	0	0	0	0	0	0
AR-296	805986	243962	0	0	0	0	0	0	1	0	0	0
AR-297	805987	243959	0	0	0	1	0	0	1	0	0	0
AR-298	805986	243946	0	0	0	0	0	1	0	0	0	0
AR-299	805984	243944	0	0	0	0	0	0	1	0	0	0
AR-300	805992	243944	0	0	0	1	0	0	0	0	0	0
AR-301	806080	243926	0	0	0	1	0	0	0	0	0	0
AR-302	808708	243885	0	0	0	0	0	0	1	0	0	0
AR-303	806107	243881	0	0	0	1	0	0	0	0	0	0
AR-304	808669	243874	0	0	0	0	0	0	1	0	0	0
AR-305	808866	243869	0	0	0	1	0	0	1	0	0	0
AR-306	808722	243843	0	0	1	0	0	0	0	0	0	0
AR-307	808725	243826	0	0	0	1	1	0	1	0	0	0
AR-308	808757	243813	0	0	0	1	0	0	1	0	0	0
AR-309	808738	243811	0	0	1	0	1	0	0	0	0	0
AR-310	808678	243805	0	0	0	1	1	0	0	0	0	0
AR-311	806033	243802	0	0	0	1	1	0	1	0	0	0
AR-312	805963	243756	0	0	0	1	0	0	0	0	0	0
AR-313	806029	243755	0	0	0	0	1	0	0	0	0	0
AR-314	808760	243753	0	0	0	0	1	0	0	0	0	0
AR-315	807892	243381	0	0	0	1	0	0	0	0	0	0
AR-316	807893	243376	0	0	0	1	0	1	1	0	0	0
AR-317	807634	243242	0	1	0	1	1	1	1	0	0	0
AR-318	805000	242244	0	0	0	0	0	0	1	0	0	0
AR-319	804981	242240	0	0	0	1	0	0	1	0	0	0
AR-320	804931	242199	0	0	0	1	0	0	0	0	0	0
AR-321	804887	242186	0	0	0	1	0	0	0	0	0	0
AR-322	804990	242179	0	0	0	1	0	0	1	0	0	0
AR-323	804904	242161	0	0	0	0	1	1	0	0	0	0
AR-324	805009	242090	0	0	0	1	0	0	0	0	0	0
AR-325	804887	242080	0	0	0	0	0	0	1	0	0	0
AR-326	804968	242052	0	0	1	1	0	0	0	0	0	0
AR-327	804920	242040	0	0	0	0	1	0	0	0	0	0
AR-328	804899	242026	0	0	0	1	0	0	0	0	0	0
AR-329	805005	242011	0	0	0	1	0	0	1	0	0	0
AR-330	804898	242002	0	0	0	1	0	0	0	0	0	0
AR-331	805062	241996	0	0	0	1	0	0	1	0	0	0
AR-332	806058	241558	0	0	0	1	0	0	0	0	0	0
AR-333	810703	241332	0	0	0	1	0	0	1	0	0	0
AR-334	810306	241324	1	1	1	0	1	0	0	0	0	0
AR-335	810708	241288	0	0	0	1	0	0	1	0	0	0
AR-336	809972	241260	0	0	0	0	0	0	1	0	0	0
AR-337	809971	241254	0	0	0	0	0	1	0	0	0	0
AR-338	809968	241210	0	0	0	0	0	0	1	0	0	0
AR-339	810663	241183	0	0	0	0	0	0	1	1	0	0
AR-340	810702	241159	0	0	0	0	0	0	1	0	0	0
AR-341	810508	241157	0	0	0	1	1	0	1	1	0	0
AR-342	810753	241060	0	0	0	0	0	0	1	0	0	0
AR-343	810756	241031	0	0	0	1	0	1	1	0	0	0
AR-344	810648	240998	0	0	0	1	0	0	1	0	0	0
AR-345	810765	240985	0	0	0	0	0	0	1	0	0	0
AR-346	810620	240981	0	0	0	1	0	0	1	0	0	0
AR-347	810871	240980	0	0	1	0	0	0	0	0	0	0
AR-348	810698	240898	0	0	0	0	0	0	1	0	0	0
AR-349	810524	240871	0	0	0	1	0	0	1	0	0	0
AR-350	810735	240853	0	0	1	0	0	0	1	0	0	0
AR-351	810721	240807	0	0	0	0	0	0	1	1	0	0
AR-352	810536	240771	0	0	0	1	0	0	0	0	0	0
AR-353	811703	240748	0	0	0	0	1	0	0	0	0	0
AR-354	810735	240671	0	0	0	0	0	0	1	0	0	0
AR-355	810457	240564	0	0	0	0	0	0	0	1	0	0
AR-356	811447	240390	0	0	0	1	0	1	1	0	0	0
AR-357	811536	240368	0	0	0	1	0	0	1	0	0	0
AR-358	811540	240352	0	0	0	0	1	1	0	0	0	0
AR-359	811424	240280	0	0	0	0	0	0	1	0	0	0
AR-360	811636	240205	0	0	1	0	0	0	0	0	0	0
AR-361	810655	239989	0	0	0	1	0	0	0	0	0	0
AR-362	809756	239988	0	0	0	1	0	0	0	0	0	0
AR-363	810575	239983	0	0	0	1	0	0	0	0	0	0
AR-364	809656	239952	0	0	0	0	0	0	1	0	0	0
AR-365	809747	239944	0	0	0	1	0	0	1	0	0	0
AR-366	811842	239928	0	0	0	1	0	1	1	1	0	0
AR-367	810051	239923	0	0	0	1	0	0	0	0	0	0
AR-368	809514	239922	0	0	1	1	0	1	1	0	0	0
AR-369	811752	239872	0	0	0	1	1	1	1	0	0	0
AR-370	811701	239868	0	0	0	0	0	0	0	1	0	0
AR-371	809521	239850	0	0	0	0	0	0	1	0	0	0
AR-372	809565	239845	0	0	0	1	0	0	0	0	0	0
AR-373	809530	239825	0	0	0	1	0	0	0	0	0	0
AR-374	809504	239802	0	0	0	1	1	1	1	0	0	0
AR-375	811222	239802	0	0	1	0	0	0	1	1	0	0
AR-376	810754	239707	0	0	1	0	0	0	0	1	0	0
AR-377	811403	239682	0	0	0	1	0	0	1	0	0	0
AR-378	811304	239676	0	0	1	0	0	0	1	0	0	0
AR-379	811234	239668	0	1	0	1	1	1	1	0	0	0
AR-380	811244	239643	0	0	0	1	0	1	0	0	0	0
AR-381	810872	239643	0	0	0	0	0	0	1	0	0	0
AR-382	810861	239618	0	0	0	1	0	0	1	0	0	0
AR-383	810702	239591	0	0	0	0	0	1	1	0	0	0
AR-384	811348	239591	0	0	0	1	0	1	1	1	0	0
AR-385	811237	239591	0	0	0	1	0	0	0	0	0	0

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded									
			Pottery - Rim/Neck	Pottery - Decorated	Pottery - Undecorated	Lithic - Quartz	Lithic - Chert	Lithic - Obsidian	Lithic - Rhyolite	Lithic - Other	Palaeontological	Jewellery
AR-386	810737	239590	0	0	0	1	0	0	0	0	0	0
AR-387	810885	239589	0	0	0	0	1	0	1	0	0	0
AR-388	810857	239543	0	0	0	0	0	0	1	0	0	0
AR-389	810978	239541	0	0	0	1	0	0	1	0	0	0
AR-390	811961	239538	0	0	0	1	0	0	0	0	0	0
AR-391	812256	239535	0	0	0	1	1	1	1	0	0	0
AR-392	812228	239534	0	0	0	0	1	0	1	0	0	0
AR-393	812160	239532	0	0	0	0	0	0	1	0	0	0
AR-394	812222	239531	0	0	0	1	1	1	0	0	0	0
AR-395	812089	239522	0	0	0	1	0	0	1	0	0	0
AR-396	809682	239511	0	0	0	1	0	0	0	0	0	0
AR-397	811885	239510	0	0	0	1	0	0	0	0	0	0
AR-398	811774	239496	0	0	1	0	0	0	0	0	0	0
AR-399	811890	239493	0	0	0	1	0	0	1	0	0	0
AR-400	811804	239483	0	0	1	0	0	0	0	1	0	0
AR-401	811998	239430	0	0	0	0	1	0	0	0	0	0
AR-402	811985	239413	0	0	0	0	0	0	1	0	0	0
AR-403	811742	239169	0	0	0	0	0	0	1	0	0	0
AR-404	811678	239130	0	0	0	0	0	0	1	0	0	0
AR-405	811668	239110	0	0	0	0	0	0	1	1	0	0
AR-406	811656	239101	0	0	0	1	0	0	1	0	0	0
AR-407	811658	239076	0	0	0	0	0	0	1	1	0	0
AR-408	811727	239066	0	0	0	0	0	0	1	1	0	0
AR-409	811631	239011	0	0	0	0	0	0	1	0	0	0
AR-410	811529	238998	0	0	0	1	0	0	0	0	0	0
AR-411	809428	238958	0	0	1	0	0	0	0	0	0	0
AR-412	811540	238958	0	0	0	1	1	0	0	0	0	0
AR-413	811591	238944	0	0	0	1	0	1	1	0	0	0
AR-414	811098	238939	0	0	0	0	0	0	1	0	0	0
AR-415	811615	238935	0	0	0	0	0	0	1	0	0	0
AR-416	811579	238921	0	0	0	0	1	0	1	0	0	0
AR-417	811788	238865	0	0	0	1	1	0	0	0	0	0
AR-418	811731	238832	0	0	0	1	0	0	0	0	0	0
AR-419	809433	238800	0	0	0	1	0	0	0	1	0	0
AR-420	809452	238794	0	0	0	0	0	0	1	0	0	0
AR-421	809449	238767	0	0	0	0	0	0	1	0	0	0
AR-422	809436	238745	0	0	0	1	0	0	1	1	0	0
AR-423	809078	238593	0	0	0	0	0	0	1	0	0	0
AR-424	808945	238533	0	0	0	1	1	1	1	1	0	0
AR-425	810064	238480	0	0	0	0	0	0	0	0	1	0
AR-426	809976	238243	0	0	0	0	0	0	1	0	0	0
AR-427	810499	238130	0	0	1	0	0	0	0	0	0	0
AR-428	812324	237424	0	0	0	0	0	1	0	0	0	0
AR-429	812284	237388	0	0	0	1	1	0	0	0	0	0
AR-430	811350	237372	0	0	0	1	0	0	1	0	0	0
AR-431	812346	237293	1	0	1	0	0	0	0	0	0	0
AR-432	812399	237267	0	0	0	1	0	0	1	0	0	0
AR-433	811212	237257	0	0	0	1	0	0	0	0	0	0
AR-434	775019	229971	0	0	0	0	0	1	0	0	0	0
AR-435	774330	226769	0	0	0	0	0	0	1	1	0	0
AR-436	774329	226615	0	0	0	1	0	0	0	0	0	0
AR-437	774252	226285	0	0	0	1	0	0	0	0	0	0
AR-438	773428	222913	0	0	0	1	0	0	0	0	0	0
AR-439	768921	218533	0	0	0	1	0	0	0	0	0	0
AR-440	770629	219501	0	0	0	0	0	1	0	0	0	0
AR-441	771824	219856	0	0	0	1	0	0	0	0	0	0

Table 2: Gazetteer - Living Cultural Heritage Assets

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded				
			Grave/Burial	Religious Building	Protected Tree	Fire Pit	Living CH - Other
CH-001	801022	283306	0	0	1	0	0
CH-002	800711	283156	0	0	1	0	0
CH-003	801217	283052	0	0	1	0	0
CH-004	800634	282848	1	0	0	0	0
CH-005	796068	282615	1	0	0	0	0
CH-006	795947	282517	1	0	0	0	0
CH-007	796247	282476	0	0	1	0	0
CH-008	795711	282063	0	0	1	0	0
CH-009	798615	281878	0	0	1	0	0
CH-010	800877	281637	0	0	0	0	1
CH-011	797835	281503	1	0	0	0	0
CH-012	797936	280928	1	0	0	0	0
CH-013	801612	280546	0	0	0	0	1
CH-014	800333	275775	0	0	0	1	0
CH-015	800335	275774	0	0	0	1	0
CH-016	800335	275773	0	0	0	1	0
CH-017	800323	275772	1	0	0	0	0
CH-018	800105	275548	0	0	1	0	0
CH-019	800118	275546	0	0	1	0	0
CH-020	800114	275543	0	0	1	0	0
CH-021	800105	275538	0	0	1	0	0
CH-022	800102	275532	0	0	1	0	0
CH-023	795841	274890	0	0	1	0	0
CH-024	796170	273945	0	0	1	0	0
CH-025	795893	273925	0	0	1	0	0
CH-026	798539	273285	1	0	0	0	0
CH-027	798313	273202	1	0	0	0	0
CH-028	799088	273186	1	0	0	0	0
CH-029	797497	272223	0	0	1	0	0
CH-030	796604	271831	1	0	0	0	0
CH-031	800381	269353	0	0	1	0	0
CH-032	800098	269245	0	0	1	0	0
CH-033	802391	268001	0	0	1	0	0
CH-034	802388	267991	0	0	1	0	0
CH-035	802366	267975	0	0	1	0	0
CH-036	802363	267973	0	0	1	0	0
CH-037	802369	267969	0	0	1	0	0
CH-038	802357	267966	0	0	1	0	0
CH-039	800863	267334	0	0	0	1	0
CH-040	800871	267320	0	0	1	0	0
CH-041	800866	267319	0	0	0	0	1
CH-042	800866	267317	0	0	1	0	0
CH-043	800744	267087	0	0	1	0	0
CH-044	801424	267021	1	0	0	0	0
CH-045	801419	267018	1	0	0	0	0
CH-046	801227	266888	0	0	1	0	0
CH-047	795968	264069	1	0	0	0	0
CH-048	795139	263996	0	0	1	0	0
CH-049	795278	263506	0	1	0	0	0
CH-050	795404	263312	0	1	0	0	0
CH-051	794916	263256	0	1	0	0	0
CH-052	797884	263232	1	0	0	0	0
CH-053	796134	262743	1	0	0	0	0
CH-054	803067	262540	0	0	0	0	1
CH-055	803056	262518	0	0	0	0	1
CH-056	803044	262517	0	0	0	0	1
CH-057	796272	262460	1	0	0	0	0
CH-058	796243	262455	1	0	0	0	0
CH-059	796827	262228	1	0	0	0	0
CH-060	799338	261684	1	0	0	0	0
CH-061	805747	259701	1	0	0	0	0
CH-062	806541	259029	0	0	0	1	0
CH-063	806529	259023	0	0	0	0	1
CH-064	806523	259019	0	0	1	0	0
CH-065	806526	259019	0	0	0	0	1

Golder ID	Easting (UTM)	Northing (UTM)	Materials Recorded				
			Grave/Burial	Religious Building	Protected Tree	Fire Pit	Living CH - Other
CH-066	806088	258976	1	0	0	0	0
CH-067	805831	258783	1	0	0	0	0
CH-068	798943	258412	1	0	0	0	0
CH-069	797001	256433	0	0	0	1	0
CH-070	796997	256423	0	0	0	0	1
CH-071	796995	256422	0	0	1	0	0
CH-072	796812	256365	1	0	0	0	0
CH-073	796821	256364	0	0	0	1	0
CH-074	797684	256071	1	0	0	0	0
CH-075	798969	256067	0	0	0	1	0
CH-076	798961	256062	1	0	0	0	0
CH-077	804709	251236	1	0	0	0	0
CH-078	804878	251215	0	0	1	0	0
CH-079	804874	251208	0	0	1	0	0
CH-080	804870	251194	0	0	1	0	0
CH-081	804876	251191	0	0	1	0	0
CH-082	804872	251189	0	0	1	0	0
CH-083	813686	246117	0	0	0	0	1
CH-084	813224	246018	0	0	1	0	0
CH-085	813389	245779	1	0	0	0	0
CH-086	813391	245773	0	0	0	1	0
CH-087	813384	245727	1	0	0	0	0
CH-088	813362	245712	1	0	0	0	0
CH-089	804520	245394	1	0	0	0	0
CH-090	808495	245382	1	0	0	0	0
CH-091	813290	243866	0	0	1	0	0
CH-092	813290	243795	0	0	1	0	0
CH-093	813294	243790	0	0	0	0	1
CH-094	813376	243334	0	0	0	0	1
CH-095	813377	243332	0	0	0	1	0
CH-096	813372	243315	0	0	1	0	0
CH-097	811009	239468	1	0	0	0	0
CH-098	810212	238527	1	0	0	0	0
CH-099	809269	238468	1	0	0	0	0
CH-100	809275	238452	1	0	0	0	0
CH-101	809269	238430	1	0	0	0	0
CH-102	811254	238187	1	0	0	0	0
CH-103	773372	222930	1	0	0	0	0
CH-104	772475	219936	0	0	0	0	1
CH-105	807920	245636	1	0	0	0	0
CH-106	807605	244917	1	0	0	0	0
CH-107	762595	212641	1	0	0	0	0

2.0 CATALOGUE OF KEY INFORMANT INTERVIEWS

Details of the KIIs completed in 2016, which focused solely on cultural heritage, are presented in Table 3. Details of KIIs completed in 2019, which had a broader focus but included questions on cultural heritage, are provided in Section 12.0.

Table 3: Catalogue of Key Informant Interviews

Audio Recording ID	Date	Settlement	Participants	Position of Participants
R1	07 Apr 2016	Lochwaa	Mary Amoni Lokope Lokuruchana Lolimo (+1 Elder in attendance)	Chief Chief Elder
R2	07 Apr 2016	Karoge	Achuka Mzee (+30 Elders & 16 women in attendance)	Seer
R3	08 Apr 2016	Kapese	Peter Eregai James Ewoi	Elder Elder
R4	09 Apr 2016	Kapese	Regina Ikal Lokuno Peter Eregai James Ewoi	VSO Elder Elder
R5	09 Apr 2016	Lokook	James Ekomol (+ 18 Elders in attendance)	Elder
R6	11 Apr 2016	Nakukulas	Not applicable – witness to ceremony only	
R7	12 Apr 2016	Lotimaan	Dominic Loreng Daudi Anyankori Ekwom Amoni	Legio Maria follower Legio Maria follower Elder
R8	12 Apr 2016	Nakukulas	Ikimat Lomeyen (+24 Elders in attendance)	Seer
R9	13 Apr 2016	Lokicheda	Ekatapan Nakoel Locheriapus Alemu (+12 Elders in attendance)	Elder Elder
R10	13 Apr 2016	Lotimaan	Nakali & Natuom (2 women who were at the watering point) (+4 other women in attendance)	Women from village
R11	14 Apr 2016	Lotimaan	Nakali & Natuom (2 women who were at the watering point) (+3 other women in attendance)	Women from village
R12	14 Apr 2016	Lotimaan	Ekwom Amoni Kale Ekitela	Elder Elder

Audio Recording ID	Date	Settlement	Participants	Position of Participants
			(+4 other men, +4 other women)	
R13	15 Apr 2016	Asikiim (part of Kapese)	Salina Akal Edung Peter Eregai (+2 others – 1 Elder and 1 elderly woman)	Elder Elder
R14	16 Apr 2016	Nakukulas	Ikimat Lomeyan	Seer
R15	18 Apr 2016	Kapese	Imaniman Nadonyang	Seer
R16	19 Apr 2016	Kapese	Peter Eregai James Ekomol Regina Ikal Lokuno	Elder Elder VSO
R17	19 Apr 2016	Kapese	Simon Ekutan	Elder (of Asikiim)
R18	21 Jul 2016	Kasuroi	Ekiru Kapua; Loree Lotonya; Robert Elipan; Peter Erongat; John Enipona; Selina Iligwel; Amoboi Kangole; Mary Epeyon; Annah Namiir; Jeremiah Ekapan; Eurien Naut; Joseph Ekai; Annah Amathe; Emuria Sapirnyang; Ayanae Enipona; William Ewoi; Ekoriachumi Ekai; Abuu Mauyo; Simeon Kitoe; Lomenye Ejore; Lowoi Lotur; Alfred Ebenyo; Ekai Naut; Achuka Losekon; Lorot Etabo; Margaret Etabo; Peter Ekeno; Samuel Awesit; Anna Lorot; Ejikon Lokemer; Christine Ekai; Lourien Akai Lokiru Lochuch; Ekal Lomokirion; Esinyen Naut; and Maruo Webei.	Elders, women and youths from village
R19	22 Jul 2016	Karoge	Achuka Mzee [introduction]	Seer
R20	22 Jul 2016	Nawoyalim	Erebona Akriakol Nakereru Lopwal	Women from village
R21	22 Jul 2016	Akibuket	Achuka Mzee Ewolan Lopuyo Lowari Lorot Kiyoga Lorot Eturoe Loperito Loumwa Nachoo	Seer Women from village

Audio Recording ID	Date	Settlement	Participants	Position of Participants
			Lyorio Nachoo Aperit Lopungurei Koole Nachoo	
R22	23 Jul 2016	Tirikol	[elder absent, so villagers did not wish to talk]	
R23	23 Jul 2016	Kaikol	Kitoe Nakuwa; Atiir Nakuwa; Akiru Nakuwa; Kooli Nakuwa; Akalepatan Elibit; Lokeredio Losil; Ekutan Elibit; Esinyan Akatapan; Edut Angomot; Amaler Akatapan; and Sarah Ngisekon	Elders, women and youths from village
R24	25 Jul 2016	Amoruakwan	Esther Amuron Awesit Aletia Napatet Ngikinae Peter Ewalan Sarah Amatoi; Esther Achuka; Margaret Asinyen; Christine Akadeli; Nalet Napatet; Lotujan Loimaluk; Akeno Epong; Akure Eporon; Nawar Epong; Lokol Etot; Awesit Epong; Ayangan Ebow; Ekadeti Lokitoe; and Teresa Ewal	VSO Chief Elder Elder Youth Representative Women and youths from village
R25	25 Jul 2016	Nayanae-engol	Erupe Marus Loregai Etidong Longoria Lokaale Lobolia Marus; Elyan Marus; Mtomi Mulen; Rose Ekalale; Marum Loporucho; Apese Loponcho; Alinga Logiron; Lokota Logiron; Nakuwa Lokai; Amujal Lokwong; Ekalale Lokuruka; Selina Nasekeny; Mary Lagotol; Aron Itidong; Losen Aiim; Aladiko Naburo; Atabo Ngimuyok; Alice Nakuwa; Christine Loregai; Mary Tenge; Ilikwel Akwee; Ekeno Lomojong; and Elabo Ngitirai	VSO VSO VSO Elders, women and youths from village
R26	26 Jul 2016	Kapetatuk	Egiron Ekitoe; Lokwaoi Longorimug; Bogoita Alim;	Elders, women and youths from village

Audio Recording ID	Date	Settlement	Participants	Position of Participants
			Aliwot Longorimug; Lobolia Ikari; Lopei Alem; Echaa Lomojong; Aregae Alim; Loporicho Lomojong; Abengo Lojore; Ekolan Loyomo; Namedi Nakuwa; Akiru Lomojong; Awesit Nangolerupo; Awoi Ikari; Nangoduk Loyomo; Ngikamatak Nakuwa; Loyomo Lomojong; Julius Amoja; Taakaem E John; Longorimug Lotwal; Lochodo Lomokomar; Ekaleruk Lomokomar; Kooli Esekon; Lokeno Alimikai; Agitait Ekaran; Nakuwa Akasukwout; Aperit Nawet; Lotakuny Longor; Ekaran Ingole; Lokwama Ikapol; Nakengi Ngakah; Kisike Alim; Ekitoe Ekomwa; Lokipi Alim; Emuria Loposimong; Losingen Loposimong; and Ekiru Epuu	
R27	26 Jul 2016	Lomokamar	Lowar Loputiro; Lpatiro Esil; Ekaran Longech; Erupe Ngasike; Epeyon Lochodo; Akuwom Ekaran; Esekon Kamais; Atebo Ngamuyok; Ekudud Ngasitae; Akure Lowoi; Ekuwom Lonyami; Atiir Ekales; and Awoi Amaler	Elders, women and youths from village
R28	27 Jul 2016	Dapar	[names not recorded as SP assistant was absent]	Elders, women and youths from village
R29	27 Jul 2016	Lowoidapal	Nakwa Lomojong; Esokon Erka; Ewoi Lonyalang; Etit Erika; John Ekitala; Lodeng Lomojong; Logok Lomojong; Lorot Emate; Ebei Ekuru; Lokomol Ekwong; Echakan Ngataikale; Lokiru Kibakte; Esinyen Ome; Jackson Lukiria; Elim Elifan; and Lokee Ongoleyo	Elders, women and youths from village
R30	28 Jul 2016	Kaloucholem	Ailet Lotukoi Ekai Etidong; Alerinyang Lowoton; Emaniman Agurum;	VSO Elders, women and youths from village

Audio Recording ID	Date	Settlement	Participants	Position of Participants
			Ngiduruko Lopong; Chom Ebach; Erupe Lowoton; Nanjak Epur; Lokaru Eiton; Lokwee Nakoo; Moru Lotukoi; Ekeno Kamar; Eyanae Kula; Eligoi Lotwae; Ngimuz Adoro; Kapelo Alemuu; Ngipeyok Kapela; Esinyen Lodio; Lokinyi Edome; Lodes Lopong; Ereng Lodio; Erupe Kula; Naikon Nakwan; Ekadeli Echwa; Ekwom Eserum; Amaler Naato; Ewolete Lowote; Alewot Alema; Agerio Lodio; and Kimat Illikwel	
R31	01 Aug 2016	Karoge	Achuka Mzee	Seer

3.0 PHOTOGRAPHS

Figure 1: Undecorated pottery (AR-217)

Figure 2: Decorated pottery (AR-317)

Figure 3: Undecorated pottery with hole (AR-080)

Figure 4: Undecorated pottery (AR-079)

Figure 5: Cowrie shell (AR-142)

Figure 6: Cowrie shell (AR-142)

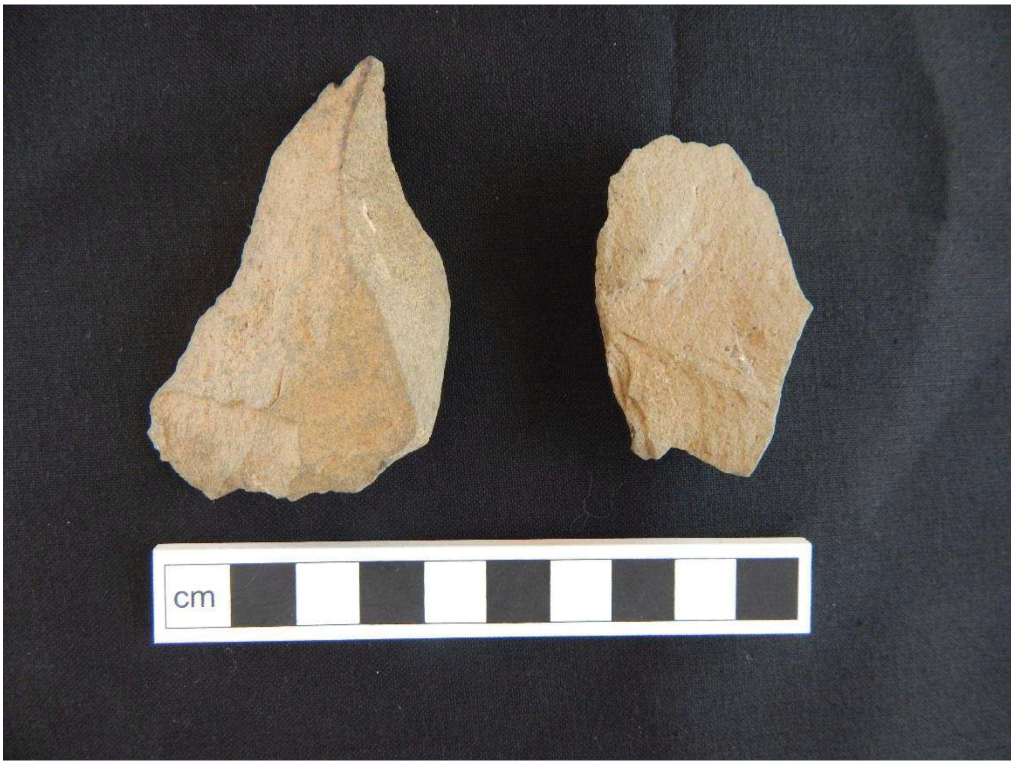


Figure 7: Rhyolite flakes (AR-213)

Figure 8: Rhyolite flakes (AR-213)

Figure 9: Quartz flakes (AR-303)

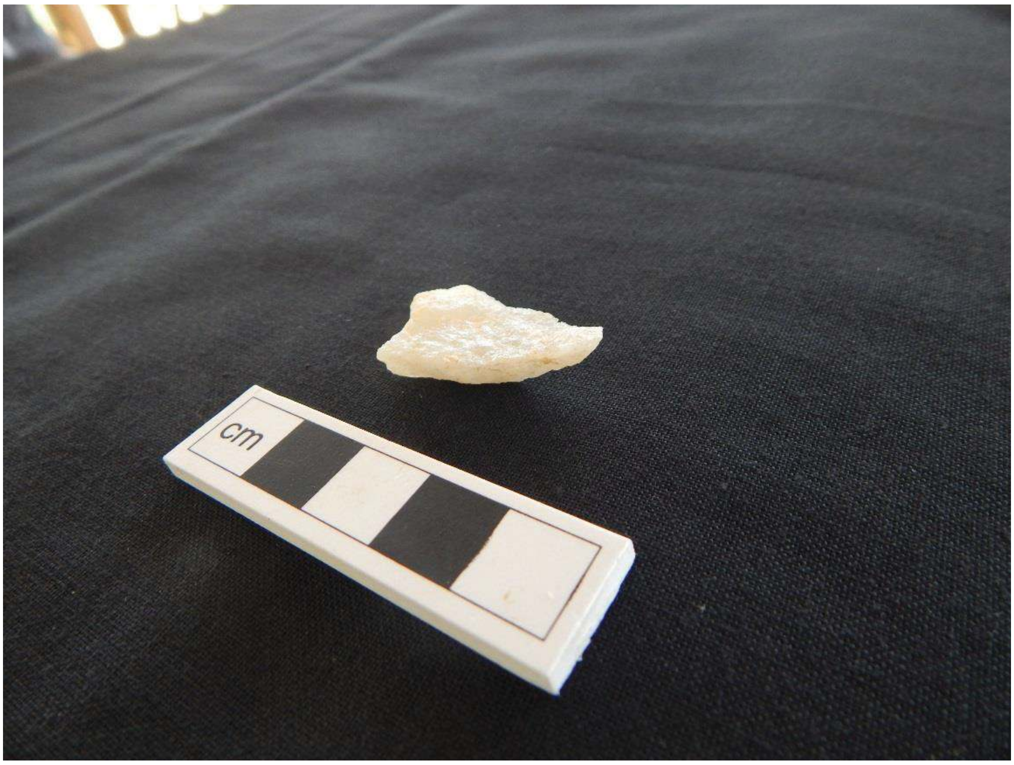


Figure 10: Quartz flake (AR-303)

Figure 11: Chert flake (AR-284)

Figure 12: Chert flake (AR-284)

Figure 13: Obsidian flake (AR-088)

Figure 14: Obsidian flake (AR-088)

Figure 15: Lithic assemblage (AR-252). Stone tools ranging from large rhyolite flakes to smaller obsidian and chert flakes (including some microliths).

Figure 16: Lithic assemblage (AR-251). Stone tools ranging from large rhyolite flakes to worked quartz to smaller obsidian and chert flakes (including some microliths).

4.0 ARCHAEOLOGICAL CHRONOLOGY FOR KENYA

Table 4: Archaeological Chronology for Kenya *(Schematic representation for illustrative purposes only. Not to scale)*

Geological Period	Kenyan Archaeological Period	Other periods referenced
Pliocene (5.3 Million BP - 2.6 Million BP)		
	Early Stone Age (ESA) (3.3 Million BP – 300,000 BP)	
Pleistocene (2.6 Million BP – 11,700 BP)		Acheulean (1.8 Million BP –300,000 BP)
	Middle Stone Age (MSA) (300,000 BP – 50,000 BP)	
	Later Stone Age (LSA) (50,000 BP – 2,000 BP)	
Holocene (11,700 BP - present)		Neolithic (8,000 BP – 2,000 BP)
	Iron Age (2,000 BP – 500 BP)	

TURKANA FIELDWORK SUMMARY

The following fieldwork summary reports were prepared by Philemon Ochieng' Nyamanga (National Museums of Kenya) in 2016. They document the work undertaken in the field to conduct Key Informant Interviews (KIIs) and summarise the findings of those KIIs. KIIs were undertaken with community members in 20 settlements across the South Lokichar Basin in 2016, in order to achieve the following objectives:

- To identify sites of cultural significance (e.g. religious, sacred or ritual sites, cemeteries or burial areas), record their locations and extents and understand how they are used/accessed;
- To record the oral history of the settlement and land use in the area; and
- To document an understanding of local traditions and practices (e.g. belief systems) that are important to the communities (intangible cultural heritage).

The 20 settlements in which KIIs were conducted in 2016 were:

- Akibuket;
- Amoruakwan;
- Asikiim;
- Dapar;
- Kaikol;
- Kaloucholem;
- Kapese;
- Kapetatuk;
- Kaaroge;
- Kasuroi;
- Lochwaa;
- Lokicheda;
- Lokook;
- Lomokamar;
- Lopuroto;
- Lotimaan;
- Lowoidapal;
- Nakukulas;
- Nawoyalim; and
- Nayanae-engol.

Turkana Fieldwork Summary

Philemon Ochieng' Nyamanga

April 2016

1. Introduction

We have had a fruitful two week interviews with Turkana elders in South Turkana sub-county, conducted between the 7th and 17th April 2016. The purpose of this fieldwork was to document the tangible and intangible cultural heritage of the Turkana people. The following is a brief summary of the key findings of the fieldwork highlighting the possible gaps. The summary captures the history, lifecycle, religion, and economy. We were lucky to attend a cultural ritual and managed to interview two seers. All the interviews were audio-tapped except the discussion with the Kapese Chief and the Kapese seer. We took photographs of the sites visited and recorded the locations. We talked with the chiefs where they were available and sought permission to interview the identified elders, village social officers (VSOs) and seers.

2. History

The Turkana are a Nilotic speaking people. They have had a long connection with the Turkana plains and are thus referred to as Plains Nilites. As a pastoral people, the Turkana pursue a seminomadic lifestyle. Most of the centres we visited consisted of temporary structures with few material possessions other than their rich and diverse livestock. New permanent or semi-permanent structures are being established largely in urban centres like Lokichar. It is not yet clear how the settlements originated and developed historically. Many Turkana settlements are closely parked together or isolated homesteads within particular localities. The main challenges of the community have rested with insecurity, drought and water problems. Most informants held that they were born in those settlements and that even their fathers and grandparents also lived here. It implies that several generations have lived in these settlements. Since most of the settlements are constructed with perishable materials little evidence about past settlements is available other than a few graves and archeological finds. For example, the abandoned homes with standing structures in Lokicheda, water blocking structures formerly serving irrigated farmlands in Askiim, abandoned settlements like Lopuroto and elsewhere now turned into grazing lands, among others. It is therefore important to regard the Turkana as the natives of the area with a long history of occupation to their settlements and grazing lands spread across the expansive plains to the neighbouring highlands.

3. Childhood and education

The Turkana value children and therefore each man usually married several wives to beget children. They socialize their children to take up the pastoral skills of herding livestock and protecting the people and their livestock. At birth, the child is given a name, usually a name of a family member or elder. There is also naming by where children are born, for example, Ekion is a name given to a child born in the kitchen. Birth celebrations are mainly attended by women and children to welcome the newborn. Men never attended such celebrations but gave the animals and other provisions to be used in the ceremony. The food of the new-born was mainly goat milk, breastmilk and porridge. Meat was provided for the mother of the newborn and the guests who came to welcome the baby. The mother of the newborn was expected to consume sufficient meat to enable her regain strength and energy and resume other key roles of family care. The mothers nursed the children and taught them basics of survival in the arid and insecure environment that is Turkana land. As they grow older the boys are closely supervised by their fathers and elders while the girls are supervised by their mothers and taught skills on milking, cooking, and constructing houses and structures for the livestock. With the introduction of modern education it is realized that few children go to school. In urban centres children drop out due to early marriages. Modern educational institutions and urban life style and other changes in the area are likely to bring in changes in Turkana cultural traditions relating to child development and socialization.

4. Adulthood and Marriage

Turkana young men are usually initiated into adulthood through a ceremony conducted by the elders in the various ritual tree sites. The initiate brings with him an animal to be slaughtered, roasted and shared by the community elders who then bless the initiate and give him a guide to talk on his behalf and to teach him community secrets. After about a week another animal is slaughtered to release the initiate and separate him from the guide. It is after this that the young adult can now seek a marriage partner, for whom he pays bridewealth. The marriage process begins with the young man informing his father that he wished to get married. The father would then confirm if there were enough sheep, goats, cows and camels for the bridewealth and then directs him (his son) to go and find a suitable woman. He would go to the girl's family and report back to his father, who then takes the initiative of arranging for the negotiations regarding the bridewealth to be given to the bride's family. Such negotiations would take even a month and upon agreement the bridewealth would be given and a wedding conducted. Married women were expected to guard against immorality as this affected the entire family and the livestock. It is only when bride-price was paid and a traditional wedding conducted that the man had rights over the children born by his wives. Like most African communities, the Turkana practice polygyny and the payment of bridewealth in terms of camels, cattle, sheep, goats and donkeys.

5. Religion

The Turkana have retained their traditional beliefs and practices although some new forms of change might be expected as a result of the twenty other religious institutions (churches and mosques) that are spreading in the area. The traditional beliefs of the Turkana were influenced by the belief in God (Akuj) and the seers who were responsible for solving the problems facing the community such as drought, insecurity, diseases and death. The Turkana believe that Akuj is in control of their lives, the lives of their livestock, their security and their environment. The seer is a very important spiritual leader in the Turkana community. There are three kinds of seers depending on what they rely on for spiritual guidance for understanding phenomena around them: dreamers, shoe-readers and livestock intestine-readers. Each settlement might have all the three kinds of seers together; otherwise each settlement usually has a seer. Most of the remedies for the various problems diagnosed by the seers involved some ritual in which an animal (domestic and wild), bird or plant could be used/slaughtered.

Most of the modern religions are largely based in town/urban centres across Turkana land. The pastors and preachers usually go out to the villages to preach to their followers. They do not wait for the followers to come to them in the churches. Most church activities are held once weekly, especially on Sundays except for the Seventh-day Adventists who congregate on Saturday. Apparently the modern/Christian new churches' traditions are being integrated in the Turkana cultural/traditional practices as even seers are active members of the ? churches with some of them even serving as pastors.

6. Economy and industry

Turkana people rely largely on their livestock as a source of their livelihood. Some of the community members are traders and others are contractors working in the construction industries. In some areas there are people who live by cultivation especially along the River Turkwell and others on fishing along Lake Turkana. Most of the people in the research area practice a pastoral economy. They keep and manage their livestock which includes cows, camels, goats, sheep, donkeys and some poultry. Women also make charcoal for sale largely in the nearby urban centres. The discovery of oil and gas and water will undoubtedly contribute the economy and industry and the lives of the people of Turkana County.

7. Tangible Heritage

There two forms of tangible heritage: movable and immovable. Among the movable cultural heritage of the Turkana include clothes and body covers, bowls, pots, sufuria, knives, spears, water containers, headrests, snuff containers and metal rings among others. The women wear a rich collection of necklaces made of beads and metal. Both men and women wear earrings and bangles. Special metallic bangles identify individuals with their respective age grades. There are two such grades, Ngirsae and Ngimor. The Ngirsae wear silvery metals on the left hands while the Ngimor wear golden metals on their right hands.

The immovable heritage of the Turkana includes their houses, burials and livestock structures as well as meeting and ceremonial sites under various trees. Turkana houses are built by women from materials collected from the available plants (tree branches and grass). Due to scarcity of grass most of the structures are covered with large polythene sheets. Some of the houses are smeared with soil while others have iron sheet roofing.

8. Intangible Heritage

The intangible heritage of the Turkana includes their language, myths, stories, chants, ceremonies, and skills and knowledge expressed in body incisions, haircuts styles, the culinary traditions and practices and games.

The Turkana people around this area speak mainly their native language. Some of the members of the community speak Swahili, English and neighbouring languages of the Borana and Pokot. There exist no folklore on the origin and development for most of the settlements, what exists in some cases are names of settlements associated with certain personalities, for example Kapese, named after Apese, a young girl who loved music dearly and used to sing praises to people.

In the ceremonies, the Turkana slaughter rams, goats and camels and share the ritual meat among the elders and male children in attendance. The meat of the slaughtered animal is roasted and portioned out to elders beginning with the eldest to the youngest. Most of the ritual sittings and dances are conducted in arc-like or circular formations around the *akiriket* – the food serving platform. The elders sit on their stools and in front of them lies a table of foliage onto which the meat is served.

9. Death and Burial

The Turkana have a rather inconspicuous funerary tradition. In the past the Turkana used to mourn and bury only elderly men and women. The elders were buried in their respective cattle sheds usually the camel or goat-shed in a sitting posture and the grave covered with a heap of sticks. Women on the other hand were buried in their houses. The children and young people were just thrown in the fields or put on trees where they would be covered with their clothing and left there. People avoid burial places, especially the pregnant women as this might bring bad luck to the woman and unborn child. When a person dies people mourn only for a while and burial is done immediately. Thus if someone died in the evening s/he would be buried the following day. An animal would be slaughtered and shared with the family and relatives who come to mourn. After burial the home would be abandoned as people moved to another site. Widows are usually not remarried except those that are still young and in their reproductive age. Today there are permanent graves made of stone and plaster. We documented some of these where? in the sites that they existed. It is not clear who leads the burials. All that is known is that a grave is dug using a hoe and then the covered body is laid in it and covered with soil.

10. Conclusion

Modern changes may affect any traditional society both positively and negatively. The Turkana have a pastoral cultural tradition whose continuity hinges on the committed embrace by the people. This brief report has summarised the findings of the recent baseline survey conducted in Lokichar at the following settlements: Lochwaa, Kaaroge, Kapese (lokook and Askiim), Nakukulas, Lokicheda and Lotiman. It has touched on the history, the tangible and intangible cultural heritage and the economy of the Turkana from the purview of the elders of these settlements. The comprehensive report will provide appropriate details and fill in evident gaps. The accuracy of the information provided might be affected by the translations which were made in three languages (Turkana, Swahili and English) used simultaneously in the interviews. Another challenge the research faced relates to the willingness of the informants to give information. Some of the informants were unwilling to discuss some issues, to be taped or photographed. All possible effort was made to secure permission to record the interviews and take pictures. Finally, there was the challenge of requests for gifts of food; gift giving being an essential aspect of Turkana culture.

South Turkana Cultural Heritage Baseline Survey

Phase 2, July to August 2016

Report

By

Ochieng' P. Nyamanga

August 2016

CONTENTS

1. INTRODUCTION

During this phase of the consultations, we dealt with thirteen interviews that were attended by several persons (in excess of two hundred, annex 1) from whom we obtained crucial data on the Turkana cultural traditions based on the natural and cultural heritage. We relied on the interview guide that was prepared by Golder Associates as in the previous phase. The interviews were conducted from between the 21st July and 1st August 2016. The following report provides the results of the interviews following the order in which the information was obtained by date and village. Lucas Ariong assisted with the translations and we are immensely thankful to his good job without which this report would not have been possible.

2. KASUROI

We were scheduled to have an interview with the community on the 21st July 2016. We first had a courtesy call with chief Josephine of Kapese. We then proceeded to Kasuroi from Lokichar and had a fruitful interview with thirty six members of the settlement. Lucas Ariong made the introductions and then in the next two hours we gathered immense knowledge about the community. The thirty six people in attendance at the interview included the following:

Ekiru Kapua	Emuria Sapirnyang	Peter Ekeno
Loree Lotonya	Ayanae Enipona	Samuel Awesit
Robert Elipan	William Ewoi	Anna Lorot
Peter Erongat	Ekoriachumi Ekai	Ejikon Lokemer
John Enipona	Abuu Mauyo	Christine Ekai
Selina Iligwel	Simeon Kitoe	Lourien Akai
Amoboi Kangole	Lomenye Ejore	Lokiru Lochuch
Mary Epeyon	Lowoi Lotur	Ekal Lomokirion
Annah Namiir	Alfred Ebenyo	Esinyen Naut
Jeremiah Ekapan	Ekai Naut	Maruo Webei
Eurien Naut	Achuka Losekon	
Joseph Ekai	Lorot Etabo	
Annah Amathe	Margaret Etabo	

Kasuroi has a background of flight from the Pokot. Originally a grazing land, Kasuroi became a Turkana settlement the herdsmen who settled here run away to the east fearing the Pokot the worst of which occurred in the nineteen thirties. The inhabitants of Kasuroi started living here in the nineteen thirties as a Crown settlement established by the British as a Pastoralist Kraal the original inhabitants of this settlement may have come either from the south or west but nobody seems to know for certain where they came from. What is known about the inhabitants is that they have lived here for several generations much of whose history is forgotten due to the oral nature of the Turkana knowledge system.

The inhabitants of Kasuroi are largely of two sections of the Turkana community Esonyoka and Ngimatak. There are fourteen ere in this settlement, namely: Kasuroi, Kalkol, Natudawo, Kadongolo, Amaruakwan, Wachorokalei, Nanangakina Kaekoe Ekwan, Akou Ekori, Lomeseksil, Hoyo kwee, Kaapoa, Kalitakere, and Tirikwel.

The economy of this community has largely depended on pastoral livelihood system gathering wild fruits and hunting game. Although considered among the richest settlement of the Turkana, Kasuroi people today engage in shop-keeping, charcoal trade among other business people whose mainstay is herding large livestock. They are mainly sheep herders and the name of Esonyoka derives from the sheep tail.

Charcoal burning and selling of maize, flour (unga) and shop-keeping are merely fallback occupations resulting from drought and insecurity.

Kamatak (Ngikamatak) are a people whose speech is unclear, they speak in a way that they mean the opposite of what they shay for instance if a member of the community tells you take this and share with so and so he means do not share what I give you. The people do not speak plainly and it is rather difficult to understand them.

How do the people of Kasuroi bring up their children? Although today the people take their children to school pursuing formal education that begins with Pre-School and Primary to Secondary School, traditionally the people taught the children how to tend animals. They began by taking care of small stock and later assist older people with the work before they could be left alone to look after the livestock all by themselves. Once a boy was able to care for the livestock by himself he would be mandated to raise his own stock having the prerogative to sell or give them out to anyone at will even so the father remained in control guiding the son until old age.

When does a child become an adult? When a Turkana child gets initiated or marries he becomes an adult given a portion of livestock and may decide where to live independently.

How is initiation done? Initiation is a long process beginning with the decisions of the father. The father may decide that all his sons are initiated all at the same time or separately for which provides the requisite ritual animal for every initiate must slaughter an animal during his initiation. Initiation is usually done following age-set system Ngimor and Ngirsae. Each initiate must bring with him beads two sheets headgear tobacco sugar animal fat and an animal to slaughter (if there are ten initiates they must have in total ten goats or sheep to kill each one killing his own). After the slaughter of the animal and sharing with the members present the initiate stays away from his family for five or seven or ten days after which he is given animal gifts to start life with. Headgear and ochre special earth smeared on the initiate body and ostrich feathers were central to the ceremony the initiate had to wear these during the five to ten day period after which the hair was shaved and normal life resumed. One has to be initiated before one could marry.

Who decides when one is fit for marriage? It was the father of every boy to make such a decision or the eldest son if the father was not there. It also depends on the wealth an individual has. Once one was initiated one could marry one's preferred wife. The family looked for special qualities in the girl to be married especially such traits as being social friendly and hardworking. After that identification negotiations were. Somebody was assigned to the initiate as his guide. After that identification negotiations were made especially between the man and the girl at personal level but if the girl was tough the man needs reinforcement of friends (mothers and sisters) after which the father was engaged together with other relatives to visit and have discussions with the girl's father and is usually characterised by eating of a ram and presentation of gifts like sugar and the bride-wealth is finally given to seal the marriage. Many people are brought to witness the agreement sealed by slaughter of a bullock. Friends then gave the girl gifts> the following animals would be given as bride-wealth: two hundred shoats (sheep and goats), thirty to fifty camels, eighty cows and five to ten donkeys.

the groom and the bride wore traditional attire (goatskin for the lady< beads and ostrich feathers and headgear for the man) ostrich feathers are usually bought from the local shops smuggled from the game parks/reserves through the black market. These items greatly provide colour and pomp to the wedding and the feather colours especially defined one's age (black for the Ngimor and brown or white for the Ngirsae.

Which cultural places are used by the people of Kasuroi? The community has a traditional cultural tree in the east where elderly people meet to rest, make important community decisions and pray and offer gifts to Akuj (God). the pray to God in through animal offerings and food sharing> a camel cow or goat would be killed and roasted through the roasting process the people believe they are presenting an acceptable gift to Akuj and as the smoke rises to the sky they believe they are in communion with God. Traditional prayers (agata) are performed by an elderly person (usually a seer/dreamer) who is able to foresee rain< floods and other calamities as drought and invasion and would call upon God to protect the community and give them rain during drought as well as forgive their wrongs or stop floods and raids from neighbouring communities the people believe that when they meet with God they must appease him with a sacrificial gift and show reverence to him as giver of life and riches on which the community's existence lies. There is no designated place for initiation and marriage; for these activities the people would go to the elderly kraal and this gives them some difference from other Turkana communities which have designated initiation and marriage sites. The community also treasures the Alusili grave in Kaikol village.

Kasuroi has fourteen ere and the community apart from being committed to their traditions also has representatives in modern religions, especially Christian Churches such as Roman Catholic, Reformed Church, Maranatha Church, Seventh-Day Adventist Church (SDA), and Legio Maria.

The fourteen ere of Kasuroi include:

Kasuroi	Wachorokalei	Hoyo Kwee
Kalkol	Nanangakina	Kalitakere
Natudawo	Kaekore Ekwan	Tirikwel.
Kadongolo	Akon Ekori	
Amaru Akwan	Lomeseksil	

The Kasuroi people reportedly have no myths or legends but usually sung and dance in the evenings when all activities are finished when the young men and women would go to an open-land and sung general songs praising community heroes. They jump high and land in a systematic pattern in dances that took about four hours. Men and women sung and dance during happy moments of plenty during the rainy season when the people had plentiful food, a lot of milk plenty pasture and water and dancing reflected the bounties and joy of the people
the elders' tree site was noted as a group of trees forming a triangle in the Kasuroi River. The trees are ekurichanait (36N 0795893 0273925), ekurichanait and esekon (36N 0796170 0273945) and three acacia where the participants gather and share meat (36N 0795841 0274890).

3. NAWOIYALIM

Interview with the People of Nawoyalim was conducted on the 22nd July 2016. We first drove to the home of the elder and seer, Achuka Mzee. We found him and his wife preparing snuff in the grinding stone in the company of their little girl. There were three other men with him. The main grinding stone is called akries (aknes?) and the small one ikalele. We then drove to a few homes to ask the people to assembly for the interview under the tree of meeting. The homes (kraals) are very wide apart and few. We spoke with two women, Erebona Akriakol and Nakereru Lopwal, and a boy who was tending shoats and three children.

Nawoyalim derives a tall elim tree among acacia. The trees are available to the east. Children grow up to assume various roles. Children cared for up-to seven or ten years and if male he looks after the young animals but if a girl she prepared to watering of animals and building structures for both people and livestock. It is the responsibility of the female Turkana to do homemaking while the boys took care of the goats and camels.

While in the past the people fed the children on milk, fat and meat, today however they are fed on porridge (uji), ugali, soup and milk. The routine daily life activities of the people of Nawoyalim includes bread earning through charcoal burning and selling, fetching water and taking care of children as well as watering livestock as other people go out to look for water, firewood one woman usually remained at home to take care of the children

That is the importance of beadwork to the Turkana? Beads stand for the Turkana culture being part of the traditional attire; wearing beads helps preserve the people's traditions. On top of the beads hung a metal ring which represents that one is married. The colours of the beads mean nothing other than providing variation and enhanced aesthetics.

The people of Nawoyalim have schools in Karoge and older children go there for formal education. Churches are also found in Kaaroge and only outreach programmes reach the village especially those of the Catholic Church.

Traditionally the people of Kaaroge approached God through meetings especially when there are issues such as drought or disease outbreak when elders converged during day or at night to kill an animal (a goat, sheep or camel) and pray to Akuj. Such prayer is called agata. It is when all elders come together and pray, hoping that appropriate and immediate answers would be given to the community and relieve any pain and suffering of the people. During such occasions the people sing and dance as they sought God's guidance and protection.

There are two **significant cultural sites** in **Nawoyalim**: tree of meeting for elders and the grave of Aman Lochuch after which one of the ere is named. The elders' tree where the people conduct marriage negotiations (today others go to the church), initiations and prayers under two acacia trees (36N 0801022 0283306; 36N 0801217 0283052). The grave to the west in the upper side of the river (36N 08000634 0282848).

When does a girl or boy become ready for marriage? As the girl grows up she is engaged in daily watering of livestock and periodic construction and repair of living structures (houses for people) and for animals, she is bound to meet young men one of whom could approach her with a marriage proposal which she communicates to the family in due course and negotiations begin. it must be remembered that the girl must be fully prepared by training her in animal care, watering and construction skills by the elderly women she is also given proper training in appropriate dressing with beads and hair makeup as well as slaughtering skills. Cooking is part of the training she is given including the distribution of food and the sources of construction materials. The construction materials are basically derived from plants such as ekurichanait (for houses), eregai for livestock structures.

Comment on any taboos (food taboos during pregnancy). Some clans with special marks (Ngimacharim) forbid pregnant women from eating animal entrails as this would lead to abnormal births and difficulties including miscarriage, deformities (cripple dumb or deaf) any contemporary changes in women roles? Not really, most of the people are still rural and traditional in focus and therefore remain attached to the pastoral economy.

4. AKIBUKET

After the interviews at Nawoyalim we moved on to Akibuket and spoke to a much larger group, about twenty people in the company of the Kaaroge elder (Achuka Mzee) who is also a seer. Like Nawoyalim, the village has few inhabitants mainly women and children as the men go out very early to attend to the cattle. We drove across the village inviting the available people to converge at the elim tree where we conducted the interview for about two hours. The elim tree is a very important meeting place. The meeting started with seven women and eight children but rose to around twenty as more women and children joined in. Apart from the women, one harder, Ekiru Edopal, came with some sheep and joined in the interview. The women included: Ewolan Lopuyo, Lowari Lorot, Kiyoga Lorot, Eturoe Loperito, Loumwa Nachoo, Lyorio Nachoo, Aperit Lopungurei, Koole Nachoo and several children. We took pictures of those present at the interview. Akibuket derives from bountiful milk and churning to produce fat. The name derives from the wet season when the community has a lot of pasture and water during which animals produce a lot of milk which is fermented and churned to produce fat (animal oil), the churning (shaking) process is called akibuk.

What are the most important plants used by the community? To the community living here land and trees mean much to their welfare and that of the livestock. Most important plants include elim, ekalale, ewoi, eipa, acaciaand eegai. Eregai is very important to the livestock when the livestock have enough eregai to eat, the people also have enough food and living conditions improve. In terms of priority: ewoi (acacia) and ekalale are the most important trees for the Turkana, the trees produce fruits. Ekalale produces leaves and flowers for livestock and fruits for people. Ewoi produces leaves, flowers for livestock and pods for both man and livestock. They produce these during the dry season and are the trees that the people rely on for pastoral production due to their resilience (resistance to drought).

There are also some six **medicinal plants** used by the community: emus, echuchulka, amuroekile, elim, locham and ekamongo. Amuroekile is used for treating stomach diseases including diarrhea, vomiting. Etesro helps when someone is pricked by a thorn which breaks in the body. You break etesro and drop its milk in the place pricked by the thorn. The thorn would come out two days later. Epetet is used for treating eye ailments. Elim is pound and used to treat stomach complaints such as diarrhea, vomiting and constipation. Ekamongo treats wounds and is considered the most important antiseptic, but it is usually very painful. Locham is used for treating coughs.

The community also uses a number of plants for construction work- construction of houses and resting sheds : the eregai and small acacia trees as well as epetet. Edung is especially used for constructing houses but ebucharatet also serves as a house construction material. Edung is used in other cultural activities in the community including initiation. The seeds of edung are boiled for several hours and used to seal the process of initiation. The seeds are eaten by the elders presiding over such initiation as a sign of final blessing to the initiates. The same is true for marriage ceremonies and when a mother has given birth. In both cases edung is consumed as the final meal served to the elders and the mother when she is ready to come out of seclusion from the house. Edung is, therefore, key in Turkana community cultural life. When the young child is shaved edung is cooked and fed to the woman who has shaved him or her.

Few animals and birds are used food by the community. Small children eat birds like ekolsalalat, ekuri as well as rabbits (sungura) and squirrels. Middle-aged people and the elderly do not eat such foods.

How is the daily life like here? Girls and women in general engage in several domestic activities. They burn and sell charcoal, herd and water livestock, process skins to make traditional attire such as dress, dance costumes and ceremonial pieces as elou, abwo, egolos which are important women attire.

How frequent were the ceremonies? Most Turkana traditional cultural activities took place during the wet season and more so during the transitional phases of the seasons,
between the wet and dry season, around July and August, just before the onset of dry season in September. The community conducts several ceremonies including initiation (asapan), traditional weddings usually are conducted with pomp and celebration as there is plenty supply of food and water and the people make merry with songs and dances>

Who makes the beads that the Turkana women wear? Everyone usually has the choice of what beads to wear by colour design and layers. One of the women present (Ekionga Lorut) is known for making such beads to the family members and for other people in the community at a small fee just like it is done in the salons. She is usually paid five hundred shillings for making the beads but insisted that she made the beads free of charge for family members. She buys the beads from the shops at one thousand one hundred for each layer of beads (each layer is marked by different colours: black, red, blue, green, and yellow. The beads are usually supplied from Nairobi, Nakuru and Eldoret.

The community members held that there were no myths, legends or historical stories commemorating special events in the area. What the people remember is a universal Turkana myth about the Pokot man and the Turkana woman. Once upon a time in Turkana South, there were conflicts between the Turkana and the Pokot. Men had gone grazing as usual but left a woman in the kraal to take care of it and the children. A Pokot man came and found the woman alone in the kraal. The Pokot man asked the Turkana and the community has treasured the story to show that even women can defend the community and should not belittled. The story reminds the living of the need to think and act fast especially when in danger. The story indicated that females have abilities: strength, speed and clear quick thought that could be used in defence of the society. Elsewhere in Loima the woman has been identified as Lokitaung.

The interview ended with the beliefs and heritage sites. Among the churches that were said to exist in the area included New Apostolic and Catholic. Most of the people are members of the New Apostolic Church which serves the community through an outreach programme. They meet near the women's houses and under the trees. They generally meet on Sundays and Tuesdays. Among the important heritage sites in the community are the elder's tree (36N ?) under which we held the interview and whose coordinates had been taken the previous time (in April). The other site is the grave of Nachoo Kopwa Kaikol (36N 0798613 0281876).

6. KAIKOL

We conducted the interviews at Koikol on 23rd July 2016. We started by asking which people lived here and where they come from as well as the meaning of Kaikol. Kaikol is named after an old woman who was married to the founder of the village. The first wife of this man was called Kaikal. When she died the people renamed the community after her for remembrance.

Kaikol belong to the Esonyoka subsection of the Turkana. They came here from the east from a place named Kaikor Sogol. The founder was called Nasenyang. The people of Kaikol rely on their environment for many things. Among the important plants are ewoi, ekalale, ekurichanait, epetet, eyadung and eregai.

Ewoi (acacia) provides pods for both people and livestock as well as construction materials for building homestead structures (houses for people and sheds for the animals). It is also a source of charcoal and stools (headrests). Ekalale provides fruits for livestock and people, sheds and meeting places for the community, its leaves are feed for the livestock and the tree provides construction materials. Male stools are usually made from ewoi and ekalale. Ekurichanait flowers are important fattening feeds for the livestock (animals eat ekurichanait to grow fat) but the plant also provides the best materials making traditional stools (ekicholong) and for construction of homestead structures (houses and sheds for livestock and people). Most traditional tools are made from ekirichanait (plates and other containers used by the community). Epetet provides leaves and barks for animals as well as flowers for honey making and seeds for livestock. Edung (eyadung or eadung) have bitter fruits that must be boiled thoroughly (for several hours) to be edible to people. Edung leaves are livestock feed, much as eregai flowers. Eregai also supplies much of the construction materials to the community. The community also exploits the wildlife resources for food especially rabbits, squirrels and birds (ekuri). The fox however is among the great enemies of the Turkana as it preys on the goats.

How is the daily life pattern of men and women in this village? Female members of the Kaikol community usually engage in several economic activities including charcoal burning and sale, gathering firewood, watering livestock and fetching water for family use for drinking and cooking, constructing shelter for use by the people and livestock (anok), houses (akou) and resting sheds (ekol).

Men on the other hand looked after cattle and other livestock by providing day and night guards (security) as well as ensuring the family needs such as food, clothing among others were met by providing animals for slaughter or sale to acquire essential domestic needs, planning for periodic migrations especially through the guidance of seers.

While the people settled here a long time ago, there are no songs, myths or legends commemorating their migration or subsequent settlement.

How does a man prepare himself for marriage? After all necessary preliminary preparations and negotiations are done, the man gives out bride wealth (dowry) to the bride's family (five hundred shoats, fifty cows, thirty camels and ten donkeys) is given out (usually contributed by his brothers, and friends).

How is the camel important to the community? Camels provide milk and being resistant to drought can survive anywhere during difficult situations of prolonged drought as well as plentiful conditions. Camels are basically attached to the male members of the society. They usually live longer than other livestock, being less vulnerable to theft from rustlers and attack from wildlife and when sold a camel fetches a lot of money (up to fifty thousand shillings) which can be used to meet crucial home needs.

What are the basic items used in your homes? The Turkana home has several utensils and tools. Akurum serves as gourds for storing milk while waiting to be used by the family. Elepit is the smaller milk container used for milking and pouring the milk into the bigger milk container, akutwam, for longer fat storage lasting up to one year. Atubwa serves as the traditional plate, akaloboch is the service spoon, and ebur is a gourd for storing fried meat lasting at least two weeks. Etio gourd for storing fresh milk to be churned to produce fat and the rest of the milk drunk by the family, ejomu (traditional sleeping mat), asajait carrying tray used for transporting things during migration.

When does a child become an adult? A child attained adulthood when teenage ends (akreum), when he is able to bring a woman home, marry and impregnate a woman. But it is initiation which clears a child to enter adulthood. Initiation (asapan) is usually conducted after the initiate has had enough requirements to undergo the ceremony. The initiate buys beads, sheets, arm bands (rings) tire shoes, ostrich feathers (white or black), cooking fat, sugar, fresh milk from cattle and tobacco. Tobacco is particularly important to the Turkana. Bought from the shops tobacco is involved in all traditional ceremonies in the community (blessing the new born and symbolizes sharing and communion with Akuj (God). In asapan the elders share the tobacco and put some into the fire as God's share.

How does the community approach God? Turkana elders usually converge in certain site, slaughter and eat an animal (cow, goat, sheep or camel). after all has been done one of the elders stand up with a spear that was used to slaughter the animal (its sharp end facing upwards) and prays (prays that God supplies plenty of livestock, many camels, health for both people and livestock, blessings to the community in the form of rain), for all the good things the community needs and curses all bad things. Prayers are said at all times (especially whenever there is need, when there was threat of livestock diseases or impending raid or drought). Such prayers are made either very early in the morning or at night depending on the types of need. Although there are many churches in the area the people still cling to such traditional ways of approaching god. The available churches include: Catholic, Maranatha and Reformed Church.

We need to recall in closing that Kaikol has two ere: ere Alusil and Amasenyang. The community has two significant cultural sites: the grave of Losil Nasenyang (enter coordinates) where to date is visited by family members whenever they wish presenting various gift items (sugar, tobacco and slaughter a goat and share. They go there under the leadership of the eldest son of senior mother living. We saw three sets of fire stones on the site (enter coordinates) and the tree of meeting (36N 0800102 0275532) consisting of five trees (two ekalale and three acacia). The following sixteen people were present during the interviews:

Kitoe Nakuwa	Akalepatan Elibit	Edut Angomot
Atiir Nakuwa	Lokeredio Losil	Amaler Akatapan
Akiru Nakuwa	Ekutan Elibit	Sarah Ngisekon
Kooli Nakuwa	Esinyan Akatapan	Five Children

6. AMARUAKWAN

We arrived early on Monday 25th July 2016 and luckily found a number of people assembled for interview. In fact we started off with three men, fifteen women and five children. A little while later three other women and one child also came and joined the group. There were therefore twenty-one adults and six children in attendance at the interview, but only the following eighteen of them had their names written down (two adults and six children were not taken):

Esther Amuron (VSO)	Margaret Asinyen	Nawar Epong
Napatet Ngikinae (Elder)	Christine Akadeli	Lokol Etot
Peter Ewalan (Youth Rep)	Nalet Napatet	Awesit Epong
Sarah Amatoi	Lotujan Loimaluk	Ayangan Ebow
Esther Achuka	Akeno Epong	Ekadeti Lokitoe
Awesit Aletia	Akure Eporon	Teresa Ewal

Amaruakwan means the grave of a woman on which a white stone was placed- this elderly woman was called Lobotol Ekalale. Her husband died long before she came here with her two sons. Later when she died she was buried at her grave (enter coordinates) the community then adopted the name of the stone on her grave in honour of her since she was a very kind person.

How long have the people lived here? The community has lived here for many years, having migrated from Loima during drought they arrived her in search of pasture and water. They came here as Ngimatak clan but today their off-springs are now Esonyoka. The community has four ere (lobor, lukwei, lobalyo and ekaran) today. When the people arrived they first settled at Lochwaa and then to Kaaroge, Kasuroi and finally here at Emuruakwan.

What is basis of the people's livelihood here? The community relies on pastoralism raising livestock (camels, donkeys (esikiria), and exploiting natural resources in the surrounding, mainly plants.

How do you manage the livestock? During wet season when there is plenty supply of pasture for the livestock the people are never so worried. But as dry season sets in there is trouble yet the livestock must be sustained with regular supply of feed. Thus during dry periods the livestock feed on acacia pods as well as leaves of several trees including ekalale, epetet, erurichanait and ewoi.

It’s the duty of young mature boys to take care of the cattle (cows), but it must be noted that the community must ensure the good health of their livestock at all times. They depend on modern and traditional medicine to treat livestock diseases. Traditional treatment involves use of various herbal remedies derived from a number of trees including echuchuka, egis, emus and eligoi. Among the livestock diseases affecting the community’s pastoral economy are loukoi, emany, lojaa, lokot, lotomee, lomoo, ngiboruok (foot and mouth disease), amil, lonyang, lokot, loidiit.

Emany is a liver disease. Traditionally the people would put a stone on fire and press against the stomach of the sick animal but nowadays they buy modern livestock medicine from Agro-vet stores and shops in Lokichar.

Men bring down leaves from tall trees to feed livestock, provide food for the family (decide on which animals to slaughter or sell and when). More importantly the men are involved in traditional prayers and providing security for the family and community.

You indicated that among the roles of men is the judging cases (pursuing and punishing wrong doers) how do you decide on the cases? When a crime has been committed, for example, a goat has been stolen by someone, the footprints of the suspect is traced (followed) and if found the person is arrested and given preliminary discipline by caning (beating) and asked where he comes from, who his father is and how many they were when stealing the goat(s). He the guides the goat owner to his father (family) once he has revealed his father the goat owner explains the incidence to him and asks him to pay for the stolen goat (normally the charge for such theft is three goats for every stolen one) thus of three people were involved in the theft each of them would be fine three goats! Such punishment helps to deter livestock thefts.

Turning to the females, we must take note of the daily life pattern of activities they are engaged in. The interviewees noted that women especially contributed to the making of homes, spreading sleeping mats, organising the utensils (putting calabashes and plates well), fetching water, preparing and serving food for family use. They also burn and take charcoal to Kasuroi or Lokichar to sell to acquire other essential items for the family. It must be noted that charcoal buyers are not easily available sometimes one has to wait for a number of days before her charcoal is sold. Usually a debe which holds four goro goros (two kilogramme containers) is sold for one hundred shillings while a fifty kilogramme sack which contains five debes goes for five hundred shillings and the money is used to buy maize meal, beans, fat, sugar and tobacco for family use. The women also gather wild fruits for food. For instance, a woman could gather three debes of edung fruits in one instance. Other wild fruits are obtained from ngakalale, ngitit (acacia), esokon, egilae and loarakimak (kill woman). Most of the wild fruits are poisonous and could kill if not properly cooked (edung and elamach fruits are poisonous and must be cooked for several hours to be edible).

Which are the most important cultural sites in the community? There are two important sites: this place where we are conducting the interview is the elder's (note coordinates) and the founder woman's grave (give coordinates). The tree of meeting serves the community as a traditional prayer place, conducting initiations and marriages (negotiations and engagement). All community activities and celebrations are held here officiated by elders and the main elder is called Aleta (present in the interview) and seers (the community has two seers: Nakuyen Ewoton who is a rain seer and Loree Lotone seer of diseases and misfortunes).

How do you approach God? While noting that there existed a number of churches (Maranatha and Catholic) the community still relied on traditional rituals to commune with Akuj (God). For instance, when a member of the community falls sick the family members got together in the family and slaughter an animal and share with god and ask for healing for their son or daughter. The slaughter of an animal is believed to bring the community closer to God. Once slaughtered and roasted the animal is cut into pieces (some of the pieces are thrown about for use by God) and the rest of the meat is shared among those present. Thus, before any meat is eaten the cut pieces are placed in a container and thrown to god by the officiating elder to appease him and ask for his blessing through prayer. After scattering the pieces of meat around the place and sharing with those present, the lead elder or seer chants prayers to God and then people disperse.

7. NAYANAE ENGOL

After the interview at Amaruakwan, we proceeded to Nayanae Egol for another interview for the day. We had twenty six people in attendance for the interview which like the others was tape recorded (using a digital recorder) and photographs taken of the people and the key heritage sites. There were eight men, fifteen women and five children (names of children were never noted unless they were old enough). The interview started a few minutes after eleven o'clock in the morning with the following persons in attendance:

Erupe Marus (VSO)	Alinga Logiron	Aladiko Naburo
Loregai Etidong (VSO)	Lokota Logiron	Atabo Ngimuyok
Longoria Lokaale (VSO)	Nakuwa Lokai	Alice Nakuwa
Lobolia Marus	Amujal Lokwong	Christine Loregai
Elyan Marus	Ekalale Lokuruka	Mary Tenge
Mtomi Mulen	Selina Nasekeny	Ilikwel Akwee
Rose Ekalale	Mary Lagotol	Ekeno Lomojong
Marum Loporucho	Aron Itidong	Elabo Ngitirai
Apese Loponcho	Losen Aiim	

Where did the originators of this community come from? There used to be a palm tree in the area. Tall palm tree had stayed for so long and when these people came here they got the tree and stayed nearby. The place was thus named after the palm tree. The inhabitants of this place belong to the Esonyoka clan. As there are no myths of traditions about the community's origin rather than the palm tree the present generation, being far removed do not remember where the people came from.

Which are the main cultural sites in the community? There are two significant tree sites in the community which act independently from each other: Erilbe Marua's family which uses the ekurichanait and Lorogae Etidong family which also uses it own tree for traditional decisions. The community has two ere: Engenai Engol and Loporucho Alinga. The people go to various churches including SDA, Maranatha and Roman Catholic.

Which trees supply food and medicine to the community? All small and big trees are important to the Turkana people of this area as well as to their livestock (cows, shoats and donkeys). Ewoi leaves, flowers and pods are used as livestock feed (pods are also consumed by the people). Ekalale leaves are feed for livestock while its fruits are used by livestock and people. Ekurichanait leaves and flowers are feed for livestock and pods as food for livestock and people. Etesro (photographed) flowers, leaves and pods are used by livestock. The tree is also medicinal and serves as purgative to removing the stuck placenta when a camel delivers but the placenta fails to come out normally. It is given to the camel to drink after which the placenta is released from the body. People also use etesro while consuming tobacco to retain its taste for long. Tobacco is wrapped in etesro gauzelike pods and put in the mouth and chewed. Leaves of etesro also serve as curative for wounds (the milky fluid from the leaves serve this purpose). Fresh edung leaves are consumed by camels and they are dry and fall down are important feed for goats and donkeys. Edung fruits are gathered by women and boiled for long hours to supply food for the family. Being poisonous the fruits are usually boiled from seven o'clock in the morning to three o'clock in the afternoon to be ready for human consumption. Donkeys feed on barks of edung tree. Eipa which needs support from other trees to grow (always existing near acacia trees) is eaten by camels and goats (which consume the leaves). The tree also serves as toothbrush to the people since it produces superior quality brushes than esekon and is also believed to contain certain germ killing chemicals.

Esokon has three major uses: first, esekon fruits are eaten by livestock and people. Secondly fresh esekon leaves are good feed for camels while the dry leaves are eaten by goats and donkeys. Finally, esekon roots are used to treat stomach ailments (acids, ulcers); they are pounded and put in water and drunk only once to induce vomiting. But the esokon drink also serves as an apetizer (giving one an urge to eat).

Kayep leaves are not only used as feed for livestock they also provides treatment for certain ailment in both people and livestock. Akabekebeke is also very special to the community. It serves purely as camel feed but is also used to produce transport trays used during migrations to carry luggage. Moreover it is also a very effective treatment for snakebites (fluid from the leaves are smeared in the bitten place to remove the poison and fangs stuck in the body).

Eregai is feed for livestock. Esanyanait leaves and branches provide shed for both people and livestock. Apart from serving as animal feed, eragai branches are fencing material for livestock structures but they also serve as ngiminai (used as sweets just like ekunoit whose fluid is tapped and chewed as sweets) for children. Epetet pods, leaves and flowers are important livestock feed. its fluid serves as sweets to children too, but it is also used for treating eye diseases and stomach ailments. Poisonous ebei fruits are boiled like edung to provide food for people, while the leaves are eaten by livestock. Elamach fruits are also boiled for hours to provide food for people while the leaves are eaten by livestock.

What is the importance of wildlife (animals and birds)? Rabbits, squirrels and rock burgers are among the wildlife available here as well as dikdik and numerous birds such as the dove which are edible.

The various roles and functions assigned to men and women in Turkana community reflect the core of their cultural life. For women, core tasks gravitated around burning charcoal, collecting firewood, looking after small stocks (goats and sheep), watering livestock and drawing water for the family use, taking care of children and other domestic responsibilities including cooking, serving children with food and milking livestock (camels, goats, cows). The Turkana woman also goes to shop in Lokichar (buying essential items needed by the family).

Men on the hand oversee various family management matters as well as caring for family livestock, taking care of the family members by providing food during difficult seasons of the year, organising marriage ceremonies, supervising the watering of family livestock, trekking and recovering missing livestock, conducting initiation for young Turkana men and deciding on the marriage of the girls. Custom requires that girls should be given out in marriage in the order of the birth- beginning with the eldest and ending with the last. Men in this community usually have a huge responsibility of proving security for the family, the people and their property largely livestock, making critical decisions affecting the community and solving societal problems such as theft, fighting and quarrels and planning for future activities. It is therefore quite crucial that men must exercise good judgement and provide appropriate solutions to ensure societal prosperity.

What happens when a person dies? When an elderly person dies, his body is put inside the animal kraal and burial ceremonies ensue. First, people mourn and dig the grave, and then the body is buried in the livestock-pen after which the family members are shaved (wives, children and relatives) and cleared to depart and resume normal activities. We should note that during the mourning period nobody is allowed to kill an animal, marry or engage in initiation. It is after cleaning ceremony has been conducted at the funeral that the people are now free to carry out their normal duties. Burial usual takes place early in the morning or in the evening (five to six) and three to four days later the family members and relatives are shaved to mark the end of mourning and allow people to resume normal life.

8. KAPETATUK

We started the meeting with twenty five men some of whom were elderly others looking much younger. There were also four women and two children in the interview. Many more people joined till the number in attendance swelled to thirty nine, some of whom are listed below (see, p. 26). Kapetatuk is considered an important wet season grazing reserve. Those who migrate to graze as far as along the Kenya and Uganda border usually come back here with their large number of cattle. The place is therefore called a place of many livestock. Lomokomar was the founder of this settlement. As a cattle raiser Lomokomar migrated and settled around this place long ago (none of those in the interview would remember how long ago). The people who live here belong to the Nasenyoka (Esonyoka) clan and they have the following five ere: Lomokomar, Aalim, Loporuto, Lomojong, Ekaran and Kooli.

What are the traditional duties of men and women living here and especially in relation to the environment and heritage conservation? Men have always had such central roles as listening and judging cases like theft of shoats (sheep and goats together), conducting initiation ceremonies for young boys, presiding over marriage ceremonies and participating in all important events in the community, helping to resolve disputes in the community, supervising various herding units, land protection including the conservation of the environment. The elders plan land use and demarcate it for ownership among the sub-clans and eres. One elder said, ‘when you look around you will certainly notice that there are many trees here and there is no sign of cutting down of trees here. The elders ensure that those owning portions along the lugga do not destroy the trees because the trees provide the essential needs of their food needs and feed and medicine for our livestock.’ This place receives very little rain and the shrubs and the trees must be seriously protected. When someone cuts down a family tree he is severely canned but when anyone cuts down a tree of another family he is finned ten goats or one camel particularly if the tree is ewoi, edung, esanyanait, ekalale or esokon.

What are the main uses of the primary trees? Ekalale fruits are eaten by livestock and people, but its leaves and flowers are eaten by livestock. Esanyanait pods, leaves and flowers are consumed by livestock during dry season. Ewoi flowers, pods and leaves are used by livestock. Its pods are consumed by people and livestock and its leaves and flowers are essential livestock feed. When an ewoi tree dries up it is used to provide firewood and charcoal for domestic use for cooking and for sale. Esokon is used to supply the people with tooth brushes. Elim tree supplies the materials for construction of various structures and its leaves are eaten by livestock.

Ekurichanait is used to make all the traditional Turkana stools, utensils (plates, cups and spoons). Edweite supplies the same traditional stools and utensils. Edung provides the main food needs of the community, but its fruits must be boiled long enough to make them edible, and so are elamach fruits. Some trees provide medicine to the community. First, echuchuka fluid is used as an effective remedy for stomach problems (acidity and ulcers). It induces vomit through which the sickness fluids are removed from the body. Emus serves the same medicinal function like echuchuka, erodo, echokokile, ekabonyo- all act in the same way as echuchuka inducing vomit and treating stomach ailments.

Where do you get the feathers and what is their importance? Most Turkana men wear huts with ostrich feathers in ordinary life they have little meaning but in traditional ceremonies they serve important marks for the occasion. The feathers are important during marriage ceremonies.

In the initiation of boys which was dramatized, the initiates usually come from helplessness state requiring support to full responsibility of adulthood, they youth must stand up, be strong as they undertake the challenging life encounters.

When does marriage occur and what does it involve? After initiation comes marriage. Marriage begins with engagement (elotol) during which the mother and father of the girl are given a fat rum and tobacco privately by the boy admiring their daughter. When this has been done the engagement is made public and bride-wealth offered to the girl's family. Usually a huge responsibility several relatives and fruits contribute to the bride-price. The normal customary price given includes: a hundred camels, a hundred cows, five hundred goats and one to four donkeys. The marriage ceremony is sealed by killing a bull and putting on the pete around the neck of the wife. The bride is then introduced to the family during which time she is given gifts to start life (gifts of livestock).

When is the girl brought home? Before the bride-wealth is given to the girl's family she should have already left to be with her husband's family (her family of procreation). Once a ram, fat and sugar have been given to the bride's family she is usually grabbed and taken to her new home>

What are the roles of women? Turkana girls and women have similar duties. It is the basic duty of women to construct houses, look after small stock, cut branches of acacia for building family structures and animal sheds, fetching water, preparing hand-dug water-points in the lugga, burn charcoal and sell to acquire other things the family needs that can be contained from shops in Lokichar, cooking for the family, gathering wild fruits and cooking them for the family to eat in the evening.

Which items do women use in the homes? Items used by women in domestic work include Utensils (sufurias for cooking and carrying water, and plates) and water gallons. Young girls made and prepared skins (important traditional clothing), smeared red soil on the hair, bead-making and decorating the beads, watering livestock, supporting the mothers in gathering wild fruits and fetching water for the family, women gave food and water to their husbands.

Gathering Points: Elders Trees
Whenever there is an issue facing the community such as sickness, drought, the elders come together under the tree (ewoi and esanyanait) and slaughter a camel, goat or sheep and share the meat with God and amongst themselves. After sharing the meat the most elderly person stands up with a spear in his right hand and leads the prayer (agata); a special prayer made under adverse condition and conditions of great need. The ceremonies are usually conducted very early in the morning. The animal is killed at midnight and nobody interferes with it till morning when it is cut and roasted, then smaller pieces are cut out and offered to God first after which prayers are made and people disperse. We visited and noted two tree sites: a meeting tree (enter coordinates) and initiation tree (enter coordinates).

There are church adherents who usually go to various churches in Lokichar to pray especially Roman Catholic Church and Reformed Church. Music and dance are usually characteristic of marriage ceremonies. The persons at the interview all indicated that there are no myths or traditions commemorating events in the area.

Attire: Turkana men usually adorn in unique ways and carry several articles with them. The personal items of every Turkana man include; a walking stick, traditional stool, spear for killing animals and notching livestock and is a sign of protection, and a knife (abaidat) with a leather layer used for defence and for cutting meat. Women braid their hair mow-howk style smearing it with oil and ochre. Both men and women wear shukas, beads and bangles of various colours as customary markers. The following individuals were at the interview:

Egiron Ekitoe	Awesit Nangolerupo	Agitait Ekaran
Lokwaoilongormug	Awoi Ikari	Nakuwa Akasukwout
Bogoita Alim	Nangoduk Loyomo	Aperit Nawet
Aliwot Longorimug	Ngikamatak Nakuwa	Lotakuny Longor
Lobolia Ikari	Loyomo Lomojong	Ekaran Ingole
Lopei Alem	Julius Amoja	Lokwama Ikapol
Echaa Lomojong	Taakaem E John	Nakengi Ngakah
Aregae Alim	Longorimug Lotwal	Kisike Alim
Loporicho Lomojong	Lochodo Lomokomar	Ekitoe Ekomwa
Abengo Lojore	Ekaleruk Lomokomar	Lokipi Alim
Ekolan Loyomo	Kooli Esekon	Emuria Loposimong
Namedi Nakuwa	Lokeno Alimikai	Losingen Loposimong
Akiru Lomojong	Lomojong	Ekiru Epuu

9. LOMOKOMAR

We had another interview on the twenty six at Lomokomar. We started off with four elders, five women and five children and the others joined later.

Lomokomar is the name of the elder who started living here long ago. Many people and generations existed before we were ever born they said. Lomokomar derives from abnormal horns: one normal and the other overturned. The people are Esonyoka clan and there are four ere in Lomokomar: Loputiro, Ekaran, Engole and Emaniman.

History: when did the first settler in Lomokomar come and where did he come from? The interviewed group did not know when Lomokomar settled here and where he came from. They do not remember any myth or story narrating such event.

What are the major roles of family members? A Turkana family is made up of a father, his wives, children and livestock. The people treasure large families and are therefore polygynous. One of the elders indicated that a typical Turkana family could have ten women and twenty or more children.

Birth and Childhood: when a child is born a ceremony is performed to welcome the child into the family. A ram is killed and eaten together with edung, but this is basically a women ceremony where only women participate. After welcoming the birth there is a period of seclusion for the mother and the newborn. Thus another ceremony of reintegration (inviting them out of isolation from the rest of the community) is performed. It involves the slaughter of a goat and cooking of animal fat which the women share and the kid is shaved by the first woman of the family. It is after shaving that the child could be given to other people to carry the child is also taken to the father. Naming is usually done immediately after birth. Names are called out and any name that will be mentioned and the child begins to suckle will be the name of the child. Children are also named after other people, events, trees under which a birth takes place (e.g. ekalale, esanyanait, etis, eregai etc). The main food for children is breast milk, milk and fat from livestock. As they grow up children are taught appropriate roles related to homemaking and the pastoral economy while girls fetch water and water livestock, boys herd the livestock and defend the community.

When does one become an **Adult**? The maturity of children is noticed by the physical changes happening to their bodies as they mature the boys concentrate in livestock herding and later after asapan (initiation) they become adults allowed to marry and take men’s chores. As with boys, girls’ physical changes are noted: development of breasts and they are charged with fetching water and buying items from the market for family use. The girls are never initiated.

What is involved in **Initiation**? The climax of this central traditional process, young people sit down together under a tree and lean on it. Animals are slaughtered and initiates and elders share the meat. After that the initiates are smeared with dung from the slaughtered animal and then sprayed with water. The water is held in a wooden container and splashed out by the elder on the initiates using a calabash. The most elderly person living officiates the ceremony (the elder was said to be over a hundred years old officiated such events). The event usually starts from around ten am and ends by midday basically for security reasons and if it goes beyond that time it would not be blessed by God. Every initiate must be taken by a guardian. Note that when they sat under the tree they had to be supported to get up. The guardian takes the initiate for several days and introduces him to the world and shows him all things that he needs to know: livestock (goats, sheep, camels, cows, and donkeys), various plants and food items like milk. The initiate used to take seven days with the guardian but today due to various commitments of the elders the periods lasts for only four days. Consumption of millet, sorghum, local brew (ngimeturana) is usually greater.

Roles of married men: Men are the pillar of Turkana nation providing security, medical needs during sickness, supervising and liaising with other elders from nearby eres on issues related to grazing and security.

How are disputes resolved? One of the possible problems faced by the community relates to adultery. When this is noticed the culprits are arrested and brought to the tree of elders and interrogated to confirm the allegations. If found guilty they are severely punished: both are canned and forced to sit in the hot sun for several hours, but the man must also pay a fine almost equivalent to the customary bride-price paid (five hundred shoats, twenty cows, twenty camels)- the bride-wealth typically includes two hundred to four hundred goats, thirty cows and forty camels.

What are the **Roles of Women** in your community? Women are active members of the community involved in constructing houses, homestead structures, fetching water for livestock, collecting fuel-wood for cooking, watering livestock, burning and selling of charcoal, looking after goats, shaking the trees for pods and leaves for feeding the livestock, going shopping, taking care of children and sick persons and cooking and serving them with food. When a woman takes charcoal to Lokichar it is sold to acquire maize flour, beans, sugar and tobacco for the family. In many occasions the women gather wild fruits like edung and cook them to provide food for the family. Cooking and serving meals for the family is a key duty of every married woman.

Which churches are found here? Catholic, Reformed Church, PAG and SDA are the main churches in Lomokomar.

While the community insists there are no myths, they have songs and dances which are usually characteristic of the wet season when the community has enough pasture and water and during happy moments like marriage ceremonies.

Important **Cultural Sites** noted include: Tree where elders (36N 0802388 0267991) meet to discuss community matters and conduct marriage ceremonies and Lomokomar grave (36N 0801424 0267021).

The Lomokomar interview was attended by the following thirteen persons from the community:

Lowar Loputiro	Akuwom Ekaran	Ekuwom Lonyami
Lpatiro Esil	Esekon Kamais	Atiir Ekales
Ekaran Longech	Atebo Ngamuyok	Awoi Amaler
Erupe Ngasike	Ekudud Ngasitae	
Epeyon Lochodo	Akure Lowoi	

10. DAPAR

We started off with eleven men. We did not go with Lucas Ariong for the interview because he was attending some training.

Dapar is an area with a big river and the place had dense forest. It was a very risky place where thugs would stalk and waylay people. The name echoes the risky area of mugging and death.

Dapar has the following eight ere: Esokuoy, Losantei, Lomariamgei, Naduito, Nabulucha, Dapar, Remremee, and Karepum.

Lomokori, Nakwa, Komol, Kalimnyam, Echwaa, Namacharin, Lopole, Esekon, Ngataikwan, Murkwel, Lamuuk, Etubokori, Etwen and Kangole are the main (sub-clans elders?). The people interviewed indicated that in Dapar today there are three main churches: KAG, Full Gospel and Agape.

How did the people of Dapar worship God in the past? Before the Christian churches came the people sought help from Akuj to help their life, their livestock and their children. The community members came together and called upon God to heal them and to return anything or animal that was stolen from them. An elderly man would come before God with members of his community under the elders' tree of meeting and ceremonies and slaughtered a goat and shared the meat. To seek God's face during sickness, pieces of meat cut off from every part of the slaughtered animal would be offered to God and the prayers said whenever there was need. But the community also relied on herbal medicine to address health problems. They used lorodo to treat *lobute* (swellings), *egong* (diarrhoea) and chest problems. Lorodo tubers and roots are pounded and its liquid drunk while the rest put in water for bathing. The medicine is very sharp in taste.

Men's work: very old men were not assigned heavy duties apart from participating in community rituals and ceremonies. Men in general oversaw the care of livestock and ensuring security to the families.

Women built structures for both livestock and people, fetching water and collecting firewood for cooking and selling in town (at fifty shillings a bundle). They also burn charcoal and sell (about two hundred a debe) to obtain food items for the family; women also prepare and serve meals to family members.

What are the **Main Foods** used by the community and their livestock? Livestock is the main source for food for the Turkana people supplying their meat, blood, milk and fat. Shoats are the most commonly slaughtered being numerous. Various plants also provide food for both the people and livestock. Edung is collected and put in water and cooked for several hours to remove their bitterness. Edung leaves are consumed by livestock. Edung, ewoi and ekurchanait are the most important plants providing food for people and livestock. Ekurchanait and eminae roots and pods are used as medicine and food while ekwangorong is eaten by livestock only. Ekurchanait also provides timber for producing containers, spoons and milking containers.

What are the main duties of men? Turkana men in Dapar as others engage in the care and management livestock and family and community. Accidental fights are resolved by compensation and fine of thirty goats is usually given to the person who has been wrongfully injured by another. Men listen to various families and community disputes (resolving conflicts between one ere and another) by bringing them together and discussing their issues. Those who provoke disputes are usually rebuked and serious troublemakers forced out of the community. For theft of livestock the elders ensure that compensation is made to the offended. The tree of elders serves as primary centre for meetings and customary activities like initiation and marriage which are officiated by elders.

Marriage: being polygynous the community members usually marry from two to ten women> when they still have little children they usually stay together but when the children grow older the homes are distributed around the lugga and remain close to one another for support during times of trouble and difficulties. When women have quarrels amongst themselves they are usually canned by their husbands. A man would always inform his wife of the need to have additional hands to help with the care of livestock, this way a man keeps his family larger and larger. It is not proper for a man to marry his wife's sister. When a boy grows up he weighs himself and if fit physically and materially, goes ahead to marry and pay requisite bride-wealth: one hundred camels, two hundred goats, fifty cows and ten donkeys. He buys rings of beads of different colours and neck rings and goes to the girl's family with sheep, sugar and tobacco. Interethnic marriage is not encouraged. The people emphasized that a Pokot girl would not be married by a Turkana man.

Death: when a person has died he is carried to his home. A grave is dug in the livestock pen where the body is buried and some livestock are slaughtered and consumed. The widows and their children are usually cared for by the brother of the deceased. Children remain with their mothers. Graves are markers of dead members of the community. Graves are only dug for the elderly people only. There are several graves in Dapar: Nakwa and Lukwel graves were marked.

Cultural Sites of **Dapar** include: an acacia Tree of Meeting and Rituals (36N 079695 0256422), and three graves- Illikwel grave (36N 0798966 0256062) and Echwa grave (36N 0797684 0256071) and another (36N 0796812 0256365).

11. LOWOIDAPAL

After the interview with the elders of Dapar we proceeded to interview the people of Lowoidapal. The following were present for the interview: Nakwa Lomojong, Esokon Erka Ewoi Lonyalang, Etit Erika, John Ekitala, Lodeng Lomojong, Logok Lomojong, Lorot Emate, Ebei Ekuru, Lokomol Ekwong, Echakan Ngataikale, Lokiru Kibakte, Esinyen Ome, Jackson Lukiria, Elim Elifan and Lokee Ongoleyo.

History: The origins of Lowoidapal is unknown. The people maintain that they have always lived here over several generations. The founder of the Lowoidapal was a man called Lomojong Lomekere who had ten wives: Atai Ekare, Nakwa, Loyomo, Ekeno, Akeru, Achwe, Maruch, Namoni, Lokorita and Iteleng.

Lowoidapal has sixteen ere namely: Kiongomo, Naskarakiru, Esalotir, Nanyania, Nasomokoboko, Natwel, Ekunoit, Naitiokol, Kalemnyang, Napalagatao, Nayienere, Naiyene, Ekale, Lomokori, Ngakakimok, Lobei Angmanki and Namuniio.

Community Duties: Children take care of the small goats and sheep. Women collect water for family use and for cooking, they build home structures (houses for people and pens for livestock, burn and take charcoal to town and prepare meals for the family. Men organise initiations and marriages, solve community problems such as theft of livestock and discipline erring family members. When someone's child steals another family's goat he spoken to and property returned to that family. In marriage men help with negotiations and pay dowry.

Environment and Food: Various trees provide food for the people and their livestock as well as medicine for their continued health. Emus (the thorny plants) are first roasted over the fire to remove the thorns. It is then pounded with stone and put in water to boil and mixed with milk and drunk- only one cup helps one to remain healthy for up to two years! It induces diarrhoea which then relives the individual of the trouble causing fluids. Epong (only found in the hills) is useful for curing worms (*minyoo*) and stomach problems. It also heals joint pains and eases delivery in camels but it is highly poisonous and must be taken with great caution; it must be boiled and the top cream removed and thrown away. The sieved clear solution is drunk. The people consume engomo, ewoi, edung, engiminae, ekaliko, epat, ekalio, elap, elamach. Ewoi, ekalale and dung are the most important. Ewoi is pounded and added with milk and eaten> it is believed to satisfy hunger and keeps one satisfied for long. Ekalale is pound with stone and to is added milk, blood, fat and flour to make a firm paste which is very delicious and keeps one satisfied for long. Around October, edung becomes plentiful. It is collected and cooked in large sufurias for sharing with everyone. All Turkana foods are shared> but some foods are restricted especially entrails are never eaten by pregnant women as it is believed to bring bad omen and deformities.

Enemy Attack: Each member of the family remains alert to any security threat. Strangers are monitored to know their intentions. In this community Ejakan (an elder) looks into such matters.

How do you approach God which churches are found here? People today approach God through church services. There are Roman Catholic, AIC and Apostolic. Before the churches came the elders would raise their hands and ask god to help them especially if a child was sick or livestock missing. They would slaughter an animal (usually sheep of goat) at the elders' tree after which the elder would call upon god to intervene and restore the child's health or return the livestock safely.

The **Cultural Sites of Lowoidapal** that were documented include**:** Ritual Tree (36N 0806523

0259019) and four graves- Akwaita Grave (36N 0805747 0259701), Eromul Mokrion Grave (36N 0806088 0267991), Jalinga Grave (36N 0802388 0267991) and Emuk Ekwakore Ekale Grave (36N 0802388 0258976). Amaler's Grave was not visited due to shortage of time.

12. KALOUCHOLIM

The interview was carried out on the 28th July2016 and the following thirty four people were in attendance (thirty-one men and three children):

Ailet Lotukoi (VSO)	Ekeno Kamar	Naikon Nakwan
Ekai Etidong	Eyanae Kula	Ekadeli Echwa
Alerinyang Lowoton	Eligoi Lotwae	Ekwom Eserum
Emaniman Agurum	Ngimuz Adoro	Amaler Naato
Ngiduruko Lopong	Kapelo Alemuu	Ewolete Lowote
Chom Ebach	Ngipeyok Kapela	Alewot Alema
Erupe Lowoton	Esinyen Lodio	Agerio Lodio
Nanjak Epur	Lokinyi Edome	Kimat Illikwel
Lokaru Eiton	Lodes Lopong	and three children.
Lokwee Nakoo	Ereng Lodio	
Moru Lotukoi	Erupe Kula	

The founders of Koloucholem included Lopuda Kare, Lelea Etidong, Eremon, Edome, Adero, Kapokor, Kula and Naaton Echwaba. They belong to the Esonyoka clan and have the following ere: Ekai, Lokonyi, Nakwan, Kwam, Najak, Aliwot, Erupe, Esinyen, Lolimi, Lokwee, Kimat, Esokon, Ekal, Amagae, Lokaru, Kapelo, Akuma and Iwalete.

Origins: None of the people resent remembers where their ancestors came from. There is no myth or legend about Kolouchalim but they have songs and dances performed during events like marriage but there is no singing in initiation.

What happens during **Initiation and Marriage**? Sharing of meat from slaughtered animals, fat from cows, milk, sugar, tobacco, millet, maize flour and the ceremony ends with prayers from an elder. Initiations are usually done in groups among the people present in the interview five had recently undergone initiation.

Marriage: marriage begins with young men having secret relations with the girls. Sometimes such relations were discovered they would be punished severely. Turkana customs require that an elder brother must marry before the younger. Thus if it is found that the boy has an unmarried brother he would not be allowed to marry the girl until his brother is officially married. Official marriage is commissioned by the father. The father would invite his wives, sons and tell the family that one of them was ready to get married and he is ready to pay the requisite bride-wealth. The mothers would then disclose the identity of the girl and the family would go ahead to debate to accept or reject her.

After this and especially when they are in agreement that the girl was suitable to join their family. The father then sends an envoy for engagement and allows the two families to sit together. Meanwhile the boy would be in the fields herding cattle. For this engagement meeting there must be rams depending on how large the girl's family is but normally four to five rams and the same for tobacco. The rams would be slaughtered and served to the girl's parents and then the girl's family would also slaughter an animal for the boy's parents. At this stage the family of the girl asks whether the suitors were ready for marriage and if they had the stipulated number of bride-wealth: sixty camels for rich people or twenty to thirty for not so wealthy, forty cows for rich families or twenty for not so rich, four hundred shoats for wealth families or one hundred to two hundred for the poorer families and ten donkeys for rich families or five for the not so rich families. The bride-wealth would be shared among the family members systematically. The beneficiaries of such a wealth would be the following: elderly brother of the girl's father, the father of the girl, mother of the girl, uncles, girl's brothers and aunts. The elderly brother of the girl's father would for instance get ten camels, twenty goats, ten cows and a donkey.

Roles of a wife: as other women a marriage girl would engage in milking animals, watering livestock, bring water for family use, collecting firewood, cooking food and cleaning utensils.

Which are the consumed foods? Livestock (provides meat, fat, milk and blood) and plants (edung, esokon, ekalale, ewoi, emekwi and ergai) and are the main foods of the Turkana people. Edung fruits for food to people and livestock, herbs to treat ailments and leaves for livestock. Esokon fruits for people, leaves for livestock and roots for medical care for the sick people and livestock. Ekalale fruits for people, roots for medical care and leaves for livestock.
Ewoi pods and fruits for people and flowers and leaves for livestock; black discharge is used for drinks (put in water and boiled as sugar and milk are added to it). Emekwi is main food for camels and donkeys. Ereng for people's toothbrushes, pods for people, leaves for livestock and construction materials for people's houses and livestock structures.

Because of the great value the Turkana people attach to trees they do not cut trees down or burn charcoal in Kaloucholim. The community takes care of their animals and children in the same way they do their trees from which their livelihood derives. When a person cuts down a tree he is severely punished by canning and a fine of a camel or two cows. In like manner, the community hopes that their heritage will continue to be protected. Thus the men have huge responsibilities in the society: ensure the continued preservation of the environment, care for the sick both livestock and people, by offering traditional remedies derived from plants especially esokon roots (but if the ailment persists, the sick are referred to Lokichar).

How are ersokon roots/tubers obtained and prepared? The tubers are dug from the soil, smashed and put in water, allowed to rest for sometime before being administered on the sick. It is then drink as prescribed - half two hundred and fifty grammes container for children and the full tin cup for adults.

Death: Should an individual die he or she would be given a suitable burial. Small children are buried immediately while elderly persons are buried after one day; the grave is usually dug by young men. they dig the grave in the morning or in the evening between four and six pm. mourning period takes one month and is usually at individual level, there are usually no large gatherings as happens during traditional ceremonies are held (initiation and marriage) not being well managed or the people not living to the stipulated customs. For instance, one someone dreams that the deceased relative needs food an animal is slaughtered immediately and taken to the dead person's grave and the rest of the meat is shared by those present. Usually meat, tobacco, sugar and fat are poured on the grave as gifts to the dead.

Churches and Family Problems: Kolouchachalim people adhere to such churches as Roman Catholic and Maranatha which are in Nakukulas as well as Apostolic and Legio (Legio Maria which is basically found in Lokichar). Family problems range from theft (akoko), scrambling for water -points and pasturelands, rape. In rape cases perpetrators are arrested, interrogated and punished- the man is usually fined several livestock equivalent to what was given as bride-wealth for married women. For girls the offender is charged two bulls which are then eaten by the elders. For conflicts related to water-points and pasturelands the issues are usually brought before the elders who listen to the intricacies of the conflict and prescribe appropriate penalty.

Two Cultural Sites were noted in kolouchalim: Elders Tree (36N 0802388 0267991) and Lopudakare Grave (36N 0804707 0257236).

13. KAAROGE SEER (ACHUKA MZEE, ALIAS ACHERIASE)

Paul Wheeler-house, Lucas Ariong and I were driven to Kaaroge the morning 1st August 2016 in a rather cooler weather than usual as it had rained in the night and early morning. Achuka Mzee welcomed us to his home. We presented him with the requisite gift (a white ram, two sheets wrappers (Maasai Shukas), sugar, tea leaves and maize meal). We then embarked on the interview as Paul took photos of the seer and his home, his livestock and filmed the interview in some phases. I also administered the interview, took pictures and recorded the interview, taking some notes with an audio recorder as Lucas made the translations. The family of Achuka was present. We took pictures of the compound, the livestock, the wives, children (four sons, Ekal Mzee, Ekalonon Lukwawi, Esekon Ahuka and Daniel Achuka were photographed with their father after the interview at about eleven o'clock.

Achuka was nicknamed Acheriase after the brown sports in his favourite white bull. Achuka has several livestock in his home but his cattle are held on the hilly grasslands to the west. Achuka had a big white bull with such sports. The Turkana call brown sports in livestock *ariase*.

Achuka's father was called Mzee Lomeyananaa. Mzee (Achuk's father) had a large family: four wives and several children. Achuka was born to Mzee's first wife. Achuka's mother had four sons all of whom are now dead except Achuka. The second wife of Mzee had three sons, the third had one son and the fourth had a son and two daughters. In brief Achuka's father had four wives who gave birth to eleven children altogether. All the second mother children are also dead but they have left behind grandchildren. The third mother s son is alive but not interested with traditional matters. Of the three children of Achuka's fourth mother only one daughter is still alive (brother and sister passed away). In summary, Achuka has two siblings who are still alive- the sister who is married to Nawakring family and the brother from the third mother. Achuka s father was a seer of the Kamat clan. Achuka is now the one continuing the legacy of his father.

Why were you chosen to succeed your father as a seer? *To become a seer one has to receive a blessing following a sequence which has now seen him as a seer after his third brother passed away, he received the blessing to become the seer of Kaaroge. His living brother who lives in Turkwel River at Kalimnyam was non-cooperative and defiant to traditional Turkana customs though of nearly equal age with him could therefore not become a seer.*

Where did your family come from before you settled here? *They originated from Loima as Ngimatak clan. They first settled at Lochwaa before coming to Kaaroge*.

What made your people move from Loima? *Our people migrated from there because they were searching for water and pasture for their livestock. Lochwaa has a perennial spring of water which never dried and the place was therefore called Echwaa Ngimatak.*

What means of transport did you use during that migration from Loima? 'Our people used donkeys to transport our personal belongings and to date donkeys continue to be used for such service. Do you have donkeys? *I have a few donkeys and they have gone grazing that is why you haven't been able to see them.*

Which other livestock do you have? *I have all types of lives (camels, cattle, goats and sheep. My cattle are kept at the northwest as cattle cannot survive here in plains because there is insufficient pasture.*

What is the value of chicken I have seen some chicken and dogs in your home? *Chicken for me are valueless. In fact, a want they taken away from here, they are merely used by children who love them dearly and who sometimes eat them. My family loves dogs. The dogs help catch squirrels and rabbits which children also eat. Dogs also assist us with grazing livestock.*

How large is your family? *I have a large family: two wives and several children> my two wives live in this compound with me.*

What kind of work do you do? *I have many responsibilities. I listen to and make judgements over family cases and advising my family members on how best to get out of problems and live good lives. I also assist with negotiations during the marriage of my daughters< talking to the family of my daughters' admirers and giving them over to their families. I also have an honourable responsibility of providing food for my family that is why I have the livestock (camels, goats, and sheep) that you just saw leaving for grazing. These animals are also used to pay bride-price to the families of the girls who get married to my sons. I also serve an important function as a seer of Kaaroge, reading intestines of slaughtered livestock, interpreting phenomena from shoe patterns and dreams.*

Judgements: In serving the mandate of listening to and judging cases, which are some of the cases you have dealt with? *I have handled many cases touching on marriages, theft, adultery committed in the family and fights with neighbours.*

How do you handle fights? *Cases involving fighting are brought before me. I listen to them well carefully and give appropriate advice especially that such fights should not be repeated and prescribing solutions usually a fine of a goat. That goat is taken to the elders who slaughter it and roast it and eat to show reconciliation.*

How is theft handled? *For theft cases I listen to both the complainant and the accused and make appropriate judgement. Usually a fine of two goats for every goat stolen is levied on the offender. When facts prevail but the accused persistently refuses to accept, he is canned until he admits stealing. It is the boy's brothers who will cane him in the present of the elders and after he admits to the theft he is asked to pay the fine which is then given to the offended individual or family.*

How do you deal with cases of adultery? *Once such a case has been brought to my attention, I call two other elders to help me listen and judge the case well. If the accused is proved guilty of such offence he is finned a certain number of livestock and then warned to keep away from the woman. The fine for adultery is forty-two animals: thirty shoats, five camels, five cows and two donkeys. This fine is given to the members of the family of the woman who was defiled, and is subsequently shared out freely by that family. The woman or girl is usually canned by her parents and relatives (not the husband s family). It should be noted that the adulterous man having been warned but persists in the act will eventually die.*

How long does it take to resolve *a case such as adultery?* The adultery case usually lasts for ten days.

Please, now tell us about your work as a seer: how do you read the intestines, work with the shoes and handle dreams?

Reading intestines: *Whenever a goat has been slaughtered the intestines are placed on a flat surface read. The things that are usually seen are rain, drought, diseases, war, conflicts or raids. Whenever I see any of the above problems I summon the affected family or section of the community and disclose the matter to them and advise them appropriately on what to do to avert* *the impending problem as soon as possible, for example, to migrate in case of a raid or drought or kill another goat and conduct a fitting ritual to prevent the occurrence of disease or invasion. In case of a disease problem in a certain family, the family is advised on what to do whether to slaughter an animal in the night and sprinkle water on the affected or to gather at the elder's tree and conduct the ritual slaughter there. The slaughtered animal must be of a specified colour and gender as prescribed in the reading (e>g a black female goat or a white male goat.*

Shoes: The pair of sandals is place on the ground and some tobacco is put on them before casting the pair of shoes. The resultant pattern formed as they land on the ground will be read and prescriptions made. The brown leather sandals were passed on to me from my father Mzee. They are made of giraffe hide. If the shoes spread out without lying on the other, it is understood that there is no trouble. But if they are touching at a certain inclination or upturned there is a problem- it could be a flood, drought, sickness or raid.

What is the role of tobacco in this activity? Tobacco is used to solicit permission from my father to give me an understanding of trends in the family health and advise on prescriptions for identified problems.

What might you see in case of drought? When drought is detected there may be advise to emigrate, or ask an elderly person to come and pray in a traditional way (slaughter an animal, give pieces out Akuj (God) and share the rest of the meat with people present and pray. For invasions, the people may be advised to migrate to safer places or to ready themselves to fight the enemy. In that case the warriors (*ngingiroko*) are prepared by giving them weapons and advised on effective strategies to fight and win over the enemy.

Dreams: *Whenever I have a dream relating to any matter (be it floods, drought, disease outbreak), I am also given ways to address and solve the problem(s). The same dream may, for instance, advise that it is best for the community to migrate. In these dreams I believe it is my father (Mzee) who comes to me occasionally to help the community with impending problems. I have had a number of dreams in the recent past. I dreamt about a Whiteman coming for oil exploration and for the seismic cables which came to me as auno (string) and in the case of the* *perennial Pokot-Turkana conflicts. I dreamt that two brothers who have been fighting for so long sharing one plate in the form of blood of a white cow. The dream meant that peace and harmony had been restored among warring groups.*

What items do you use for your work? *I use a number of items while performing my work as a seer. I must dress up in traditional regalia as you see, have a bull's horn (*amwara*) in which tobacco is contained, shows (a pair of giraffe sandals), a long horn with a cows tail which is a symbol of authority as a seer and it also holds some tobacco, a spear which symbolizes power and a walking stick which is a normal item for all Turkana men.*

In relation to officiating core community cultural functions as initiation and marriage, what is your role in these? I do not officiate any of the above functions but other elders do so. I only go to these ceremonies as a participant if and when I am invited.

How is initiation done? *Normally the group of people to be initiated comes together bringing with them presents* to the place where the ceremony would take place. Each initiation candidate comes with a goats, tobacco, new sheets, beads, animal fat. When they are ready, each slaughters his animal and all slaughtered animals are roasted and shared out among the them and officiating elders. The initiates sit down next to a tree with their arms at the back and legs stretched out in front of them. While at such a position the most elderly person officiating the ceremony says a traditional prayer and water is sprinkled the initiates, two elders the help the initiates to stand (get up).

How is the initiation food shared? *There are two classes of food and items brought into the initiation forum: first are the animals each candidate brings a goat for the ceremony, which is killed, roasted and shared as a common meal for the people present at the ceremony. The other items include tobacco, sugar, beads, sheets and shoes which are given to the guardians (sponsors of the initiates).*

When does initiation take place? Turkana initiations take place from nine o'clock *in the morning till midday and must not go beyond the stipulated time otherwise the ceremony must be repeated* *if the time is passed. Tradition specifies that initiation ceremonies must last until midday and any ceremony that goes beyond such stipulated is considered a failed even which then must be redone.*

When does marriage take place? What happens during such event? When a son of my family wants to marry he identifies a suitable girl from a family in another clan. I then organise the engagement team to visit the in-laws (the family of the girl). During engagement if the family is large two rams are slaughtered but is it is small only one ram would be slaughtered and eaten. In each case a bunda (a kilo) of tobacco is given to that family and serves as a binding factor, just as is performed at birth to bring together the new born with the world and family.
After engagement they return home to collect livestock for the bride-wealth. The bride-price is varied between the rich and the poor: whereas the poor give out thirty to forty shoats, the rich give two hundred to four hundred, thirty to fifty camels for the rich or tent to twenty for the poor, fifty to a hundred cattle for the rich or as few as ten for the poorer, and ten donkeys for the rich or two to five for the poor.

What are camels used for in the Turkana community? *Camels are significant in Turkana as a sign of permanent relationship as it survives anywhere and provides plenty of milk. Camels are given as bride-wealth during marriage, but also camels are given to friends and brothers as a symbol of genuine friendship and trust.*

What is the importance of community trees? The Turkana people love trees very much. They rest under them to escape the scourging heat of the sun. But more importantly there are trees where community ceremonies and significant functions are held. Every section of the community has an elder s tree where initiations and community cases are discussed and settled. The most important trees to the Turkana people are ewoi, ekalale, elim and edome (in order of their value in the community, beginning with the most important to the least).

How does the community deal with diseases and death? *The community relies on traditional and modern ways of dealing with these critical matters of existence. When a problem of grave magnitude such as disease or threat of death is experienced or revealed to the community by the* *seer by either reading of intestines, shoes or dreams, other elders are invited to the victim's home and a goat or sheep of a preferred colour and gender as directed by the seer is slaughtered, roasted and small pieces of meat cut out from various parts of the carcass is thrown about randomly by the officiating elder (seer). Finally, a prayer is conducted by him or someone delegated to do so. The prayer is called agata. After the prayers, water is given in a calabash to the seer who proceeds to sprinkle it on the sick person to cleanse him or her from sickness or impending death. For a sick animal roots from specified trees are extracted smashed and soaked in water and given to the animal to drink. The plants mostly used for treatment are egis, etestro, echuchuka and eligoi. Today, however, some people rely on veterinary services and medicines as well.*

How do the Turkana perceive death? *For the Turkana death is perceived as a bad thing. When a child dies it is mourned and buried immediately after digging the grave. The grave is dug by the brothers or family members. For an elderly person the burial could be done the same day in the evening or early in the morning of the next day. When an elder has been buried, animals are killed and eaten. The family members are shaved a day after the burial. The grave is also usually dug by family members or young men. There are usually no prayers. The mourning period lasts for five to seven days. When the man dies the widows are isolated in a closed room for a while and will only come out when they have been shaved. Shaving the family after a member of the family has died symbolizes that a close family member has died and the family must be cleansed by shaving so that the misfortune could be kept at bay. Whereas only the forehead of initiates are shave at initiation, for deaths the entire hair must be shaved leaving only a narrow strip at the centre.*

14. SUMMARY AND CONCLUSIONS

The interviews with the remainder of the South Turkana community were done from the twenty first of July to the first of August 2016. All the planned communities were visited and interviews conducted except at Tirikol where the people refused to talk with us as their elder was not around. We returned a week later but the elder had not returned. The interviews followed the prepared guide noting the villages, dates and times of interviews as reflected in the pictures of interviewees and digital audio records, and coordinates of significant cultural sites (elder s trees and graves) were taken using a GPS and noted (Annex 2 & 3).

The persons attending the interview were counted and names recorded (see lists under each village and Annex 1 column three). The interview centred on settlement and land use, religion and beliefs and the intangible cultural heritage. It took a life cycle, environmental and roles approaches- touching especially on birth, initiation, marriage, death, livestock management, livestock and people s foods, medical care, roles of children (boys and girls), women and men and finally the place and work of seers, for which the seer of Kaaroge, Achuka Mzee, was selected and interviewed as the climax of all the work for the second phase of community consultative forum as a basis for environmental and social impact assessment (ESIA) as required by law to evaluate the impact of oil production (explorations, discovery, drilling, transportation and processing and eventually sale), background information about the Tullow Oil activities in Kenya was distributed during the interviews.

The results depict a similar pattern with the first phase and the data from this phase will enrich and clarify some of the information obtained in April. For instance, the various pictures capturing recent cultural activities confirm the vivid ceremony we witnessed in Nakukulas. This indicates a similitude of the ritual process over the region. The most common clan is Esonyoka and the eres vary from four to sixteen (Annex 5). There are several churches (Annex 6) which are likely to infuse new traditions and thoughts in the community alongside the schools and may soon contribute to slow culture change. Already there are new housing forms using modern materials (iron sheets, blocks, and tiles). As indicated in the previous phase, the information contained in these pages may suffer from typographical errors or translation. Much effort was made to capture the facts as closely as possible but some gaps may remain, nevertheless. We would like to thank all elders, men, women and children who volunteered useful information to us. We also thank Tullow for hosting us in Kapese and financing the survey.

APPENDICES

Annex 1: Summary of Interviews by Date, Villages and Number Interviewees

Date	Village	Number of Interviewees	Photo Number DSCN	Digital Record	Notes
21/7/2016	Kasuroi	36	7264, 7265, 7267	18	Very productive. It had the second largest number of people at the interview.
22/7/2016	Nawoiyalim	6	7326,7327,7335-7340, 7343	19	Despite being least attended, it was also very productive and the voices of women echoed their heritage.
	Akibuket	20	7382-7403	20	Very productive
23/72016	Tirikol	12	-	-	Three men, five women and four children gathered but could not speak to us because their elder was not around.
	Kaikol	16	7406-7419,7442-7448	21	Very productive
25/7/2016	Amoruakwan	27	7449-7489	22	Very productive
	Nayanae Engol	26	7518-7536, 7540-7552, 7554	23	Very productive
26/7/2016	Kapetatuk	39	7570-7607	24	Very productive and had the highest number of people in attendance.
	Lomokomar	13	7616-7625, 7628	25	Very productive
27/7/2016	Dapar	9	7642-7654, 7658-7672	26	Very productive. We took down only two names. The pictures can give the exact number in

					attendance.
	Lowoidapal	16	7674-7677, 7737, 7769-7780, 7817-7823, 7829, 7831	27	Very productive
28/7/2016	Kolouchalem	34	7852,7864,7866-7917,7921-7926, 7931-7935	28a, 28b	Very productive
29/7/2016	Tirikol & Kimirik	-	-	-	The Tirikol elder was still away. The other village was just the same as Kasuroi. There was no one in Kimirik
1/8/2016	Kaaroge	6		30	Very productive. We got the seer and saw his livestock and family. He demonstrated how he works with sandals to foretell events.
Total	13	260		13	Successful interviews with useful data highlighting the Turkana cultural heritage

Annex 2: Elders' Trees by Village and Coordinates

Village	Tree	Location	Notes
Kasuroi	Ekurchanite	36N 0795893 0273925	
	Ekurichanait and Esekon	36N 0796170 0273945	Central meeting spot.
	Acacia	36N 0795841 0274890	Participants in a ceremony gather under the three acacia where they share meat.
Nawoiyalim	Acacia	36N 0801022 0283306	Central meeting spot.
Akibuket		36N 0798613 0281876	Central meeting spot.
Tirikol	-	-	-
Kaikol	Ekalale	36N 0800102 0275532	Central meeting spot.
	Acacia	36N 0800105 0275538	There are three acacia and another ekakale. The elders sit between two acacia and ekalale.
Amoruakwan	Acacia	36N 0797497 0272123	Central meeting spot for first family group on the west
Nayanae Engol		36N 0800098 0269245	Central meeting spot.
	Acacia	36N 0800381 0269353	Used by Maranatha Church for its services.
			Central meeting spot for family group on the east was not visited
Kapetatuk	Acacia	36N 0800744 0267087	Central meeting spot.
	Acacia	36N 0800871 0267320	Recent ritual activity noted- an initiation ceremony.
Lomokomar	Acacia	36N 0802388 0267991	Central meeting spot. There are five other satellite trees nearby.
Dapar	Acacia	36N 0796995 0256422	Recent ritual activity noted an initiation ceremony.
Lowoidapal	Acacia	36N 0806523 0259019	Recent ritual activity noted
Kolouchalem	Acacia	36N 0804870 0251194	Recent ritual activity noted an initiation ceremony.
	Ewoi	36N 0804872 0251189	

Annex 3: Graves by Village and Coordinates

Village	Grave Name	Location	Notes
Kasuroi	?		
Nawoiyalim	Aman Lochuch	36N 0800634 0282848	
Akibuket	Nachokopwa	36N 0798613 0281876	
Tirikol	-	-	
Kaikol	Losil Nasenya	36N 0800323 0275772	Nasenya was a seer and founder of Kaikol settlement. The grave is visited by the community whenever there is need especially on Sundays. They come with sugar, tobacco, and slaughter a goat and ritual activities are presided over by the eldest son living.
Amoruakwan		36N 0796604 0271831	
Nayanae Engol			
Kapetatuk			
Lomokomar	Lomokomar Elder	36N 0801224 0267021	
Dapar	Illikwel	36N 0798961 0256062	
	Echwan	36N 0797684 0256071	
		36N 0796812 0256365	
Lowoidapal	Akwaita	36N 0805747 0279701	Wife of Mokrion
	Eromula Mokrion	36N 0806088 0258976	Husband of Akwaita
	Jalinga	36N 0805831 0258783	
	Emuk	36N 0799338 0261684	
Kolouchalem	Lopudakare	36N 0804707 0257236	

Annex 4: Photos

Item	Photo Number	Notes
Camels	7512-7517, 7689-7700, 7969-7983	Very hardy and most precious
Goats	7342, 7378-7380, 7437, 7506, 7510, 7511, 7656, 7754, 7555, 7557, 7759, 7563-7569, 7833-7847	Mostly used for food and rituals, they are the animals given out in large numbers during marriage
Sheep	7785, 7860-7862, 7927-7930	Are not mentioned I most discourses but usually considered alongside goats.
Donkeys	7757,7758, 7760, 7761	Donkeys serve in transport and are also given as bride-price
Chicken	7267	Owned by Children for food
Dogs	7268,7269, 7283, 8027, 8028	Help with grazing and hunting
Graves	7365-7373, 7425, 7426-7430, 7490-7499, 7631,7632, 7678, 7680-7682, 7684, 7701-7709, 7734, 7738, 7741, 7765-7768, 7808-7816	Dead men and women elders of various community's have grave across the region which were marked out using a GPS
Sites with Marks of Recent Rituals	7611-7615, 7710-7730, 7789, 7793-7803	Various tree sites indicate signs of recent ritual activity
Charcoal Burning	7330, 7359-7360, 7362-7364, 7752, 7753, 7832	Is becoming an important economic activity but may soon be a threat to the trees.
Charcoal Selling	7307, 8260, 7285	Sacks of charcoal by the roadside awaiting buyers
Important Trees	7294-7298, 7339-7342, 7374-7377, 7388, 7404, 7405, 7420-7422, 7500-7505, 7537-7540,7553, 7558, 7560, 7561, 7608-7613, 7650-7667, 7936, 7937, 7918, 7919	Trees provide food for livestock and people, shed and meeting places for community cultural functions, some provided cure to health problems and drinks, dry and dead ones supplied wood-fuel and charcoal. While there are several trees, ewoi (acacia) and ekalale are the most important trees for the Turkana.
Pod Rods	7792,7961-7963	Such rods are used to harvest pods for people's and animals use.
Structures	7260-7262,7286-7289, 7290, 7304-7306,7308,709, 7319-7325,	Show continuity and change taking place in various parts of Turkana South

	7331,7350, 7351, 7354, 7355, 7358,7435, 7436, 7438, 7505-7637, 7638, 7639, 7830, 7964,7965	
Watering Livestock	7562, 7563, 7565-7569	Tullow drilled tanks where water is available for livestock and people.
Hand Dug Wells	7781-7788	Such well as found in the main luggas to supply the people's water needs. They are usually dry.
Dramatizing Initiation Process	7588-7590, 7593-7596	This provided a graphic display of the rite of initiation depicting a rise from helplessness to firmness.
Hills		Cattle graze around the hills to the west
Maize	8011	Crops like maize could be well here if rains are abundant or through irrigation.
Achuka Mzee	7317, 7318,7320, 7321	The seer of Kaaroge
Achuka's Family	8041,8034-8037	The seer has two wives and several children.
Achuka and Four Sons	8095-8097	Four of the seer's sons were around when we interviewed him.
Seer's Assistants	7311-7316	Mzee has two assistants.
Seer & Sandals	8077-8083	Demonstrating how the seer uses shoes to foretell societal matters especially conflicts, drought, illness, floods etc.
Snuff making	7318, 9320, 7321	Tobacco is a very important cultural material used as snuff or chewed during meetings. Tobacco also serves in the gifts given to elders and is important in prediction using shoes.
Gifts to the Seer	8002-8005, 8014, 8018,-8026, 8028-8033	A ram of specific colour, two sheets of wrappers, sugar and maize-meal.
SDA Church Lokichar	7990-8001	The pastor preaching and the congregation gathering outside the church.
Lucas Ariong	7636,8008, 8068,8069	Most of the translations were made by Lucas.
Paul	7634, 8007	Participated in archaeological surveys with Christine and James. He also accompanied me and Lucas for the

		interview with the seer of Kaaroge.
Nyamanga	8009,8010	Conducted the cultural interviews
James	7633,7635	Participated in archaeological surveys with Paul and Christine.

Annex 5: South Turkana Clans and Eres by Village

Village	Clans	Ere	Notes
Kasuroi	2	14	Esonyoka and Ngimatak clans. The fourteen ere are Kasuroi, Kalkol, Natudawo, Kadongolo, Amaruakwan, Wachorokalei, Nanangakina Kaekoe Ekwan, Akou Ekori, Lomeseksil, Hoyo kwee, Kaapoa, Kalitakere, and Tirikwel.
Nawoiyalim	1	?	?
Akibuket	1	?	?
Tirikol	-	-	-
Kaikol	1	?	Kaikol belong to the Esonyoka
Amoruakwan	1		Originally Ngimatak, today their off-springs are Esonyoka clan. It is interesting to find out how such change occurs. They have two seers: Nakuyen Ewoton who is a rain seer and Loree Lotone seer of diseases and misfortunes.
Nayanae Engol	1	?	The inhabitants belong to the Esonyoka clan.
Kapetatuk	1	5	The people are Nasenyoka (Esonyoka) clan and have the following five ere: Lomokomar, Aalim, Loporuto, Lomojong, Ekaran and Kooli.
Lomokomar	1	4	Esonyoka clan and there with four ere: Loputiro, Ekaran, Engole and Emaniman.
Dapar	1	8	The eight ere are: Esokuoy, Losantei, Lomariamgei, Naduito, Nabulucha, Dapar, Remremee, and Karepum.
Lowoidapal	1	16	The sixteen ere: Kiongomo, Naskarakiru, Esalotir, Nanyania, Nasomokoboko, Natwel, Ekunoit, Naitiokol, Kalemnyang, Napalagatao, Nayienere, Naiyene, Ekale, Lomokori, Ngakakimok,

			Lobei Angmanki and Namuniio.
Kolouchalem	1	18	They belong to the Esonyoka clan and have the following ere: Ekai, Lokonyi, Nakwan, Kwam, Najak, Aliwot, Erupe, Esinyen, Lolimi, Lokwee, Kimat, Esokon, Ekal, Amagae, Lokaru, Kapelo, Akuma and Iwalete.

(Lucas was to send information for confirmation of this part and fill gaps)

Annex 6: List of Churches

Church	**Notes**
Roman Catholic	Mentioned in nearly all sites
Reformed Church	Mentioned in nearly all sites
Maranatha Church	Mentioned in nearly all sites
Seventh Day Adventist (SDA)	Mentioned in nearly all sites
Legio Maria	Mentioned in nearly all sites
New Apostolic	Mention in some places
Pentecostal Assemblies of God (PAG)	Mention in some places

Although these churches exist among the people the community remains traditional maintaining its customs of initiation and marriage. These churches might slowly impact on the community in the long run.

TURKANA BURIAL PRACTICES - SUMMARY

The following summary document was prepared by Lucas Ariong (TKBV, Social Performance) in 2016 and provides a summary of Turkana burial practices. This summary was used to help inform and contextualise the findings of the Key Informant Interviews and field walkover surveys that were conducted in 2016.

TURKANA PEOPLE’S BURIAL PRACTICES

The Turkana eminent people’s burial sites are the places where died ones are laid to rest and be visited by the members of family. Turkana way of burying individuals differs from a class to class. These classes include prominent persons, poor people, women, young persons, middle aged, widowers, widows and children. All these individuals are buried by their families members and willing neighbours.

1. **Eminent male persons;**

Only, the eminent persons are buried by members of the family, relatives and age-set group. The youth mostly the sons of the eminent deceased person are allowed to dig the grave right at the centre of the goats structure or enclosure traditionally known as ***“ A NOK”*** with the rest of mourners sited silently waiting for its completion. The body is lowered into the grave by the family members and the eminent deceased person age-set. Once the body is drawn into the grave, it is then **fully sealed** with soil initially extracted or burrowed out of the grave. On top of the soil, the heap of stones is piled on for easier identification of this grave in future. The collection of stones placed together on the grave forms lasting conspicuous elevation***.***

The final works on the grave is the heaping of branches of tree and thorns previously used in erecting goats’ structure where kept for a safe night. The burial for a very important elder, seer and a rich man is a loud speaking sign of respect and recognition of his contribution to the well being of the family and a clan at large.

Later in time, the family relocates to a new site away from the grave usually 200 -500 metres to allow the deceased eminent person rest in peace. Customarily, it is believed that the deceased person had tirelessly worked while a life and therefore he requires maximum rest. Movements from people and animals as well as noises are treated as a total disturbance to the deceased person.

However, the **eminent** deceased person (mostly seer and a rich man) is regularly visited by family members, relatives and members of his age –set. During the visit, food in form of milk, meat from fatty slaughtered goat especially the ram and tobacco is supplied/given under the supervision of a senior most member of the family. The milk is poured on the grave. The meat is cut into smaller pieces and randomly dropped around and on the grave environment. Tobacco substance is also sprinkled on the grave accompanied by the word of prayer from the senior most persons administering the event. The celebration is concluded by cutting down fresh branches of trees and heaping them on the grave. By so doing, the deceased person is sheltered or protected from the natural catastrophes namely rain, hot sun, wind and destruction of grave by predators.

Upon your inquiry, it is worth noting that heaped soil, collection and piling of stones in larger quantity and regular visitation by the family members hence the renewal of grave’s

“shade” makes such graves identical even after several years. The existence of such very important graves lays the foundation of ***“ERE”*** for the family and relatives. The family members, off-springs and relatives will always make strenuous effort to have active permanent residence *“manyatta”* within and around the grave site. The family will endeavours to make the grave area a territory where it can be identified and links to the deceased prominent person since such persons are believed to be existed in spirit ***–“living died”.*** The living died remains strategically accessible for consultations by family members and age-set (especially a seer) whenever things go wrong. The moral convictions to the deceased eminent person are absolute and it never erodes out of the mental acceptance of the Turkana people.

2. Female persons

The family members’ traditionally do not visit and preserve the graves of their deceased female persons. These graves are less than always, but more than occasionally abandoned making it difficult for anyone to recognize and appreciate. It is in this regard that we can comfortably say that upcoming young people lack automatic flow of memories about their female fore-parent, female grandparents and female relatives who passed over before they were born. The fabric stitches between generations cannot clasp any data about graves of the female persons making History helpless to that end. The graves of female persons among Turkana unfortunately go un-preserved. The notion has been nothing but subordinating the roles of female Turkana person making them equals to poor persons and as well as children in the society. No one has ever recognized and valued extreme important role played by Turkana female persons. The Female Turkana class play a sombre role to be specific on traditional medicinal knowledge, caring for the elderly as well as children; some are talented prophets; divine inspiration, without forgetting the science of midwifery role.

As a matter of fact, whenever a woman dies Turkana people run into less pain. Once buried under a traditionally shelter built by herself when she was a life, soil heaped and stones piled on the grave and rituals performed and observed, little is done to keep the memories fresh about her any more. The rest of family can migrate away without plans to visit the grave yard at any one point. Little is done to update and uphold the relationship between the “living” and the “living died”-women. Less is projected in remembering of female contribution on bearing children, watering and providing secure environment for livestock, caring for the family and preparing for the girl child for marriage in future. Instead, women are just treated as subsidiaries to Turkana man’s life. The attitude is what makes female Turkana person not to receive a worthy of respect burial hence their graves being not placed in traditional plan of continued visitation alike to the male counter parts. They are buried, forgotten like poor persons and/or children.

The reality of such grave sites can only be ascertained through social interactions and searching for information from the senior members of **“ERE”** who might have witnessed the burials of some female Turkana individuals if need be. More information is required on the graves in general so as to avoid future conflict during EOPs development.

3. The Poor persons

The people referred as poor according to the Turkana community are those with less population of livestock. For instance a person with cows **0-10,** camel **0-12**, goats **10-25** and sheep **3-6** falls under in this class.

In terms of family size, such persons have one wife with 0-2 children. Their children are not any way married to persons from richer class. The poor persons are seen as persons without value to the community. They are not allowed to participate in public matters like decision making. In gatherings where serious judgements are considered, these persons are ordinarily seen sited at the back of the crowd with women and children. And in worst scenarios, these persons are not entirely accepted in gatherings of purposeful focus. The purposeful focus meetings where the seers and supreme elders conduct traditional rituals such as traditional prayers the poor, women and children participation or presence is outlawed.

Of the time of their death and burial of the poor persons, none of the community members singles out an interest to share with others about this death occurrence. The poor persons are buried only by family members that comprise the wife and children. There is no traditional designated site within the homestead for burying the bodies of the poor persons. Instead, the grave site decision is left solely on the hands of the family members. The family may decide to dig a grave anywhere within the family vicinity or throw the body to the bush with the relationship being cut off fully. In this state of affair, the body is left un-buried on an open ground for vultures, hyenas, foxes and wolves to feed on.

The relationship between the “living” and the poor deceased person ends there. Because of the status of the family and the class of the deceased, there is no fledged celebrations undertaken whatsoever as a sign of honour and chivalry in remembering the late. The grave therefore remains un-reserved and permanently grows fainter from memories of all persons in an epoch not less **4-8** years if on rocky surface environment and **2-4** years in softer soil environment.

4. The children

This class includes foetus, children up to an age of 18. These persons are not yet identified and classified as important members of the Turkana community. They have no rights of property ownership; instead they only depend on their parents in full provision of life necessities.

When children pass away (die), their biological parents, brothers, sisters, closer relatives and family friends gather together to bury the deceased child. The grave is dug at any location within the family homestead; especially at the western axis of the home enclosure. The grave after immersing the body is covered with soil, some stones and twigs. The only traditional rituals undertaken; is the shaping of the fore-hairs of the rest of children. The family can after while migrate to a new site and life moves on with no plans of any celebrations in future. Children's grave disappeared in a period of not less than **2 -3** years if was placed on rocky/hardy surface environment and **1** years in sandy or loose soil environment.

5. Persons killed in cattle rustling raids,

These are individuals who always meet their death agonies during cattle theft or rustling. A cattle rustling is a traditional exercise practiced by pastoralist whose main livelihood depends on livestock rearing. They wander freely from place to place searching for pasture and water. During times of severe drought, the pastoralists loose several heads of livestock due to acute shortage of pasture and water resulting to ruthless livestock starvation.

However, at any time within the rain seasons the pastoralists' warriors; heavily armed youth go out to attack or raid neighbouring ethnics groups in order to replenish the lost "stock" at moments of unkind deficiency of pasture and water for the survival of livestock. At times of the raids any human being come into is never out of danger. Persons manning the targeted livestock are taken un-aware, killed to get rid of any possible resistance to the raiding "friends." Herdsmen and cattle scouts are outermost targets during such raids because their main function is to clear/killed anyone forcefully coming to away stock.

Both the raiders and the cattle defence forces (cattle scouts) killed during raiding exercise are not buried. Their bodies are left un-buried in battle fields at the mercy of **vultures, hyenas, foxes and wolves**. As the successful raiders or "friends" celebrate the loot, the predators on other hand celebrate human flesh resulting from counter less ammunition fired to and fro but in the direction of calculated destinations. On the areas of **Tullow oil** and **gas project in Turkana**, there is no single grave for those who succumbed to the force of the bullet. Not even one. But on enquiry into this situation, one can easily discover several bones leftovers and remains of human skulls, cartridges from a round of ammunition from places of Kakog'u. Kaptir, Kainuk the list long BUT NO GRAVES.

SYNOPSIS

The burial practices are divided into three categories as described here below:-

Category 1: Honourable burial practices,

These are burial for respected individuals with profound contribution to the well-being of the family and equally to that of the clan. Their graves are preserved and several traditional celebrations performed time to time in remembrance of their excellent contributions. Upcoming generations are kept informed of these individuals to reduce chance of losing recollections on their diligent efforts. These persons include seers, successful warriors and rain makers.

Category 2: Insubstantial burial practices,

These are burials of less valued persons who have not in any way contributed to community prosperity. There death or burial never capture the attention of the clan. They are buried by the family members with zero appreciation, gratitude and/ or remembrance, notably a social event adhered to the Turkana customs. No traditional social rite organized thereafter in admiration of the work of the deceased person.

The graves of these persons are not preserved resulting to rapid disappearance of the same. The candidates in this class include children and poor persons.

Category 3: Detestable burial practice,

These are shocking deaths to the family or clan members. It occurs un-expectedly to defence forces namely “cattle herders.” The victims of cattle rustling died bodies are left un-buried for predators to feast. The traditions have no records of rituals observed in respect to their fixed functions as members of community defence force.

Date: 15/09/2016.

Day: Thursday 2016.

Time: 10:45 am

Editor: Ariong Lucas

ANNEX I

D

Impact Assessment Supporting Information

1 Air Quality

2 Noise

3 Water Quantity

4 Biodiversity

5 Cultural Heritage

Air Quality

D1

1.0 AIR QUALITY SENSITIVITY ANALYSIS

Table 1: Building Height Comparison between FEED Modelling and IA

Building Number (in model)	Building Name/ Description	FEED Report Height (m)	Revised Height (m)
BLD_1	Crude Tank 1	9	9
BLD_2	Crude Tank 2	9	9
BLD_3	Crude Off Spec Tank	9	9
BLD_4	**Produced Water Settling Tank 1**	**9**	**9.6**
BLD_5	Produced Water Settling Tank 2	9	9
BLD_6	Produced Water Settling Tank (Case 1)	9	9
BLD_7	**Produced water off- spec tank**	**9**	**10**
BLD_8	Water Injection Buffer Tank	9	9
BLD_9	Water Treatment Tank 2	10.8	10.8
BLD_10	Water Treatment Tank 1	10.8	10.8
BLD_11	Water Treatment Tank 3	7.2	7.2
BLD_12	Water Treatment Tank 2	7.2	7.2
BLD_13	Water Treatment Tank 1	7.2	7.2
BLD_14	Water Treatment Building 1	3.5	3.5
BLD_15	Water Treatment Building 2	3.5	3.5
BLD_16	Vehicle Service Area	6.5	6.5
BLD_17	**Warehousing 1**	**8.5**	**7**
BLD_18	**Warehousing 2**	**8.5**	**7**
BLD_19	**Workshop 1**	**7.5**	**6**
BLD_20	**Workshop 2**	**7.5**	**6**
BLD_21	Laboratory	3.7	3.7
BLD_22	**Emergency Response Facility**	**6**	**5**
BLD_23	Admin Building	3.7	3.7
BLD_24	Control Building	6	6
BLD_25	Single Occupancy 1	2.6	2.6
BLD_26	Single Occupancy 2	2.6	2.6
BLD_27	Single Occupancy 3	2.6	2.6
BLD_28	Single Occupancy 4	2.6	2.6

BLD_29	Single Occupancy 5	2.6	2.6
BLD_30	Double Occupancy 1	2.6	2.6
BLD_31	Double Occupancy 2	2.6	2.6
BLD_32	Double Occupancy 3	2.6	2.6
BLD_33	Double Occupancy 4	2.6	2.6
BLD_34	Double Occupancy 5	2.6	2.6
BLD_35	Double Occupancy 6	2.6	2.6
BLD_36	Double Occupancy 7	2.6	2.6
BLD_37	**Multi- Sports Hall**	**8.5**	**7**
BLD_38	Gym and Fitness	3.7	3.7
BLD_39	Mini Market	2.6	2.6
BLD_40	**Club House**	**3.7**	**3.5**
BLD_41	**Religious Facility**	**3.7**	**2.6**
BLD_42	Wet Mess	3.7	3.7
BLD_43	Mess Hall	4	4
BLD_44	Laundry	3.7	3.7
BLD_45	House Keeping	2.6	2.6
BLD_46	Medical Centre	3.7	3.7
BLD_47	Admin/ Reception	3.7	3.7
BLD_48	IWMF Admin Building	3.7	3.5
BLD_49	IWMF W1	6	6
BLD_50	IWMF W2	6	6
BLD_51	IWMF W3	6	6

*Differences highlighted in **bold***

1.0 TECHNICAL MEMORANDUM

DATE 08/06/2020 **Reference No.** 1433956.647.A0

TO Paul Mowatt, Oliver McCredie Tullow KBV,

FROM Andrew Morsley, Rachel Lansley **EMAIL** amorsley@golder.com

SUMMARY OF AIR QUALITY MODELLING ADDITIONAL INFORMATION

The following information relates to the Air Dispersion Modelling (ADM) Assessment undertaken by Worley Parsons (Worley Parsons, 2019. Tullow Oil Kenya B.V. Kenya South Lokichar Foundation Project: Air Dispersion Modelling Report) as part of Front End Engineering Design (FEED) using the Lakes Environmental AERMOD software (version 9.6.5).

Golder has not independently verified the data used in the assessment, however Golder has adopted the outputs of the assessment completed by a recognised competent consultancy, with the assumption that Quality Assurance (QA) checks were completed by Worley Parsons.

1.0 MODEL SCENARIOS

Scenario 1: Peak gas scenario (Year 3) plus wellpad operations and IWMF incinerator:

- 2 x SGT-700 Gas turbines;
- 2 x gas-fired heaters;
- Enclosed flare burning fuel gas and acid gas;
- IWMF incinerator; and
- Well test operations at 3 wellpads (including one diesel generator and one flare at each of the wellpads).

Scenario 2: Peak flare scenario (Year 1) plus wellpad operations and IWMF incinerator:

- 2 x SGT-700 Gas turbines;
- 2 x gas-fired heaters;
- Enclosed flare burning fuel gas and acid gas;
- IWMF incinerator; and
- Well test operations at 3 wellpads (including one diesel generator and one flare at each of the well-pads).

Scenario 3: Peak crude scenario (Year 10) plus IWMF incinerator:

- 1 x SGT-700 Gas turbines;

- 1 x gas-fired heater;
- 1 x MS5001 crude oil-fired turbine;
- Enclosed flare burning fuel gas and acid gas; and
- IWMF incinerator.

2.0 MODEL INPUT DATA

2.1 Stack Parameters

The stack parameter information was sourced from the following:

- SGT-700 GTG and MS500 crude turbine data are derived from mechanical data sheets and drawings;
- Enclosed flare data are derived from vendor supplied information and examples;
- Fired heater and diesel generator data are derived from supplier data provided from similar facilities; and
- Turbine and engine data are derived from vendor data.

Table 1 and Table 2 present the stack parameters and emission rates of the modelled emissions points.

Table 1: Specifications of the Emissions Sources Used in the ADM

Source Description	Stack Height (m)	Stack Diameter (m)	Flue Gas Temperature (K)	Flue Gas Velocity (m/s)
Combined Enclosed Flare[(a)]	30	9.8	1373	7.2
SGT-700 GTG	16.6	2.6	473(b)	6.5
MS5001 Crude Fired Turbine	16.6	2.6	473(b)	30.4
Fired Heater	26	1.6	473	3.5
Diesel Generator (well pads)	10	0.635	771.6	32.9
Ground Flare (well pads)	1	0.300	1273	20

Notes:

a) *The enclosed combined flares were considered and modelled as a single combustion source*

b) *Temperature at Waste Heat Recovery Unit (WHRU) exit*

Table 2: Emission Rates of the Combustion Equipment in ADM

Source Description	Scenario	Emissions Rate				
		NO_x	SO_2	CO	PM_{10}	$PM_{2.5}$
SGT-700 GT	1	10.08	0.11	2.59	O.06	0.15
	2	8.18	0.09	2.11	0.05	0.12
	3	11.32	0.12	2.90	0.07	0.17
MS5001 (crude fired Turbine)	3	0.03	3.33	Insignificant	Insignificant	Insignificant
Combined enclosed flare	1	3.54	0.126	16.15	0.097	-
	2	4.07	0.132	18.55	0.102	-
Fired Heater	1	0.88	0.004	0.53	0.024	0.072
	2	1.18	0.005	0.71	0.032	0.096
IWMF incinerator	All scenarios	0.152	0.144	0.123	0.315	0.735
Diesel Gen (well pads)	All wellpads (all scenarios)	8.2	1.4	3.5	-	0.4
Well Pad Ground Flare	NG-09 & 16 (all scenarios)	7.5	-	40.8	1.20	-
	AM-10 (all scenarios)	10.5	-	57.1	1.69	-

2.2 Emission Point Locations

Table 3 presents the location of the emission sources represented in the model.

Table 3: Location of Emissions Sources

Source Description	Coordinates in UTM System (Zone 36 N)	
	Easting	Northing
Enclosed Flare	808222	247707
SGT-700- 1 plus WHRU	808337	247544
SGT-700- 2 plus WHRU	808316	247563
MS5001 No. 1 (Gas)	808353	247639
MS5001 No. 1 (Crude)	808369	247626
Fired Heater 1	808289	247592
Fired Heater 2	808274	247605
Waste incinerator	808034	247048
NG-09 Ground Flare	807053	243430
NG-16 Ground Flare	806424	245355
Am-10 Ground Flare	812118	240210
NG-09 Diesel Power Gen	807153	243530
NG-16 Diesel Power Gen	806524	245455
AM-10 Diesel Power Gen	812218	240310

3.0 MODEL OUTPUT

The outputs in Table 4, Table 5, Table 6, Table 7 and Table 8 are taken from the Worley Parsons FEED assessment.

Table 4: Contribution of the Project and Maximum Predicted Ground Level Concentration of NO_2 in CASE 1-2C Operational Scenarios (Values in µg/m³)

Period	Standard µg/m³	Unit	WP Scenario		
			1	2	3
Annual	40	Project Contribution	10.2	9.8	4.4
		Maximum Concentration	10.3	9.9	4.5

Period	Standard µg/m³	Unit	WP Scenario		
			1	2	3
24-hour	188	Project Contribution	41.8	41.7	20.2
		Maximum Concentration	42.7	42.6	21.1
1-hour	200	Project Contribution	177.7	166.4	87.6
		Maximum Concentration	179.2	167.9	89.1

Table 5: Contribution of the Project and Maximum Predicted Ground Level Concentration of NO_2 in CASE 1-2C Operational Scenarios (values in µg/m³)

Period	Standard µg/m³	Unit	WP Scenario		
			1	2	3
Annual	50	Project Contribution	1.88	1.88	2.00
		Maximum Concentration	2.98	2.98	3.10
24-hour	80	Project Contribution	10.17	10.17	8.80
		Maximum Concentration	11.47	11.47	10.10
10-minute	500	Project Contribution	114.50	114.50	70.82
		Maximum Concentration	116.10	116.10	72.42

Table 6: Maximum Raise Ground Level Concentration of CO in CASE 1-2C Operational Scenarios (Values in µg/m^3)

Period	Standard µg/m^3	Unit	WP Scenario		
			1	2	3
8-hour	2000	µg/m^3	50.8	50.8	14.1
		As % of Standard	2.5	2.5	0.7
1-hour	4000	µg/m^3	210.5	210.6	32.1
		As % of Standard	5.3	5.3	0.8

Notes: No background data is available

Table 7: Contribution of the Project and Maximum Predicted Ground Level Concentration of $PM_{2.5}$ in CASE 1-2C Operational Scenarios (Values in µg/m^3)

Period	Standard µg/m^3	Unit	WP Scenario		
			1	2	3
Annual	10	Project Contribution	-	-	-
		Maximum Concentration	-	-	-
24-hour	25	Project Contribution	1.01	1.05	0.42
		Maximum Concentration	6.91[(a)]	6.95[(a)]	6.32[(a)]

Notes:

a) *These concentrations may occur only if the IWMF operates continuedly for 24 hours or more.*

Table 8: Contribution of the Project and Maximum Predicted Ground Level Concentration of PM_{10} in CASE 1-2C Operational Scenarios (Values in µg/m³)

Period	Standard µg/m³	Unit	WP Scenario		
			1	2	3
Annual	10	Project Contribution	-	-	-
		Maximum Concentration	-	-	-
24-hour	25	Project Contribution	17.8	17.8	17.7
		Maximum Concentration	43.4	43.4	43.3

Golder Associates (UK) Ltd

DRAFT

Rachel Lansley
ESIA Practitioner

DRAFT

Andrew Morsley
Project Director

RL/AM/mb

REPORT

Foundation Stage of the South Lokichar Development for Upstream Oil Production in South Lokichar

Greenhouse Gas Assessment

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Distribution List

Golder Associates - 1 pdf

Tullow Kenya BV - 1 pdf

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TABLES

1.0 INTRODUCTION

This report presents an assessment of the greenhouse gas (GHG) impact from a collection of different gases produced by the proposed Foundation Stage of the South Lokichar Development (the Project). It is typical to report the collective impact as carbon dioxide equivalent (CO_2e) units to facilitate comparison. The term 'CO_2e' is a measure used to compare the emissions from various GHGs based on their greenhouse warming potential (GWP). The scope of this assessment is to estimate the annual CO_2e emissions associated with the Project and provide mitigation recommendations where applicable.

The six key GHG produced by human activities and covered by the Kyoto Protocol Agreement are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Carbon Dioxide is the most significant of GHG emissions accounting for 77% of the world's anthropogenic emissions (IFC, 2012a). CO_2 emissions are dominated by fossil fuel combustion.

Recorded national emissions of CO_2 in Kenya during 2018 were estimated to be around 2,000 ktpa (KNOEMA, 2020). This is the most recent data available.

The calculation of GHG emissions for use in this assessment has been undertaken by WorleyParsons reviewed by io consulting (Appendix 1). Golder has not independently verified the data used in the assessment however Golder has adopted the outputs of the assessment completed by a recognised competent consultancy, with the assumption that Quality Assurance (QA) checks were completed by both Worley Parsons and io consulting.

2.0 STUDY AREA AND RECEPTORS.

Emissions of Greenhouse Gases have the potential to impact globally, therefore the study area for this assessment is global.

3.0 KEY GUIDELINES AND STANDARDS

The International Finance Corporation (IFC) Performance Standard 3 - Resource Efficiency and Pollution Prevention is adopted to quantify any project related GHGs. The IFC PS 3 requires projects to estimate their annual GHG emissions from developments that are expected to generate in excess of 25,000 tpa of CO_2e.

Performance Standard 3 also requires that the client considers alternatives and implements technically feasible and cost-effective options to reduce project related GHG emissions. These could include alternative project locations, adoption of low carbon energy sources, the reduction of fugitive emissions and the reduction of flaring.

4.0 GHG ASSESSMENT

4.1 Method

The assessment of GHG emissions normally focuses on the following three emission areas:

- Scope 1 covers direct emissions from sources within the boundary of an organisation such as fuel combustion and manufacturing processes. Scope 1 emissions will arise from such activities as the combustion of petrol and diesel fuels for vehicles and plant on site.
- Scope 2 covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation as required; and
- Scope 3 includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation; that is, emissions from off-site waste disposal, emissions associated with the production of fuels, and emissions from the generation of purchased electricity.

The calculation of Scope 1 and 2 emissions is mandatory according to the IFC. Properties for the calculations of flare and turbine emissions were obtained from HYSYS[1] simulations. In this assessment, Scope 1 and 2 emissions relating to the planned normal operation of the CPF have been quantified and provided to Golder. Data relating to construction, drilling and commissioning emissions are currently unavailable and these will be quantified by the EPC contractor and drilling contractor, once appointed.

Scope 3 emissions (the calculation of which is optional according to the IFC), are those which occur outside the project boundary. They have not been included in the assessment at this stage as the EPC contractor will select equipment and processes based on supply chain and logistics considerations at EPC stage.

4.1.1 Scope Boundaries

The quantification of construction related GHG emissions will be the responsibility of the EPC and drilling contractors. This data will be provided to TKBV. The quantification of operational emissions and the reporting of all annual emissions (for both the construction and operational phases) will be the responsibility of TKBV.

4.2 Source of Effects

The assessment covers emissions directly and indirectly generated from the Project during a normal operational year. Emissions data is available for the operational phase which utilises two gas turbine generators (GTGs). Currently assumed to be SGT-700 or equivalent. The data from the year of maximum production, Year 4 (2024 – First year of Operational Phase), has been used in this assessment for conservatism.

Sources of effects are identified below in Section 5.2.1 to 5.2.6.

4.2.1 Construction Phase

No information is currently available regarding the calculation of CO_2e emissions from the construction phase (years 1 to 3) as the EPC contractor will select equipment and processes based on supply chain and logistics considerations at EPC stage. .Emissions resulting from well drilling, construction and commissioning will be quantified at EPC stage by the EPC and drilling contractors. Although the quantification of construction emissions is not currently available, the likely sources of emissions associated with the construction phase of the Project are outlined below.

- Removal of carbon through vegetation and soils stripping associated with land clearance.
- Exhaust emissions from construction vehicles and equipment, which will likely utilise diesel fuel. Specific sources include on-site vehicles such as light vehicles, trucks, lifting and loading machinery, and drilling and digging equipment.
- Emissions from on-site processes such as concrete batching, largely as a result of power required for the process, and the production of the components of concrete – specifically cement.
- Emissions from the provision of accommodation and utilities such as heating and water supply associated with worker accommodation.
- Emissions associated with the treatment, management and disposal of construction wastes.
- Emissions associated with the transportation of construction materials to the Project site.
- Emissions associated with well testing and commissioning.

[1] Process simulation software

- On site processes such as concrete batching will also result in emissions, largely as a result of power required for the process, and the production of the components of concrete – specifically cement.
- Indirect emissions will also result from the production of enabling and construction materials equipment and vehicles, and associated fuel use

4.2.2 Operational Phase

The operational phase relates to Project year 4 onwards. First Oil is planned for year 4.

4.2.2.1 Turbine Emissions

Two dual fuel gas turbines, burning fuel gas with waste heat recovery units (WHRU) present, with supplementary firing using fuel gas to meet heat demand as required. Gas turbines were selected over steam turbines as they were found to provide greater efficiency for converting fuel burnt into megawatt (MW) power. They also generate less emissions for the power that they deliver.

4.2.2.2 Flare Emissions

There is one enclosed ground flare located in the central processing facility (CPF) containing both a main flare and an acid (CO_2) gas flare, with a flare purge and pilot for both flares.

4.2.2.3 Crude Storage Emissions

Potential emissions from crude storage tanks have been included in the assessment.

4.2.2.4 Fugitive Emissions

Potential sources of fugitive emissions for the Project include cold vents, leaking pipes and tubing, valves, connections, flanges, packings, open-ended lines, pump seals, compressor seals, pressure relief valves, tanks or open pits / containments, and hydrocarbon loading and unloading operations.

4.2.2.5 Grid Power

The facility will be powered by electricity purchased from the Grid from First Oil (Year 4) onwards, which will supplement power generated by the GTGs. A fully grid powered solution was not considered appropriate as it would not maximise utilization of associated gas which can be used by the GTGs to generate heat and power. The use of grid power will result in direct emissions and indirect emissions which are included in the assessment calculations. Indirect emissions results from the production of the energy off site.

4.2.3 Decommissioning Phase

Greenhouse Gas emissions relating to the decommissioning phase will be dependent on the decommissioning plan developed prior to decommissioning. It is likely that the sources of GHG emissions will be similar to those identified for the construction phase.

4.3 Results

The GHG assessment considers the most significant emissions relating to the Project, which are generated from GTG and flare emissions. Table 1 presents the calculated CO_2e emissions data for the year of maximum annual combined Scope 1 and 2 emissions (Year 4: 2024 – first full operational year). The greatest contributions to the annual emissions are from the Main Flare (associated gas flaring) (49.5%) and Gas Turbine (35.8%). Table 2 details the predicted total Scope 1 and 2 CO_2e emissions from the total operational phase of the Project. The composition of the operational CO_2e emissions per year is presented graphically in Appendix 1.

Table 1: Predicted Annual CO_2e from Maximum Year of Emissions (Year 4)

GHG Emission	Gas Turbine ktpa CO_2e	Gas Fired Heaters ktpa CO_2e	Main Flare (purge and pilot) ktpa CO_2e	Acid Gas Flare (purge and pilot) ktpa CO_2e	Main Flare (associated gas flaring) ktpa CO_2e	Acid Gas Flare ktpa CO_2e	Crude Storage ktpa CO_2e	Fugitive Emissions ktpa CO_2e	Grid Power ktpa CO_2e
CO_2e	197.9	65.7	4.3	0.4	273.7	-[(1)]	0.05	0.02	11.0
% of Total	35.8	11.9	0.8	<0.1	49.5	-[(1)]	<0.1	<0.1	2.0
Total Annual CO_2e (kt)	553.2								

Notes:

1. The acid gas flare is not operational during the assessment scenario

Table 2: Predicted Total CO_2e from Project Operations

GHG Emission	Gas Turbine ktpa CO_2e	Gas Fired Heaters ktpa CO_2e	Main Flare (purge and pilot) ktpa CO_2e	Acid Gas Flare (purge and pilot) ktpa CO_2e	Main Flare (associated gas flaring) ktpa CO_2e	Acid Gas Flare ktpa CO_2e	Crude Storage ktpa CO_2e	Fugitive Emissions ktpa CO_2e	Grid Power ktpa CO_2e
CO_2e	3,181	200	108	1	1,026	<1	1	1	2,257
% of Total	47	3	2	<1	15	<1	<1	<1	33
Total Annual CO_2e (kt)	6,776								

5.0 BEST AVAILABLE TECHNIQUE

Best Available Technique will be reviewed and incorporated at EPC phase with regard to identifying and incorporating technically feasible and cost-effective options for GHG reduction measures. This may include, but not be limited to, the optimisation of heat and power, the selection of equipment with consideration to performance and energy efficiency and the reduction of fugitive emissions.

6.0 MITIGATION

Mitigation and management measures relating to the Project are outlined below.

6.1 Construction and Commissioning Phase

As mentioned in Section 4.2.1, the emissions which will result from construction, drilling and commissioning have not yet been quantified. However, the following presents the types of mitigation which should be employed to reduce emissions during this phase wherever possible.

- Record keeping and documentation to aid the quantification of GHG emissions.
- Maximisation of existing vegetation retention during land clearance to maximise carbon stocks.
- Implementation of energy efficiency measures, for example insulation and lighting design.
- Optimising construction personnel to minimise footprint
- Maximising local content to minimise travel to and from site
- Optimising the commissioning sequence to minimise flaring
- During EPC, optimising flanged connections and replacing with welded connections, where possible
- Increased use of low carbon or renewable energy and fuel sources, such as those used to power construction vehicles and equipment, and light vehicles on site, where possible. This can also be applied to power supplies for any on site accommodation.
- Maintenance and operation of vehicles and machinery in accordance with GIIP and manufacturers specifications.
- Transportation of construction materials in accordance with the Project Traffic Management Plan.
- Idling of vehicles must be avoided where possible (i.e. engines must be switched off when not in use).
- Employees should be educated and encouraged to follow energy saving measures.

6.2 Operational Phase

6.2.1 General Measures

The following general management and mitigation measures are not related to specific aspects of the operations phase but should be undertaken as GIIP.

- Record keeping and documentation to aid the quantification of GHG emissions.
- Implementation of energy efficiency measures, for example insulation and lighting design.
- Increased use of low carbon or renewable energy and fuel sources, such as those used to power construction vehicles and equipment, and light vehicles on site, where possible. This can also be applied to power supplies for any on-site accommodation.
- Maintenance and operation of vehicles and machinery in accordance with GIIP and manufacturers specifications.
- Transportation of operational materials in accordance with the Project Traffic Management Plan.
- Idling of vehicles must be avoided where possible (i.e. engines must be switched off when not in use).
- Employees should be educated and encouraged to follow energy saving measures.

6.2.2 Specific measures

The following management and mitigation measures relate to specific aspects of the operational phase

6.2.2.1 Turbine Emissions

The Project is applying indicative Best Available Technique (BAT) through the use of two SGT-700 GTGs (or equivalent) which will utilise some of the associated gas and provide all required power for the first three years of the Project. Provision has been made to minimize energy use and increase efficiency and design facilities in line with IFC PS3. Air emission specifications will be achieved through the application of Indicative BAT at various phases of the Project. The turbines also have an integrated control system which can be used to optimize combustion. Waste heat recovery will be used to provide heating demand from the turbine exhausts, therefore reducing overall energy demand and GHG emissions.

6.2.2.2 Flare Emissions

Flaring has been chosen as a simple, low cost and robust solution to associated gas, through a detailed assessment of gas management measures. Associated gas will be present in the initial operational years as the gas production rate will be greater than the demand.

Alternative methods of associated gas management were considered. These solutions included gas to liquefied petroleum gas (LPG) extraction for full utilization of gas in the process, and gas to power where associated gas is exported as power to the grid. Gas to LPG was identified as not feasible and therefore discounted. Gas to power was identified as feasible, although discussions with Government of Kenya (GoK) will be required to evaluate the practicality of this option.

A flanged connection at the CPF boundary will be installed to allow for a 3rd party user to take untreated gas for local use if considered feasible. The associated gas will be flared until a feasible alternative is identified and investigated.

6.2.2.3 Crude Storage Emissions

In order to prevent or, where that is not practicable, reduce diffuse VOC emissions to air from liquid hydrocarbon storage, the BAT study recommended tanks are double deck floating roof tanks due to their insulation properties to minimize wax formation. The formations of wax residues above the roof when the roof is low will be managed by wax scrapers on the floating roof. Storage tank location will be selected to specifically avoid water protection and water catchment areas as per BAT, and consideration will be given to colour, materials and layout.

6.3 Offsetting

In the IFC guidance, there is no requirement for carbon offsetting. There is a focus on mitigation and carbon reduction measures (as described in Section 5.0)

Due to the level of carbon emissions estimated to occur from the site, carbon offsetting options could be considered and quantified as part of future resource efficiency planning. These can include actions which can be undertaken on site and also through the procurement of carbon offset credits. On-site options could include the possibility of using low carbon energy sources for parts of the plant where it is practicable and financially feasible to do so.

7.0 PROCESS ALTERNATIVES

A number of process alternatives for the Project were considered in this assessment in terms of their impact on emissions.

The wellpad design incorporate multiple wells co-located on a single pad. This means that a factory drilling approach can be taken, whereby specialized rigs can be employed which are designed to maximise efficiency and reduce drilling time and costs. This leads to shorter drilling times and therefore a lesser demand for power and fuel, which reduces the emissions likely to arise when compared with other approaches, such as single well pads which would require greater drilling effort and time.

There are 5 wellpads which have been identified in a section of the Ngamia reservoir as having a higher CO_2 content than others. The gas associated with these wells has an average CO_2 content 50 mol% and a maximum CO_2 content of 95 mol%. Options were considered for the best use for the gas from these wellpads, such as blending the high CO_2 gas for use in the GTGs to provide power and heat, however the CO_2 content was found to be too high and would lead to corrosion. Instead, the high CO_2 gas can be vented or flared. Flaring has been considered as the best option in this case, as venting is not considered good international industry practice (IFC, 2017).

Gas turbines will utilise gas produced from the reservoir to generate heat and power for the facility. This will supplement purchased grid power at various ratios throughout the operation of the facility. As mentioned in section 5.2.2, GTGs were selected over steam turbines for power generation as they offer a greater efficiency and lesser emissions for the amount of power that they would generate.

Waste heat recovery units are to be used to recover waste heat from the gas turbines. This increases efficiency and reduces losses, making use of the recovered heat for other process requirements such as heating of make-up water and produced water streams. This reduces the requirement for generated heat, which in turn reduces emissions from primary heat generation.

8.0 CONCLUSION

The assessment has considered the key related emissions to calculate the greenhouse warming potential of Project activities.

It is assessed that the most significant Project related emissions are the Scope 1 emissions resulting from turbine and flare use. The assessment has estimated that up to 553.2 ktpa of CO_2e has the potential to be emitted annually from the Site (including Scope 1 and Scope 2 emissions). This is approximately 2.6% of the 2018 Kenyan annual emissions (21,000 ktpa CO_2).

According to the operational phase emissions calculations provided, emissions are projected to decrease over time, with annual emissions falling to 149.4 ktpa CO_2e in year 28 (2048). CO_2e emissions are projected to reduce by 50% from 553.2 ktpa in the first year of operation (2024) to 296.1 ktpa by 2030. The overall trend is a sharper decrease within the first 6 years of operation, with a steady continued decline in the following years. The composition of the CO_2e emissions are also calculated to change into the future. After the period of associated gas generation, grid power and GTGs become the most dominant sources of emissions, with grid power contributing the majority of emissions.

Assessed GHG emissions are estimated to be above the IFC reporting threshold in IFC PS3 of 25,000 tpa of CO_2e. Therefore, the Project should commit to annual accounting or auditing using actual operational data. However, reporting is not mandatory, so TKBV must keep sufficient auditable records on energy usage, fuel usage and waste generation and disposal to allow actual emissions to be calculated annually, if required. The Project is committed to adhering to BAT and will seek to implement applicable design measures, where possible.

9.0 REFERENCES

Golder Associates (UK) Ltd. May 2020. Project Description and Assessment of Alternatives. Document Reference 1433956.637.A1.

IFC. 2012a. IFC Guidance Note 3 – Resource Efficiency and Pollution Prevention, 2012a. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps3 [Last accessed June 2020].

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Signature Page

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APPENDIX A

Case 1 emissions

Dashboard

NOTES

ISSUED For use by GOLDER

Tullow oil requested that io consulting review the WP emissions dataset for Lokichar Development to ensure the emissions report was updated at the end of FEED to include Case 1 Power and heat demand data, as this emissions data set is required for inclusion to the NEMA submission ESIA at the end June 2020. As the base calculations have not been provided, io recalculated the emissions dataset which formed part of the review process. Work was only conducted on normal operating emissions, including NO_x, CO, PM, CH_4, VOC, SO_2, N_2O and CO_2 (and CO_2eq). Conclusions of the review is that although there is alignment with process equipment emissions, for normal operations, further work will be required to support better understanding of drilling, construction and commissioning emissions as there have found to be omissions and a number of data sources cannot be traced. It is expected that this work will be continued during EPC, but the selected contractors.

OPERATIONAL EMISSIONS (tpa)

PROJECT REFERENCES

Wastes and Emissions Inventory Doc no. KSLFP-0000-ES-RPT-0004, 13 Aug 19

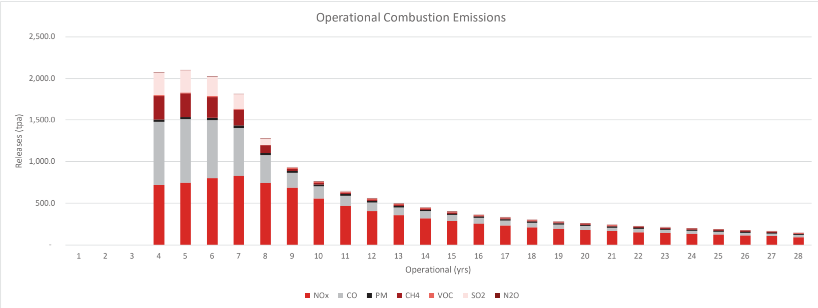
Heat and Power Load Profiles all options.xls

KSLFP-0000-PR-HMB-0011 (Case 1 Yr 5)

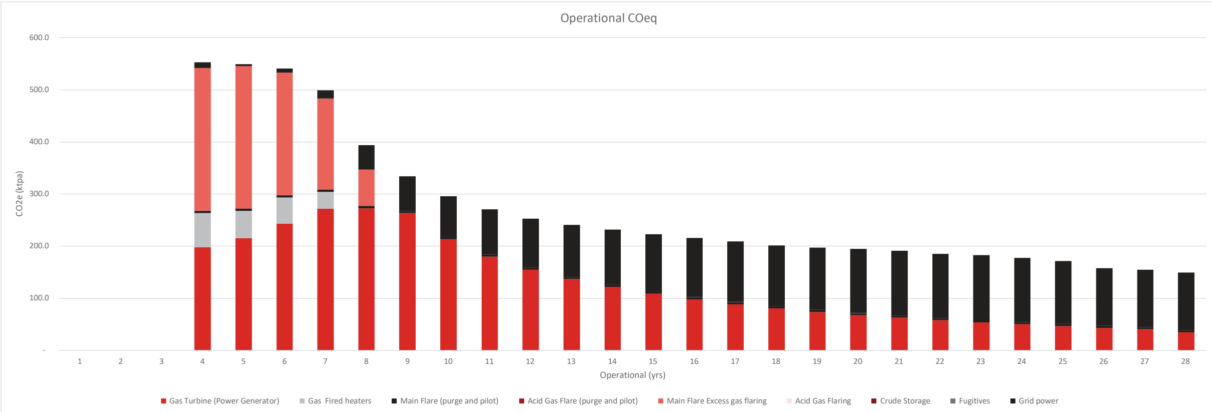
KSLFP-0000-PR-HMB-0012 (Case 1 Yr 8)

Air Dispersion Modelling Report Doc no. KSLFP-CP01-ES-RPT-0001, 19 Aug 19

Industrial designation or common name	Chemical formula	GWP values for 100-year time horizon		
		Second Assessment Report (SAR)	Fourth Assessment Report (AR4)	Fifth Assessment Report (AR5)
Carbon dioxide	CO_2	1	1	1
Methane	CH_4	21	25	28
Nitrous oxide	N_2O	310	298	265



CO2 EQUIVALENT (ktpa)



1. Reference Calculation file: Tullow Case 1 Emissions Master v3.xls

GOLDER

golder.com

D2

Noise

TECHNICAL MEMORANDUM

DATE November 11, 2016 **PROJECT No.** 1654017.511_B.0

TO Paul Mowatt
Tullow Kenya B.V

CC Oliver Patricia Arroyo; Paul Coward

FROM Stefan Cicak; Danny da Silva; Andrew Morsley **EMAIL** scicak@golder.com; Danny_daSilva@golder.com; amorsley@golder.com

REVIEW OF IFC NOISE GUIDELINE AND KENYA NOISE REGULATION SOUND LEVEL LIMITS - SOUTH LOKICHAR BASIN PROJECT

Introduction

Golder Associates Ltd. (Golder) was retained by Tullow Kenya B.V. (Tullow) to carry out a review of the *International Finance Corporation -Environmental, Health and Safety (EHS)Guidelines - Noise Management dated April 30, 2007* (IFC Noise Guidelines) and *Kenya Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations dated 2009* (Kenya Noise Regulations) with respect to the baseline noise monitoring carried out to date by Golder for the South Lokichar Basin (the Project). This technical memorandum will provide the following;

- Overview of the IFC Noise Guidelines and Kenya Noise Regulations sound level limits;
- Summary of the baseline noise monitoring carried out to date by Golder at the Ngamia and Amosing locations;
- Comparison of IFC Noise Guidelines and Kenya Noise Regulations with the baseline noise monitoring data; and
- Recommendation on IFC Noise Guidelines and Kenya Noise Regulations to the Project.

IFC Noise Guidelines and Kenya Noise Regulation Summary

The IFC Noise Guideline and Kenya Noise Regulation are documents that provide guidance in managing sound levels at specific locations. Noise is defined as unwanted sound; however, the terms noise and sound are often used interchangeably, including presenting acoustic values. Key concepts and terminology used in the assessment of outdoor acoustics is presented in Appendix A.

The following table summarizes the sound level limits presented in the IFC Noise Guideline and Kenya Noise Regulation;

Table 1: Overview of IFC Noise Guideline and Kenya Noise Regulation Sound Level Limits

	IFC		Kenya Sound Level Limit		Kenya Noise Rating Level (NR)	
	Daytime	**Nighttime**	**Daytime**	**Nighttime**	**Daytime**	**Nighttime**
Time Period Duration	0700 - 2200 (15 hrs)	2200 - 0700 (9 hrs)	0601 - 2000 (14 hrs)	2001 - 0600 (10 hrs)	0601 - 2000 (14 hrs)	2001 - 0600 (10 hrs)
Noise Metric	1 Hour LAeq (dBA)	1 Hour LAeq (dBA)	14 Hour Leq (dBA)	10 Hour Leq (dBA)	14 Hour Leq (dBA)	10 Hour Leq (dBA)
Residential; institutional; educational [1]	55 [2]	45 [2]	n/a	n/a	n/a	n/a
Industrial; commercial	70 [2]	70[2]	n/a	n/a	n/a	n/a
Maximum increase in background levels at the nearest receptor location off-site	3	3	n/a	n/a	n/a	n/a
Zone A - Silent Zone	n/a	n/a	40	35	30	25
Zone B - Places of Worship	n/a	n/a	40	35	30	25
Zone C - Residential; Indoor	n/a	n/a	45	35	35	25
Zone C – Residential Outdoor	n/a	n/a	50	35	40	25
Zone D - Mixed residential (with some commercial and places of entertainment)	n/a	n/a	55	35	50	25
Zone E - Commercial	n/a	n/a	60	35	55	25

The receiving environment for EOPS is best categorised as Residential under the IFC Noise Guideline and *Zone C Residential; Indoor* under the Kenya Noise Regulation. The *Zone C-Residential; Indoor* was selected as opposed to the *Zone C-Residential; Outdoor* since it has a lower daytime limit. However, it should be noted that the indoor noise levels will likely be achieved if the outdoor noise levels are also met.

For the purposes of this review, only the Kenya Noise Regulation *Kenya Sound Level Limit* will be compared with the IFC Noise Guidelines. Golder has assumed the Kenya Noise Regulation *Kenya Noise Rating Level* is for indoor purposes and takes into account the WHO Guidelines for Community Noise assumption that a 15 dB reduction is obtained from outdoors to indoors with a window partially open.

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1 For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999)
2 Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

In regards to the IFC Noise Guideline, it allows for either the sound level limits presented in the table or a maximum increase in background levels of 3 dB at the nearest receptor location off-site. Since noise is expressed on a logarithmic scale (i.e., 5 dB + 5 dB = 8 dB) and not a linear scale (i.e., 5 + 5 = 10), a 3 dB increase is equivalent to twice the acoustical energy. The 3 dB maximum increase in background levels considers the option for one to produce no more noise than already exists at a receptor. For example, if the existing daytime background sound level without a project is 60 dBA based on a 1-hour Leq, then the project will be limited to a noise level of 60 dBA at the receptor (i.e., 60 $dBA_{\text{Existing Background}}$ + 60 dBA_{Project} = 63 dBA_{Total}). Therefore, if the existing background sound levels are lower than the sound level limits presented in the Table 1.7.1 in the IFC Noise Guideline, the sound level limits in the table are applied, otherwise the existing background sound levels may be applied.

Finally, it is important that the sound level limits are compared against sound levels within the same period of time and metric. The IFC Noise Guideline consists of 1-hour Leq in dBA for both the daytime and nighttime periods. The Kenya Noise Regulation consists of a 14-hour Leq in dBA for the daytime period and a 10-hour Leq in dBA for the nighttime period. A 1-hour Leq compared to 14-hour Leq considers a shorter time period. Therefore an activity that is intermittent (e.g., occurs for 3 hours out of a 14-hour period) and not constant across a 14-hour period, will result in a higher 1-hour Leq compared to a 14-hour Leq since the acoustical energy associated with the activity is restricted to a smaller time period and not averaged over a longer period of time.

Baseline Noise Monitoring Overview

Golder carried out baseline noise monitoring for the Project at various locations. For the purposes of this review, the Ngamia and Amosing sites were selected to evaluate the IFC Noise Guideline and Kenya Noise Regulation sound level limits with respect to the Project. The table below summarizes the field campaigns at these two locations.

Table 2: Baseline Noise Monitoring Field Campaign Summary

Field Campaign	Location	Period
1	Amosing	October 2015
2	Amosing	January 2016
3	Amosing & Ngamia	October 2016

Comparison of Baseline Noise Summary to IFC Noise Guidelines and Kenya Noise Regulations

The baseline noise monitoring data collected was analyzed and processed such that both the IFC Noise Guideline and Kenya Noise Regulation could be evaluated. Table 3 and 4 below summarize the key baseline noise monitoring parameters associated with either the IFC Noise Guideline or Kenya Noise Regulation and the resulting Project Sound Level Limit when compared to the key baseline noise monitoring parameter.

Table 3: Summary of Baseline Noise Monitoring following IFC Noise Guideline

Period	IFC Noise Guideline Applicable Sound Level Limit (dBA)	Baseline Noise Monitoring Minimum Leq$_{1\ hr}$ (dBA)	Project Sound Level Limit (dBA) [1]
Daytime (7h-22h)	55	34 – 39	55
Nighttime (22h-7h)	45	33 – 34	45

[1] IFC Noise Guideline allows for either the sound level limits presented within it in Table 1.7.1 or a maximum increase in background levels of 3 dB at the nearest receptor location off-site. Therefore, the higher level between Baseline Noise Monitoring Minimum Leq $_{1\ hr}$ and IFC Noise Guideline Sound Level Limit was selected.

Table 4: Summary of Baseline Noise Monitoring following Kenya Noise Regulation

Period	Kenya Noise Regulation Applicable Sound Level Limits (dBA)[1]	Baseline Noise Monitoring Average Leq $_{Period}$ (dBA)[2]	Project Sound Level Limit (dBA)[3]
Daytime (6h-20h)	45	46 – 63	45
Nighttime (20h-6h)	35	34 – 45	35

[1] Zone C Residential - Indoor applied
[2] Period averages based on data available. Some periods did not contain data for the entire daytime or nighttime period
[3] Kenya Noise Regulation sound level limits are described as maximum permissible and does not include an option to consider existing background sound levels. Therefore the Kenya Noise Regulation Sound Level Limits was selected.

Recommendation

Golder recommends the use of the IFC Noise Guideline for the Project.

The Kenya Noise Regulation sound level limits are definitive whereas the IFC Noise Guideline provides the opportunity for the baseline sound levels to be considered in defining the Project sound level limits. When baseline data is processed for comparison against Kenyan Noise regulations, the baseline noise monitoring data indicates higher average Leq noise levels during the daytime and nighttime period than defined in the Kenya Noise Regulation and there is no option to take baseline into consideration. Golder has direct experience implementing the IFC Noise Guideline for other projects in Africa and as a result, we are confident that it is also suitable for use on this project.

Furthermore, the comparison between the baseline noise monitoring, the IFC Noise Guideline and Kenya Noise Regulation, resulted in higher Project sound level limits should the IFC Noise Guideline be used. The higher sound level limits may provide the Project the opportunity to consider other design options, including the level of noise mitigation controls, if any, to be implemented.

Finally, it is important to note that compliance with sound level limits does not guarantee that noise complaints will not occur and it would be best that a process be put in place to address noise complaints in the event they do occur.

Appendix A – Definition of Technical Terms

- "**Noise**" or "**noise levels**" refers to the levels that can be heard or measured at a Point of Reception (POR).
- A noise "**receptor**" or POR is a location where an assessment, measurements or predictions of noise levels are made.
- The "**level**" of a noise is expressed on a logarithmic scale, in units called decibels (dB). Since the scale is logarithmic, a noise that is twice the noise level as another will only be three decibels (3 dB) higher.
- Noise emissions and noise levels have an associated frequency. The human ear does not respond to all frequencies in the same way. Mid-range frequencies are most readily detected by the human ear, while low and high frequencies are harder to hear. Environmental noise levels used in this assessment are presented as "**A weighted decibels**" (or dBA), which incorporates the frequency response of the human ear.
- The "**percentile noise level**", designated Ln, is the noise level exceeded "n" percent of a specified time period and is measured in dBA. The L_{90}, for instance, is the noise level exceeded 90% of the time. It is a noise level index that commonly refers to the baseline noise level and is most often referenced in a rural setting.
- Outdoor noise is usually expressed as an "**equivalent noise level**" ($L_{eq, T}$), which is a logarithmic average (i.e., energy average) of the measured or predicted noise levels over a given period of time (T). An equivalent noise level measured or predicted over the nighttime period would be referred to as Leq, night.
- Environmental noise levels vary throughout the day and it is therefore important to distinguish between the time of day (i.e., daytime / nighttime). The IFC Noise Guideline and Kenya Noise Regulation both are divided into the daytime and nighttime period but with different time period durations, see Table 1.

SC/Dd/AM

https://golderassociates.sharepoint.com/sites/102240/technical work/wip/esia draft/annex i/group 4 - ia supporting docs/7.2. noise/1654017 511_tullow eops_ifc kenya noise review_11nov2016.docx

1.0 TECHNICAL MEMORANDUM

DATE 08/06/2020 **Reference No.** 1433956.648.A0.

TO Paul Mowatt, Oliver McCredie Tullow KBV,

FROM Andrew Morsley, Rachel Lansley **EMAIL** amorsley@golder.com

NOISE MODELLING ADDITIONAL INFORMATION

The quantitative noise modelling referred to in the ESIA was developed based on the results of noise modelling conducted as part of the Front End Engineering Design (FEED) Worley Parsons Noise Study (Annex I). The following information relates to the noise modelling undertaken by Worley Parsons (Worley Parsons, 2019. Tullow Oil Kenya B.V. Kenya South Lokichar Foundation Project: Noise Modelling Study) as part of FEED using the SoundPLAN software tool.

Golder has not independently verified the data used in the assessment, however Golder has adopted the outputs of the assessment completed by a recognised competent consultancy, with the assumption that Quality Assurance (QA) checks were completed by Worley Parsons. The Noise Study represents the final proposed design of the Project, including noise mitigation. The modelled equipment is representative of the most significant noise sources relating to the Project.

The Golder assessment detailed in Chapter 7.2 is based on the Worley Parsons assessment scenarios and associated outputs. Golder have used the Worley Parsons FEED noise model to undertake further quantitative noise prediction modelling using the Computer Aided Noise Attenuation (CadnaA) noise modelling software, applying the modelling algorithms based on *ISO 9613 Acoustics: Attenuation of Sound during Propagation Outdoors (International Organization for Standardization 1993 and 1996)* [ISO 1993 and 1996].

The following data relate to the Worley Parsons Assessment.

1.0 MODEL SCENARIOS

The following scenarios were considered:

Scenario A: Routine operation of the CPF

Scenario A1: Routine Operation of the IWMF

Scenario B: Drilling Operations at a Generic Wellpad

Scenario C: Operational Phase at a Generic Wellpad

Scenario D: Operational Phase at Turkwel Dam Pontoon and Chemical Injection AGI

2.0 MODEL INPUT DATA

2.1 Topography & Terrain

The study area was assumed to be flat, which most closely approximates the actual topography in the modelling domain. To account for ground effects on sound propagation, the following ground absorption factors (G) were used:

- G = 0.7 - Hard terrain (compacted field and gravel) was assumed within the industrial area and the well pad.
- G = 1.0 - Soft terrain was assumed across the remaining modelling domain, typical of non-compacted ground and pasture field.

2.2 Obstacles Modelling

Obstacles of large volume within the wellpad, CFA and IWMF, such as buildings and large tanks, were introduced into the model as building elements to account for the screening and reflection effects of sound . Modelled elements and their corresponding heights are listed in Appendix C. Obstacles to noise propagation located outside of the CFA or the wellpad, such as residential buildings in settlements, were not considered. Small elements, such as pipes and racks, were not included as noise sources or sound barriers in this assessment. Golder undertook a sensitivity analysis of alternative obstacle dimensions, where applicable, and incorporated these into the assessment.

Table 1: Obstacles Included in the Model

Description	No.	Worley Parsons Model Dimensions (m)		
		Length	Width	Height
Tanks				
T-2901 Water Injection Buffer Tank	1	--	48.0	9.0
T-3301 On-Spec Crude Oil Storage Tank 1	1	--	46.0	9.0
T-3302 On-Spec Crude Oil Storage Tank 1	1	--	46.0	9.0
T-3304 On-Spec Crude Oil Storage Tank 1	1	--	30.0	9.0
T-4101 On-Spec Crude Oil Storage Tank 1	1	--	11.5	9.0
T-4401 Produced Water Settling Tank 1	1	--	21.0	9.6
T-4402 Produced Water Settling Tank 2	1	--	21.0	9.6
T-4404 Off-Spec Water Tank	1	--	42.0	10.0
Buildings				
CFA				

Description	No.	Worley Parsons Model Dimensions (m)		
		Length	Width	Height
Main CFA Gatehouse / Security Building	1	6.0	11.0	3.0
CFA Ancillary				
Gatehouse – 2 (South)	1	6.0	5.5	2.6
Warehouse – 1	1	50.0	30.0	7.0
Warehouse – 2	1	50.0	30.0	7.0
Workshop – 1	1	24.0	24.0	6.0
Workshop – 2	1	24.0	24.0	6.0
Permanent Camp				
Admin Office – 1	1	24.0	18.0	3.0
Religious Facilities – 1	1	24.0	20.0	3.5
Permanent Camp- can be used by construction				
Gatehouse – 1 (South of permanent camp)	1	6.0	5.5	2.6
Management Cabin	120	12.0	3.0	2.6
Junior Staff Cabin	60	12.0	3.0	2.6
Mess Hall / Kitchen / Diner	1	35.0	15.0	3.0
Laundry – 1	1	12.0	9.0	3.7
Medical Centre – 1	1	36.0	18.0	3.5
Mini-Market	1	12.0	6.0	2.6
Clubhouse	1	20.0	12.0	3.5
Multisport Hall	1	45.0	25.0	7.0
Gym & Fitness Room	1	24.0	12.0	3.7
CFA Construction Camp				
Admin Office – 3	1	24.0	18.0	2.6
Workshop	1	25.0	20.0	6.5
Religious Facilities – 1	1	24.0	20.0	2.6

Description	No.	Worley Parsons Model Dimensions (m)		
		Length	Width	Height
Management Cabin	564	12.0	3.0	2.6
Junior Staff Cabin				
Labour Cabin				
Ablutions Block for Labour Cabin				
House Keeping Store Rooms				
Laundry	4	12.0	6.0	3.7
Drillers Warehouse				
Warehouse	8	72.0	24.0	7.0
CFA – IWMF Integrated				
Hazardous Material Storage	1	24.0	24.0	2.6
CPF – Central Processing Facility				
Gatehouse (South)	1	6.0	5.5	2.6
Main Substation – 1	1	51.0	38.0	8.0
Water Injection Pump Shelter	2	12.0	6.0	2.6
Substation – 2	1	32.0	19.0	8.0
LP / MP / HP Booster Compressor Shelter	2	24.0	24.0	2.6
Well pad				
Chemical Injection Pumps Shelter	1	6.0	4.0	4.0

2.3 Emissions Data

Table 2: Noise Emission Rates used in the Model

Description	Source Type	Height (m)	Lw (dBA)
Compressors(1)			
Train 1 Booster Compressor	Linear	3.5	104.6
Train 2 Booster Compressor	Linear	3.5	104.6

Description	Source Type	Height (m)	Lw (dBA)
Make-up Water Filter Air Blower	Point	1.5	96
Compressor and Instrument Air Dryer Package	Linear	3.5	104.6
Water Injection Booster Pump	Point	1.5	93
Water Injection Pump	Point	1.5	93
Oil Recovery Transfer Pump	Point	1.5	78
IGF Package Feed Pump	Point	1.5	93
IGF Sludge Transfer Pumps	Point	1.5	93
IGF Recycle Water Pumps	Point	1.5	93
IGF Solids Transfer Pumps	Point	1.5	93
Filtration Package Recycle Water Pump	Point	1.5	93
Filtration Package Recycle Water Pump	Point	1.5	93
Filtration Package Sludge Transfer Pump	Point	1.5	93
Filtration Package Sludge Transfer Pump	Point	1.5	93
Water Injection Booster Pump	Point	1.5	93
Air Coolers(2)			
Oil Storage Air Cooler (4 bays in parallel/4 fans per bay)	Point	15.0	81.0
Train 1 Booster Compressor LP Stage Inlet Cooler (1 bay/3 fans per bay)	Point	15.0	96.0
Train 1 Booster Compressor MP Stage Inlet Cooler (1 bay/2 fans per bay)	Point	15.0	96.0
Train 1 Booster Compressor HP Stage Inlet Cooler (1 bay/2 fans per bay)	Point	15.0	96.0
Train 1 Booster Compressor Discharge Air Cooler	Point	15.0	96.0

Description	Source Type	Height (m)	Lw (dBA)
Train 2 Booster Compressor LP Stage Inlet Cooler (1 bay/2 fans per bay)	Point	15.0	96.0
Train 2 Booster Compressor MP Stage Inlet Cooler (1 bay/2 fans per bay)	Point	15.0	96.0
Train 2 Booster Compressor HP Stage Inlet Cooler (1 bay/2 fans per bay)	Point	15.0	96.0
Train 2 Booster Compressor Discharge Air Cooler	Point	15.0	96.0
Heating Medium Return Dump Cooler (3 bays in parallel/3 fans per bay)	Point	5.0	96.0
Fired Heaters(3)			
Fired Heater 1	Point	1.5	88.0
Fired Heater 2	Point	1.5	88.0
Pumps(4)			
Dehydrator / Desalter Feed Pump	Point	1.5	78.0
Hot Water Recycle Pump	Point	1.5	93.0
Oil Storage Feed Pump	Point	1.5	78.0
Ngamia high CO_2 pump	Point	1.5	78.0
Train 1 Booster Compressor LP Scrubber Pump	Point	1.5	78.0
Train 1 Booster Compressor MP Scrubber Pump	Point	1.5	78.0
Train 1 Booster Compressor HP Scrubber Pump	Point	1.5	78.0
Train 2 Booster Compressor LP Scrubber Pump	Point	1.5	78.0
Train 2 Booster Compressor MP Scrubber Pump	Point	1.5	78.0
Train 2 Booster Compressor HP Scrubber Pump	Point	1.5	78.0
Water Injection Booster Pumps	Point	1.5	93.0

Description	Source Type	Height (m)	Lw (dBA)
Water Injection Pumps	Point	1.5	93.0
Oil Export Booster Pumps	Point	1.5	93.0
Heating Medium Circulation Pumps	Point	1.5	93.0
Mineral Oil Supply Pump	Point	1.5	93.0
Corrosion Inhibitor Injection Pump	Point	1.5	78
Scale Inhibitor Injection Pump	Point	1.5	78
Oxygen Scavenger Injection Pump	Point	1.5	78
Antifoam Injection Pump	Point	1.5	78
Demulsifier Injection Pump	Point	1.5	78
Biocide Injection Pump	Point	1.5	78
Water Clarifier Injection Pump	Point	1.5	78
Hypochlorite Injection Pump	Point	1.5	78
IGF Package Feed Pumps	Point	1.5	93.0
Oil Recovery Transfer Pump	Point	1.5	78.0
IGF Sludge Transfer Pump	Point	1.5	93.0
Recycle Water Pumps	Point	1.5	93.0
Off-Spec Tank Pumps	Point	1.5	93.0
Make-up Water Pumps	Point	1.5	93.0
Deaerated Make-up Water Transfer Pumps	Point	1.5	93.0
Flare Knock Out Drum Pump	Point	1.5	78.0
Service Water Pump	Point	1.5	93.0

Description	Source Type	Height (m)	Lw (dBA)
Potable Package Water Pump	Point	1.5	78.0
Process Open Drains Sump Pump No. 1	Point	1.5	78.0
Process Open Drains Sump Pump No. 2	Point	1.5	78.0
Utilities Open Drains Sump Pump No. 1	Point	1.5	78.0
Utilities Open Drains Sump Pump No. 2	Point	1.5	78.0
Closed Drains Pump (reduced to 1 off)	Point	1.5	78.0
Diesel Storage Pump	Point	1.5	78.0
Primary Sludge Decant Pump	Point	1.5	93.0
Sanitary Waste Pump	Point	1.5	78.0
Power Generation Units(5)			
Gas Turbine (GT) Power Generation System			
Enclosure Walls - Each (GT Length)	Area	4.4	101.1
Enclosure Walls - Each (GT Width)	Area	4.4	96.2
Enclosure Roof	Area	4.4	102.4
Air Intake	Area	12.5	97.6
Ventilation Inlet	Area	6.5	89.3
Waste Heat Recovery Unit (WHRU)			
Walls Radiated – Each (WHRU Length)	Area	12.0	102.8
Walls Radiated – Each (WHRU Width)	Area	12.0	98.8
WHRU Stack Exit(6)	Point	21.0	96.0
Valves(7)			

Description	Source Type	Height (m)	Lw (dBA)
Valves at Water Injection Pumps	Point	1.2	96.0
Flares(8)			
Main CPF Flare & Acid Gas (CO_2) Flare	Point	(8, 9)	(8, 9)
LEF(10)			
Crude oil pipeline pumps (2 working)	Point	1.5	96
IWMF			
Incinerator (9)	Point	1.0	96.0
Anaerobic Digestor (small pump)	Point	1.0	78.0
Effluent Treatment Package (small pump)	Point	1.0	78.0
Recycling Shelter (10)	Point	1.0	78.0
Wellpad Operation			
Chemical Injection Pump	Point	0.8	78.0
Flow Reduction Valve/ Multi-stage Restriction Orifice (11)	Point	0.8	96.0
Wellpad Drilling			
Drilling Equipment (12)	Point	2.0	104.9
Turkwel Dam			
Pontoon Pumps (part of PM11-A-5001A/B) (13)	Point	1.0	93.0
Hypochlorite Injection Pump (part of PM11-A-4201)	Point	1.0	78.0

Notes:

1. Modelled to fit 85 dB(A) SPL measured 1 m from a linear (8.5 m long) source. Calculated sound power: 104.6 dB(A).

2. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 96 dB(A), assuming spherical sound propagation from each fan, which is elevated from the floor.

3. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 93 dB(A), assuming spherical sound propagation from equipment placed on the floor.

4. Fired heaters operating at 50% capacity (if at all), burners at grade; modelled to fit 80 dB(A) SPL measured at 1m from source. Calculated sound power: 88 dB(A).

5. The GT and the Waste Heat Retrieval Unit (WHRU) were modelled as area sources (except the WHRU stack exit) and the sound power was adjusted to generate the maximum allowable emission based on project requirements (85 dB(A) measured 1 m from each piece of equipment).

6. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 96 dB(A), assuming spherical sound propagation. The effect of sound directivity was incorporated into the modelled noise propagation from the WHRU stack exit.

7. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 96 dB(A), assuming spherical sound propagation from each valve, which is elevated from the floor.

8. For ground flare purging (operating) condition is from 0 to 7 mmscfd, and for CO2 flare 0 to ½ mmscfd. Ground flares are co-located. Ground flare is modelled to fit 58 dB(A) SPL measured 50 m beyond vendor's wind shield.

9. Incinerator is in a building. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 96 dB(A), assuming spherical sound propagation, which is elevated 1.0m from grade.

10. Intermittent noise as operators sort waste.

11. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 96 dB(A), assuming spherical sound propagation from each valve, which is elevated 0.8 m from grade.

12. As indicated, noise emitted values were between 51.3 and 56.9 dB(A) as measured at 100 m from a similar operating exploration rig. Assuming spherical sound propagation from equipment placed at grade, the calculated sound power is 99.3 – 104.9 dB(A). The highest value was modelled.

13. Modelled to fit 85 dB(A) SPL measured 1 m from the source. Calculated sound power: 93 dB(A), assuming spherical sound propagation from pumps located at grade.

3.0 MODEL OUTPUT

The following mitigated outputs are taken from the assessment:

Table 3: Summary of Results

	Boundary			
	North	South	East	West
CFA including IWMF (Mitigated- Case B.2.12)				
SPL at CFA Fence-line (dBA)	54	45 (49 at SW corner)	43	42
Distance from Fence-line to 45 dBA	0	0 (218 m to SW corner)	0	0
Wellpad Drilling (mitigated)				
SPL at CFA Fence-line (dBA)	<30	<30	<30	45
Distance from Fence-line to 45 dBA	0	0	0	0
Wellpad Drilling (unmitigated)				
SPL at CFA Fence-line (dBA)	49- 52	49- 52	49- 52	49- 52
Distance from Fence-line to 45 dBA	114	114	114	114
Turkwel Dam(1)				

Notes:

1. The 45 dB(A) isophone from the pontoon pumps just encroaches on the shoreline, and majority of that is within the land allocation, and there is no concern that manyattas could be impacted as the high-water level is just above the 40 dB(A) isophone. Chemical injection pump noise contour just exceeds land allocation and enclosure could be retro fitted if required. No further mitigation is required.

Golder Associates (UK) Ltd

DRAFT	DRAFT
Rachel Lansley	Andy Morsley
ESIA Practitioner	*Project Director*

RL/AM/mb

Water Quantity

D3

TULLOW OIL KENYA B.V.

Kenya South Lokichar Foundation Project

Flood Risk Assessment

Document No KSLFP-0000-EG-STU-0001

05 Feb 2019

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1.1 Synopsis

This document details the updated flood risk assessment to support land acquisition at the well pads, central facilities area and airstrip.

1.2 Disclaimer

This report has been prepared on behalf of and for the exclusive use of Tullow Oil Kenya B.V., and is subject to and issued in accordance with the agreement between Tullow Oil Kenya B.V. and WorleyParsons. WorleyParsons accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party. Copying this report without the permission of Tullow Oil Kenya B.V. or WorleyParsons is not permitted.

PROJECT 405000-00323 - Kenya South Lokichar Foundation Project - Flood Risk Assessment

Rev	Description	Original	Review	WorleyParsons Approval	Revision Date	Approval Date
A	Issued for Client Review	J Assem	N King	C Hedley	20 Dec 2018	
0	Issued for Design	J Assem	N King	C Hedley	05 Feb 2018	HK

Contents

Appendices

1. Introduction

1.1 Purpose

The purpose of this document is present and discuss the updated flood modelling results, incorporating Lidar data, to allow the determination of potential land take requirements for Company's south Lokichar development in Kenya.

1.2 Scope

The scope of the document is to update the Digital Elevation Model for the area of interest; undertake flood modelling of the inflows to the site area baseline (no development); and, flood modelling of the inflows to the site area with the proposed facilities and infrastructure with suggested mitigation options.

1.3 Definitions

Company	Tullow Kenya B.V
Contractor	WorleyParsons Europe Ltd and/or its associate companies
Shall	indicates a mandatory requirement
Should	indicates that a provision is not mandatory, but recommended as good practice
Subcontractor	Any person or persons, firm, partnership, corporation or combination thereof engaged by Contractor to perform any part of the work
Supplier	A company identified in a Purchase Order to supply equipment and/or materials and technical data pertaining thereto

1.4 Abbreviations

Abbreviation	Description
2D Model	Model flow is in 2 directions along the main flow route (upstream and downstream) but also out of bank and overland.
AD	Above datum
CFA	Central Facilitates Area
DTM / DEM	Digital Terrain Model / Digital Elevation Model
FEED	Front End Engineering Design
FRA	Flood Risk Assessment

Abbreviation	Description
GIS	Geographical Information System
Q100	1 in 100 year return period peak flow

1.5 References

Document No.	Document Title
305008-51692-00-EN-REP-0102	Water Management, Flood Risk Assessment Site Report
305008-51692-00-GM-REP-0102	Topographic Survey Report
305008-51692-00-CI-REP-0005	Access Roads Concept Report (infield and Access to Site)
3050008-51692-00-GE-BOD-0101	Infrastructure and Logistics Concept Study - Phase 1 Development Kenya Basis of Design
KSLFP-WPR-EG-STU-0004-B	Site Selection Study
USDA (2004a)	National Engineering Handbook, Part 630 Hydrology, Estimation of Direct Runoff from Storm Rainfall, Chapter 10
USDA (2004b)	National Engineering Handbook, Part 630 Hydrology, Hydrologic Soil Cover Complexes, Chapter 9
USDA (2004c)	National Engineering Handbook, Part 630 Hydrology, Hydrographs, Chapter 16

2. Methodology

The methodologies followed in this updated flood risk assessment (FRA) were developed in line with technical guidance documents such as USDA, 2004 (a-c).

The approach used has been to update the existing hydraulic model to predict the design flood level (1 in 100 year for fluvial flooding) to incorporate the more refined topographical data (Lidar) and revised development and infrastructure locations. This has been used to Identify any necessary mitigation measures (e.g. flood defences) and residual flood risks post mitigation.

The development of the unit hydrograph for use in the flood modelling has used the rainfall and flood hydrograph calculations developed at Concept Phase as described in 305008-51692-00-EN-REP-0101 Rev0 Water Management, Flood Risk Assessment Report (Advisian, 2015). This was done for four catchment areas (a to d) as shown in Figure 1.

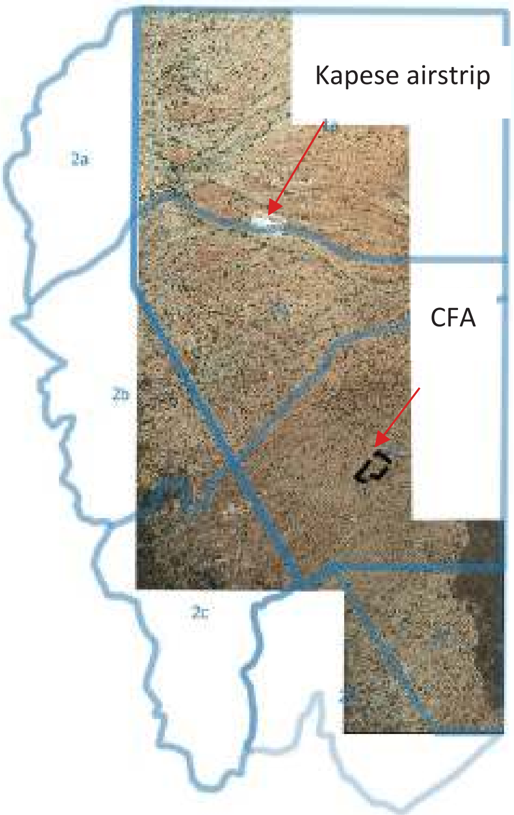


Figure 1 Catchment Areas

Within this updated flood risk assessment (FRA), the following steps where followed.

1. Update of Digital Elevation Model for the area of interest
2. Flood modelling of the inflows to the site area baseline (no development)
3. Flood modelling of the inflows to the site area with the proposed facilities and infrastructure and suggested mitigation options

Flood modelling has used the 2-dimensional modelling code, TUFLOW.

As identified in the previous Concept Phase executed in 2015 (Doc. Ref. 305008-51692-00-EN-REP-0101), the lack of locally measured long-term datasets limits the accuracy of the flood modelling results. This is not unusual in remote areas. Predictions of flooding parameters e.g. flood levels, flow velocities, are inherently less accurate in remote areas, when compared to areas where measurements have been made over several years. Therefore, care needs to be taken when interpreting the results of the analysis. The results need to be kept in context of the data used to drive the models. This means that flood mitigation options need to be designed more conservatively than in areas that are data rich.

3. Model Update

3.1 Topographic Data

LiDAR data was acquired for a subsection of the modelled area as shown in Figure 2. This has been merged with the existing DTM (described in 305008-51692-00-EN-REP-0101) for the wider area. The addition of the LiDAR has increased the resolution across the areas of interest, with better defined lugga channels.

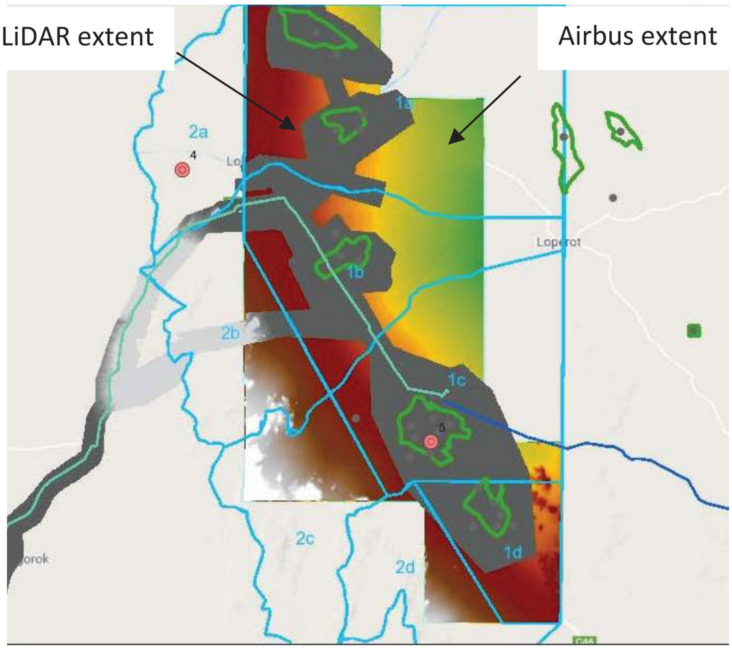


Figure 2 Extent of LiDAR data

However, processing of the Lidar data from the Digital Surface Model to create a Digital Terrain Model (DTM) has resulted in rounding to a metre, removing all decimal places. This has created a stepped effect across the LiDAR area as shown in Figure 3. The impact on the overall model results is considered to be insignificant but it should be taken into account when looking at the results in more detail. The effect can be seen as ripple on the flood model results presented in latter sections. It is recommended that reprocessing is undertaken to include the decimal places and remove the step, creating a smoother profile.

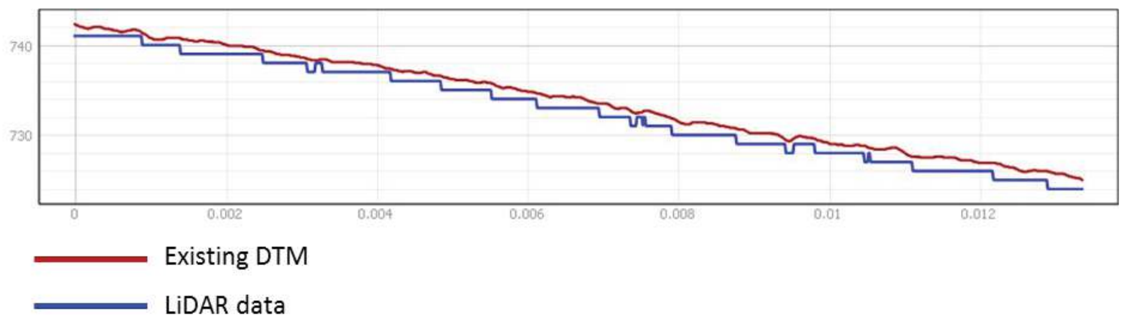


Figure 3 Stepping in the new LiDAR data

3.2 Development Locations

The locations of the Central Facility Area (CFA) and well pads have been confirmed or changed between Concept and Front-End Engineering Design (FEED) stages. The locations of the firm and contingent well pad locations, CFA and airstrip have been updated in the model.

3.2.1 Central Facility Area

A site selection study for the CFA was conducted in the FEED phase 1 (KSLFP-WPR-EG-STU-0004-B). The selected location and shape of the CFA is shown in Figure 1.

3.2.2 Firm Well Pads

The revised locations of the firm wells pads are described in Table 1.

Table 1 Locations of firm well pads

Field	Pad	Manifold Centre Location		Notes
		Easting	Northing	
Ngamia (NG)	NG-01	807071.94	244275.58	Unchanged from BOD rev 3A
	NG-02	805719.95	245412.04	Moved from Contingent to firm
	NG-03	807192.35	245879.36	Unchanged from BOD rev 3A
	NG-04	805957.84	244563.53	Unchanged from BOD rev 3A
	NG-07	808330.46	245431.52	Unchanged from BOD rev 3A
	NG-08	807660.70	244856.39	Unchanged from BOD rev 3A
	NG-09	807052.82	243430.30	Unchanged from BOD rev 3A
	NG-11	806839.07	245205.80	Unchanged from BOD rev 3A
	NG-12	806444.56	244309.20	Formerly NG-18
	NG-13	806182.50	245951.27	Formerly contingent pad NG-45
	NG-14	807795.74	244036.41	Formerly NG-15
	NG-15	807831.39	245670.58	Formerly NG-16
	NG-16	806424.39	245355.07	Formerly contingent pad NG-33

Field	Pad	Manifold Centre Location		Notes
		Easting	Northing	
	NG-17	808125.76	244542.39	Formerly NG-12
	NG-18	807698.78	246263.33	Formerly contingent pad NG-39 - Moved ~ 266m South
	NG-19	806837.33	246394.36	Formerly NG-13
	NG-20	806014.01	243845.24	Formerly contingent pad NG-35
	NG-21	805747.50	246421.37	Formerly contingent pad NG-22
	NG-22	806276.77	246907.58	Formerly NG-14
Amosing (AM)	AM-01	811935.29	239074.52	Unchanged from BOD rev 3A
	Am-03	811487.90	240005.78	Unchanged from BOD rev 3A
	Am-04	812812.63	238428.03	Unchanged from BOD rev 3A
	AM-07	811792.96	238345.49	Minor change (~2m) in pad centre coordinates
	AM-08	812662.31	239352.97	Unchanged from BOD rev 3A
	AM-09	810509.70	240660.16	New pad location added post BOD Rev 3A
	AM-10	812117.55	240209.69	Formerly AM-09
	AM-11	812406.80	237411.68	Formerly contingent pad AM-13
Twiga (TW)	TW-04	801368.75	266468.1	

3.2.3 Contingent Well Pads

The locations of the contingent well pads are described in Table 2.

Table 2 Locations of contingent well pads

Field	Pad	Manifold Centre Location		Notes
		Easting	Northing	
Ngamia (NG)	NG-10	805556.43	243127.97	Unchanged from BOD rev 3A
	NG-23	806362.99	242769.28	Formerly NG-27
	NG-24	805428.19	244429.52	Formerly NG -31
	NG-25	805119.29	243682.26	Formerly NG-36
	NG-26	805251.67	245177.03	Formerly NG-32
	NG-27	805061.65	245717.98	Formerly NG-34
	NG-28	804538.34	245409.24	Formerly NG-23
	NG-29	804315.71	246113.75	Formerly NG-24
	NG-30	804555.01	246715.61	Formerly NG-21
	NG-31	803618.05	246376.91	Formerly NG-25
	NG-32	805643.47	242308.36	Formerly NG-28
	NG-33	806451.09	242295.27	Formerly NG-29
	NG-34	806057.51	241668.33	Formerly NG-30
	NG-35	807149.94	242866.68	Formerly NG-26
	NG-36	807743.12	243142.64	Formerly NG-19
	NG-37	808280.36	245994.61	Formerly NG-17
	NG-38	809070.70	244974.96	Unchanged from BOD rev 3A
	NG-39	808901.42	245759.04	Formerly NG-37
	NG-40	809728.16	245311.03	Unchanged from BOD rev 3A
	NG-41	810299.28	244512.40	Unchanged from BOD rev 3A
	NG-42	810540.35	245269.32	Unchanged from BOD rev 3A

Field	Pad	Manifold Centre Location		Notes
		Easting	Northing	
	NG-43	808766.53	243782.42	Unchanged from BOD rev 3A
	NG-44	804994.70	242106.25	Unchanged from BOD rev 3A
	NG-45	805226.20	246997.80	Formerly NG-20
	NG-46	805022.31	246559.73	Unchanged from BOD rev 3A
Amosing (AM)	AM-05	810382.16	241008.08	Unchanged from BOD rev 3A
	AM-06	809944.64	238317.86	Unchanged from BOD rev 3A
	AM-12	810853.50	241420.75	New pad location added post BOD Rev 3A
	AM-13	810798.28	242253.98	Formerly AM-16 - Moved ~ 350m South
	AM-14	811260.00	237348.75	Unchanged from BOD rev 3A
	AM-15	809770.61	239733.79	Unchanged from BOD rev 3A
	AM-16	811100.15	238921.99	Formerly AM-10
	AM-17	810513.54	239762.06	Formerly AM-11
	AM-18	809766.42	240386.61	Formerly AM-12
Twiga (TW)	TW-01	802064.3	265933.31	
	TW-02	800467.06	265919.31	
	TW-03	802398.55	266967.4	1

3.2.4 Kapese Airstrip

At the Concept stage a number of options for the Airstrip were identified. Modification of the existing Kapese airport has been selected as the preferred option to carry forward in FEED. The location is shown in Figure 1.

4. Flood Modelling Results

Based on the methodology outlined in Section 2, the TUFLOW hydraulic models were simulated for the 1 in 100 year return period rainfall events (Q100).

4.1 Baseline Scenario Results

Baseline Scenario flood behaviour within the study area was shown to be variable due to the topographic variation of the luggas. Areas of both shallow expansive flooding, as well as discrete regions of deeper flow depths and higher velocities are evident within the study area. The following sections summarise the general flow conditions in more depth around the Central Facility location, the proposed airstrip, and the well pad locations.

It should be noted that the depths and velocities described below are highly variable across the project site. This is due to the undulating nature of the terrain across the floodplain and in particular, the overbank areas, and the processing of the Lidar data to create the DTM.

Figure 4 shows the baseline model Q100 results for the entire study area. The proposed facilities and infrastructure have been superimposed on the figure to indicate their locations with respect to the baseline flood extents.

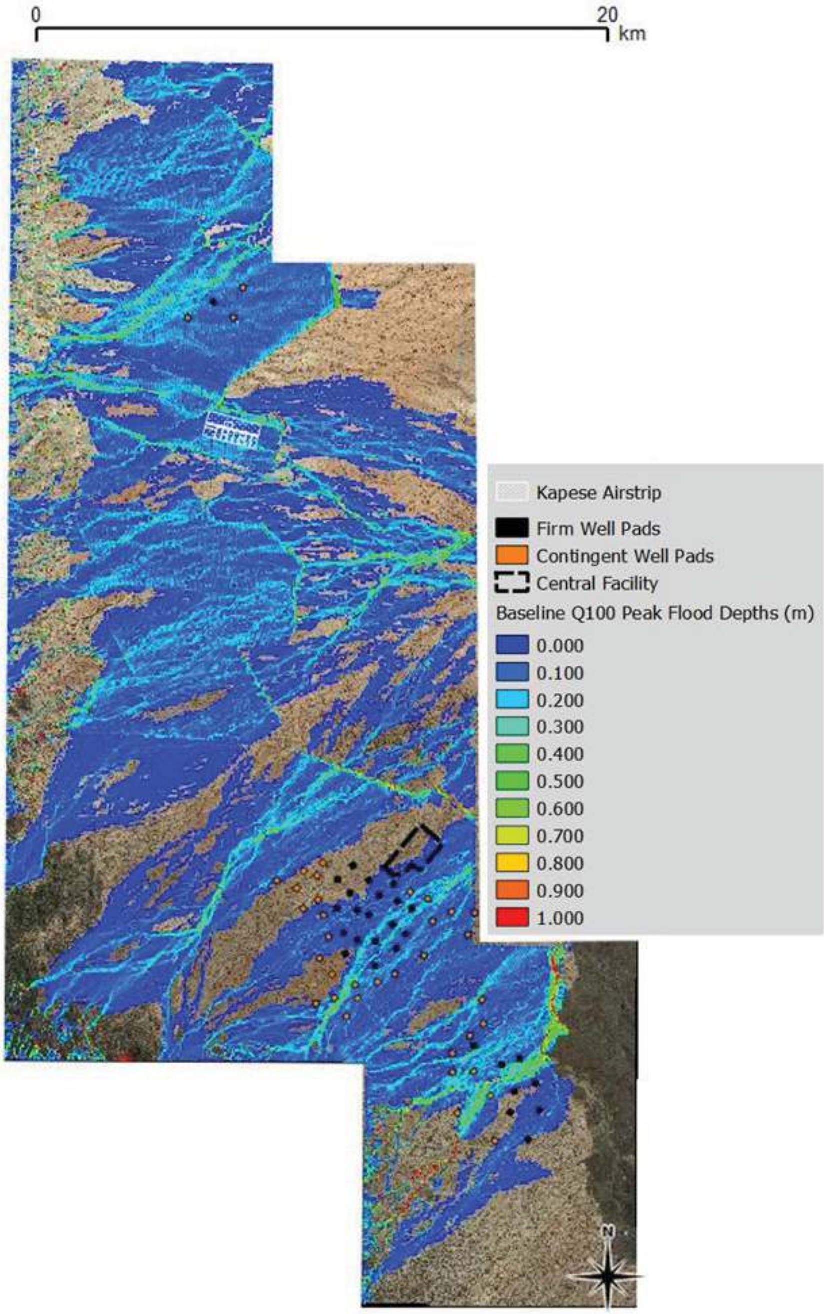


Figure 4 Overview of the Q100 Baseline Scenario flood results over the study area

4.1.2 Central Facility Area

The location for the CFA is shown in Figure 5. This shows it is located between two major luggas.

Modelling results suggest that the majority of surface water flow will be contained within luggas to the south of the site. However, at high flows it is expected that there will be a significant amount of very shallow expansive flooding which will occur in the south and east of the CFA (see Figure 5).

Peak flooding depths in the CFA are predicted to reach 0.2 m in the Q100 event, with peak velocities of approximately 0.3 $m.s^{-1}$.

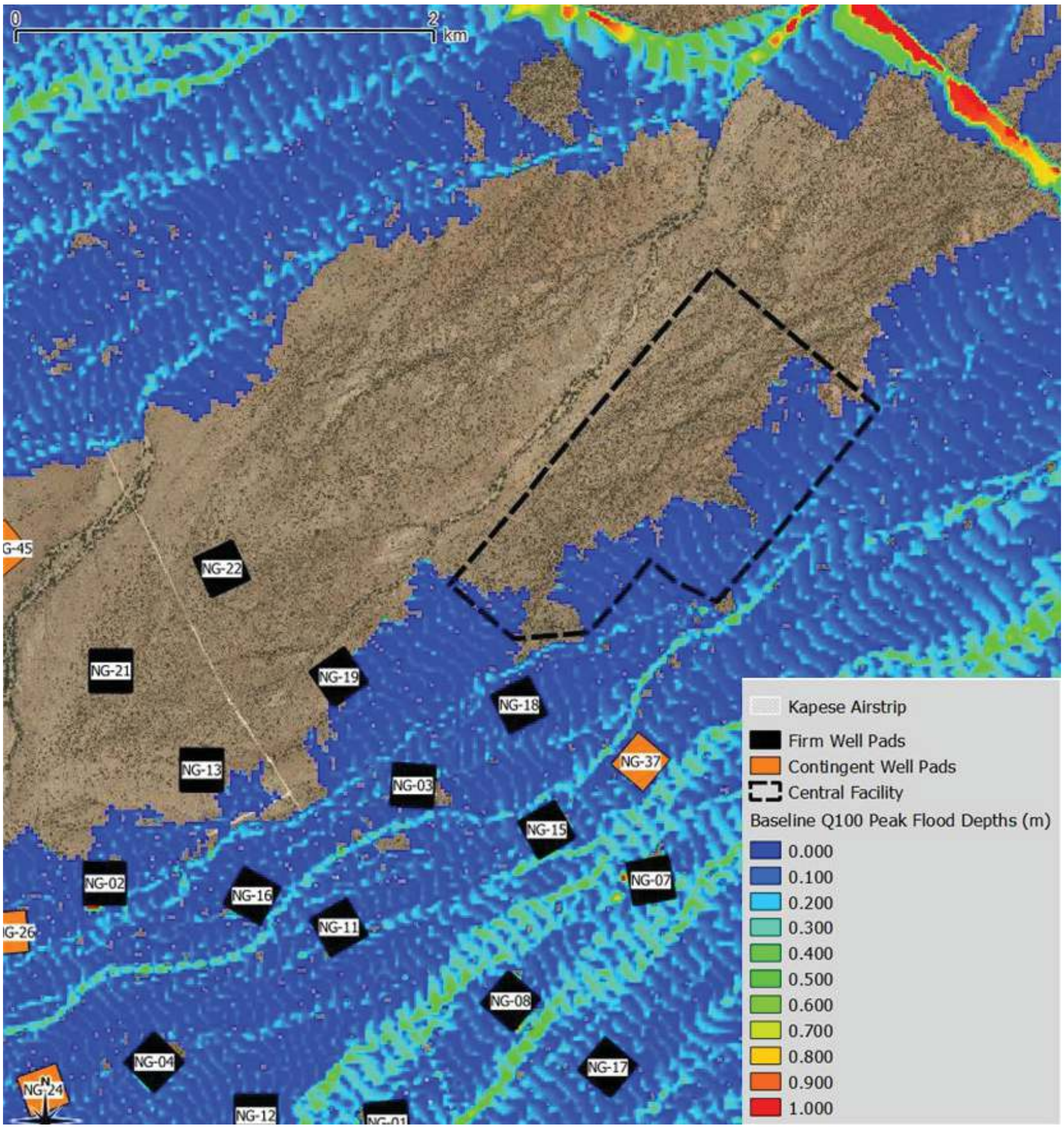


Figure 5 Q100 Baseline Scenario flood depths at the CFA

4.1.3 Firm Well Pads

The modelling results indicate that some of the firm well pads are located on naturally flood free ground and would need very little, if any, flood protection. These are detailed in Table 3. Other firm well pads are in areas of low to moderate flooding. For the well pads at risk, the peak flooding depths and peak flooding velocities are highlighted in

Table 4.

Figure 6, Figure 7 and Figure 8 show the flood model results for the three well fields.

Table 3 Firm well pads not at risk from flooding.

Field	Pad	Manifold Centre Location	
		Easting	Northing
Ngamia (NG)	NG-13	806182.50	245951.27
	NG-19	806837.33	246394.36
	NG-20	806014.01	243845.24
	NG-21	805747.50	246421.37
	NG-22	806276.77	246907.58
Amosing (AM)	AM-01	811935.29	239074.52
	AM-07	811792.96	238345.49
	AM-08	812662.31	239352.97

Table 4 Peak flood depths and velocities – firm well pads

Field	Pad	Peak flood depth (m)	Peak flood velocity ($m.s^{-1}$)
Ngamia (NG)	NG-01	1.78	1.40
	NG-02	0.91	0.27
	NG-03	2.85	0.59
	NG-04	0.65	0.62
	NG-07	0.66	1.98
	NG-08	1.30	0.94
	NG-09	0.91	1.24
	NG-11	0.25	1.15
	NG-12	0.21	0.79

Field	Pad	Peak flood depth (m)	Peak flood velocity (m.s^{-1})
	NG-14	0.22	1.07
	NG-15	0.38	1.99
	NG-16	0.26	0.71
	NG-17	0.30	0.55
	NG-18	0.19	0.18
	NG-19	0.09	0.01
	Am-03	1.05	1.39
	Am-04	0.49	0.44
	AM-08	0.18	0.005
	AM-09	0.30	0.71
	AM-10	0.73	1.98
	AM-11	0.22	0.18
Twiga (TW)	TW-04	0.27	0.67

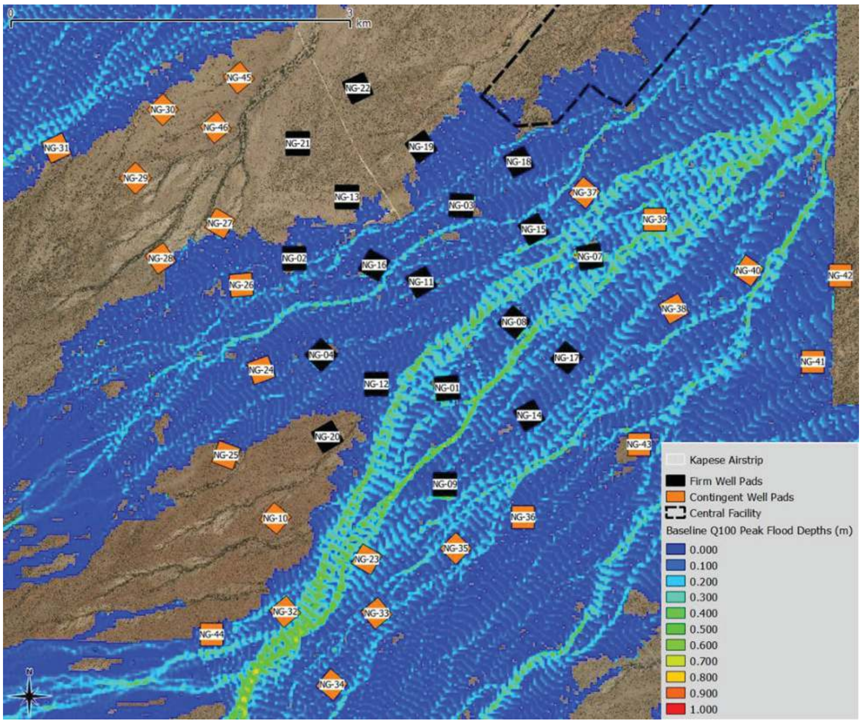


Figure 6 Baseline Q100 flood depths at the Ngamia well pads

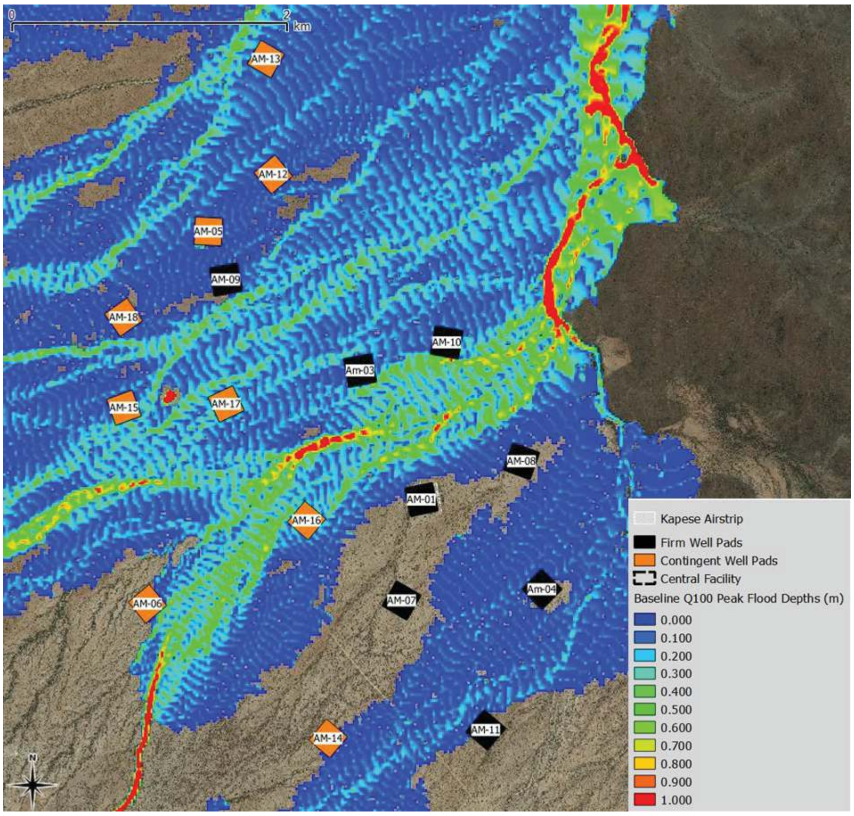


Figure 7 Baseline Q100 flood depths at the Amosing well pads

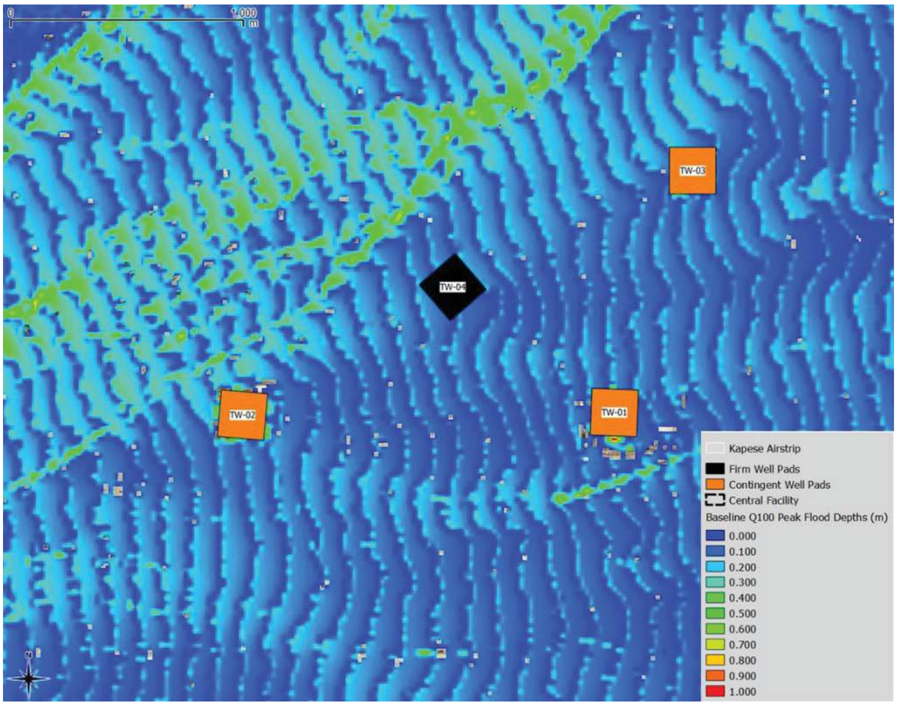


Figure 8 Baseline Q100 flood depths at the Twiga well pads

4.1.4 Contingent Well Pads

The model results suggest that some of these well pads are in areas not at risk from flooding (see Table 5) whilst the rest are in areas of low to moderate flooding.

Table 5 Contingent well pads not at risk from flooding

Field	Pad	Manifold Centre Location	
		Easting	Northing
Ngamia (NG)	NG-10	805556.43	243127.97
	NG-29	804315.71	246113.75
	NG-30	804555.01	246715.61
	NG-45	805226.20	246997.80
	NG-46	805022.31	246559.73

For the well pads at risk, the peak flooding depths and peak flooding velocities are highlighted in Table 6. Figure 6, Figure 7 and Figure 8 show the model results for the three groups of contingent well pads.

Table 6 Peak flood depths and velocities – contingent well pads

Field	Pad	Peak flood depth (m)	Peak flood velocity (m.s^{-1})
Ngamia (NG)	NG-23	0.34	1.74
	NG-24	0.18	0.15
	NG-25	0.18	0.13
	NG-26	0.34	0.81
	NG-27	0.02	0.0006
	NG-28	0.2	0.06
	NG-31	0.22	0.41
	NG-32	0.43	1.41
	NG-33	0.35	1.20
	NG-34	0.22	0.52
	NG-35	0.31	1.13
	NG-36	0.26	0.37
	NG-37	0.32	1.09
	NG-38	0.20	0.30
	NG-39	0.43	1.51
	NG-40	0.23	0.79
	NG-41	0.24	0.36
	NG-42	0.32	0.16
	NG-43	0.18	0.56
	NG-44	0.34	1.10

Field	Pad	Peak flood depth (m)	Peak flood velocity (m.s^{-1})
Amosing (AM)	AM-05	0.94	0.43
	AM-06	0.37	1.83
	AM-12	0.19	0.15
	AM-13	0.27	0.42
	AM-14	0.23	0.12
	AM-15	0.36	2.5
	AM-16	0.40	2.12
	AM-17	0.37	2.77
	AM-18	0.28	0.21
Twiga (TW)	TW-01	0.49	0.76
	TW-02	1.62	0.79
	TW-03	0.87	0.58

4.1.5 Kapese Airstrip

The Kapese airstrip is located between two major luggas. Model results suggest that the airstrip is at risk from flooding (see Figure 9) in the 1 in 100-year event with a simulated flood depth of 0.8 m and a peak flood velocity of approximately 2.3 m.s^{-1}.

It should be noted that the airstrip is located close to the boundary of the LiDAR data, where water has pooled within the model as an effect of the LiDAR and DTM merging process. This will have the effect of over-estimating the flood depth due to water being "held-up" at this point.

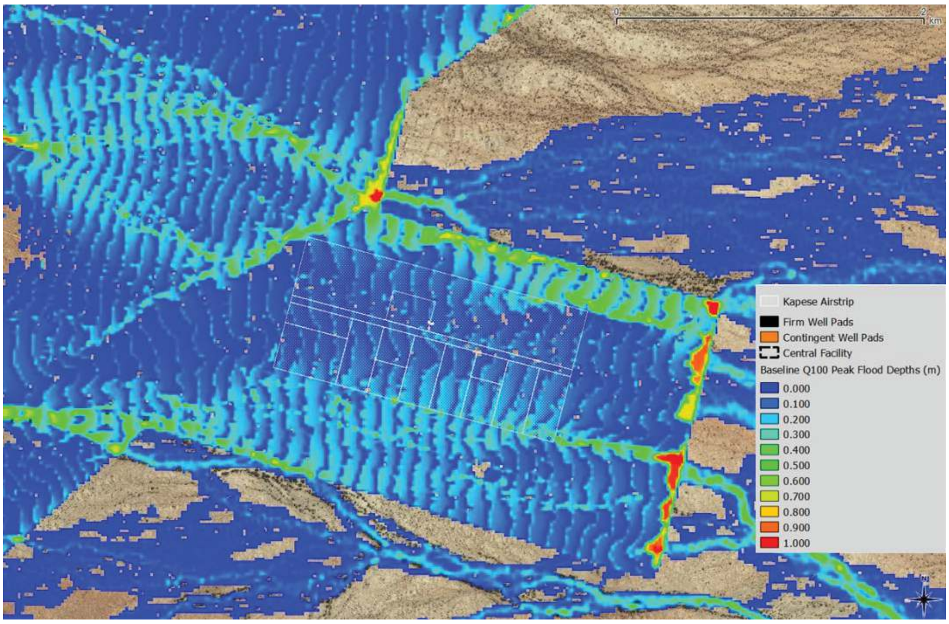


Figure 9 Baseline Q100 flood depths at the Kapese airstrip

4.2 Mitigation Scenario Results

Modelling results suggest that the facilities and infrastructure have been located in areas of shallow expansive flooding. Mitigation measures can be designed to significantly reduce the impact of flood events on the proposed infrastructure. These consist of flood diversion channels and flood protection bunds on affected boundaries of the CFA, well pads and Kapese airstrip.

4.2.1 Central Facility Area

The planned re-graded profile of the CFA is shown in Figure 10. The DTM was modified to include this data and re-run to define the potential flood risk and mitigation options.

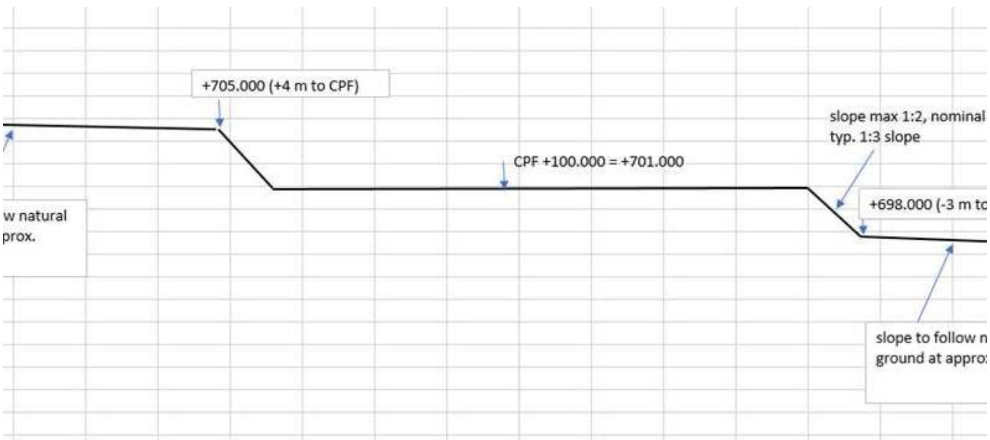


Figure 10 Site preparation level

A 0.5 m flood diversion channel with a 0.5 m flood protection bund along the south and west sides of the site is suggested to provide sufficient flood protection for the proposed CFA.

However, it should be noted road drainage associated with the access road to the CPF may modify this to a certain extent.

Impacts on surface water flows downstream of the CFA due to the mitigation are not expected to result in significant changes to the flow regime as it is deflecting away from the south-eastern edge rather than flow diversion.

4.2.2 Firm Well Pads

Firm well pads in flooded areas have been evaluated on an individual basis to ensure the required flood protection is designed. The general approach to flood protection has been to divert the flood waters, using bund walls and/or localised channel diversions, around the well pads to minimise flow disruption.

For the firm well pads a 0.5 m deep channel with a 0.5 m high bund, providing a total flood defence height of 1 m, around the upstream side of the pads has been proposed as sufficient flood protection in the 1 in 100 year event. The design calculations for this mitigation are detailed Appendix A. These calculations demonstrate that the peak flow can be dealt with by the diversion channel. The flood protection mitigation was then simulated within the model. Figure 11 shows the model results for this mitigated scenario at well pad NG-08.

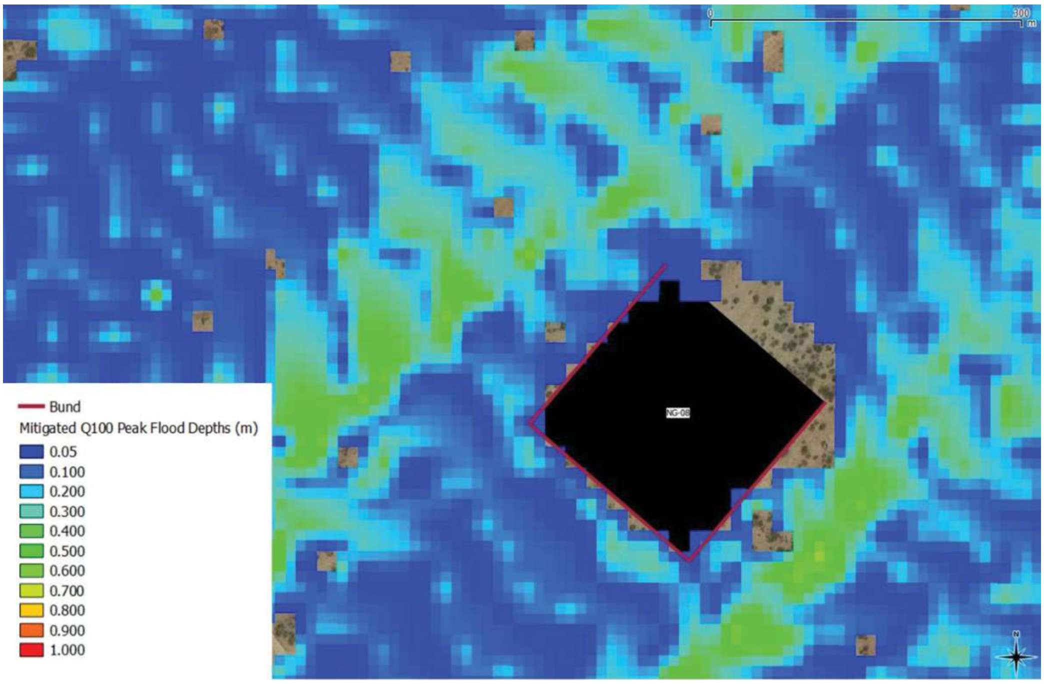


Figure 11 Mitigated Q100 flood depths for well pad NG-08

4.2.3 Contingent Well Pads

The proposed mitigation for the contingent well pads is described in Table 7. Some of the pads require a 0.5 m channel with a 0.5 m bund. For the remaining pads, a 0.5 m bund will be sufficient.

Table 7 Contingent well pads proposed mitigation

Well Pad	Proposed mitigation
NG-10	0.5 m flood protection bund
NG-23	0.5 m flood protection bund
NG-24	0.5 m flood protection bund
NG-25	0.5 m flood protection bund
NG-26	0.5 m flood protection bund
NG-27	None required
NG-28	None required
NG-29	None required
NG-30	None required
NG-31	0.5 m flood protection bund
NG-32	0.5 m flood protection bund
NG-33	0.5 m flood protection bund
NG-34	0.5 m flood protection bund
NG-35	0.5 m flood protection bund
NG-36	0.5 m flood protection bund
NG-37	0.5 m channel with 0.5 m bund
NG-38	0.5 m channel with 0.5 m bund
NG-39	0.5 m flood protection bund
NG-40	0.5 m channel with 0.5 m bund
NG-41	0.5 m flood protection bund
NG-42	0.5 m channel with 0.5 m bund

Well Pad	Proposed mitigation
NG-43	0.5 m flood protection bund
NG-44	None required
NG-45	None required
NG-46	0.5 m channel with 0.5 m bund
AM-05	0.5 m flood protection bund
AM-06	0.5 m flood protection bund
AM-12	0.5 m flood protection bund
AM-13	0.5 m flood protection bund
AM-14	0.5 m flood protection bund
AM-15	0.5 m flood protection bund
AM-16	0.5 m channel with 0.5 m bund
AM-17	0.5 m channel with 0.5 m bund
AM-18	0.5 m channel with 0.5 m bund
TW-01	0.5 m channel with 0.5 m bund
TW-02	0.5 m channel with 0.5 m bund
TW-03	None required

4.2.4 Kapese Airstrip

It is proposed that 1 m channels along the long sides of the airstrip with flood bunds at the upstream end of the strip will provide sufficient flood protection.

5. Mitigation

The new LiDAR data has shown to have an increase resolution in the modelling of the lugga channels. However, the processing to derive the DTM has resulted in a stepped profile. It is recommended that the DTM is reprocessed to provide a higher accuracy akin to the DSM.

The Baseline Scenario flood behaviour within the study area was shown to be variable due to the topographic variation of the luggas. Areas of both shallow expansive flooding, as well as discrete regions of deeper flow depths and higher velocities are evident within the study area.

The modelling results suggest that the flood risk to the CFA, well pads and Kapese airstrip can be mitigated using flood diversion channels and flood protection.

Appendix A. Well Pad Flood Mitigation Calculations

Wellpad	Catchment	Upstream catchment (km^2)	Peak upstream $m^3.s^{-1}$	Height	Base	Slope 1 in	A	P	R	Q	Comments
NG-01	c	0.95	1.42	0.6	0.8	2	1.20	3.48	0.34	1.7	Existing wellpad with channel
NG-02	c	1.67	0.60	0.5	0.3	2	0.65	2.54	0.26	0.7	Existing wellpad with channel
NG-03	c	0.11	0.16	0.5	0.3	2	0.65	2.54	0.26	0.7	Existing wellpad with channel
NG-04	c	0.17	0.21	0.5	0.3	2	0.65	2.54	0.26	0.7	Interfluve / minor lugga
NG-07	c	0.14	0.21	0.5	0.3	2	0.65	2.54	0.26	0.7	Between luggas
NG-08	c	0.21	0.31	0.5	0.5	2	0.75	2.74	0.27	0.9	Between luggas
NG-09	c	0.4	0.60	0.5	0.5	2	0.75	2.74	0.27	0.9	Interfluve / minor lugga
NG-11	c	0.35	0.33	0.5	0.3	2	0.65	2.54	0.26	0.7	Interfluve<0.1 m depth
NG-12	c	1.3	1.50	0.6	0.8	2	1.20	3.48	0.34	1.7	Interfluve<0.1 m depth
NG-13	c	n/a	0.00								
NG-14	c	0.18	0.24	0.5	0.3	2	0.65	2.54	0.26	0.7	Interfluve / minor lugga
NG-15	c	0.18	0.22	0.5	0.8	2	0.90	3.04	0.30	1.1	Interfluve / minor lugga
NG-16	c	0.77	1.05	0.6	0.8	2	1.20	3.48	0.34	1.7	Interfluve / minor lugga
NG-17	c	0.16	0.22	0.5	0.3	2	0.65	2.54	0.26	0.7	Interfluve<0.1 m depth
NG-18	c	0.14	0.21	0.5	0.3	2	0.65	2.54	0.26	0.7	Interfluve<0.1 m depth
NG-19	c	n/a	0.00								
NG-20	c	n/a	0.00								
NG-21	c	n/a	0.00								
NG-22	c	n/a	0.00								

WorleyParsons
resources & energy

TULLOW

Wellpad	Catchment	Upstream catchment (km^2)	Peak upstream $m^3.s^{-1}$	Height	Base	Slope 1 in	A	P	R	Q	Comments
AM-01	d	n/a	0.00								
AM-03	d	0.65	2.01	0.75	0.8	2	1.73	4.15	0.42	2.7	edge of lugga
AM-04	d	2.8	3.35	0.5	0.3	2	0.65	2.54	0.26	0.7	Interfluve<0.1 m depth
AM-07	d	n/a	0.00								
AM-08	d	n/a	0.00								
AM-09	d	0.8	0.89	0.5	0.5	2	0.75	2.74	0.27	0.9	edge of lugga
AM-10	d	0.1	0.45	0.5	0.5	2	0.75	2.74	0.27	0.9	Edge of lugga Channel diversion
AM-11	d	0.99	3.12								Interfluve<0.1 m depth
TW-04	a	0.56	1.12	0.5	0.8	2	0.9	3.04	0.3	1.1	minor lugga

Wellpad	Catchment	Upstream catchment (km^2)	Peak upstream m^3.s^{-1}	Height	Base	Slope 1 in	A	P	R	Q
NG-10	c	n/a	0.00							
NG-23	c	0.18	0.27	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-24	c	0.19	0.28	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-25	c	0.23	0.07	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-26	c	0.23	0.34	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-27	c	0.6	0.30	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-28	c	n/a	0.00							
NG-29	c	n/a	0.00							
NG-30	c	n/a	0.00							
NG-31	c	0.4	0.22	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-32	c	0.16	0.15	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-33	c	0.35	0.52	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-34	c	0.04	0.06	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-35	c	0.11	0.16	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-36	c	0.18	0.27	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-37	c	0.42	0.63	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-38	c	0.69	1.03	0.6	0.3	2	0.90	2.98	0.30	1.1
NG-39	c	0.96	1.44	0.7	0.3	2	1.19	3.43	0.35	1.7
NG-40	c	0.2	0.30	0.5	0.3	2	0.65	2.54	0.26	0.7

Wellpad	Catchment	Upstream catchment (km^2)	Peak upstream m^3.s^{-1}	Height	Base	Slope 1 in	A	P	R	Q
NG-41	c	0.98	1.47	0.7	0.5	2	1.33	3.63	0.37	1.9
NG-42	c	0.2	0.30	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-43	c	0.88	1.32	0.6	0.8	2	1.20	3.48	0.34	1.7
NG-44	c	0.08	0.03	0.5	0.3	2	0.65	2.54	0.26	0.7
NG-45	c	n/a	0.00							
NG-46	c	n/a	0.00							
AM-05	d	0.25	1.12	0.5	0.8	2	0.90	3.04	0.30	1.1
AM-06	d	0.49	0.04	0.5	0.3	2	0.65	2.54	0.26	0.7
AM-12	d	0.12	0.54	0.5	0.3	2	0.65	2.54	0.26	0.7
AM-13	c	0.12	0.18	0.5	0.3	2	0.65	2.54	0.26	0.7
AM-14	d	0.41	0.04	0.5	0.3	2	0.65	2.54	0.26	0.7
AM-15	d	0.11	0.49	0.5	0.3	2	0.65	2.54	0.26	0.7
AM-16	d	0.14	0.62	0.5	0.3	2	0.65	2.54	0.26	0.7
AM-17	d	0.34	1.52	0.6	0.8	2	1.20	3.48	0.34	1.7
AM-18	d	0.56	2.50	0.8	0.5	2	1.68	4.08	0.41	2.6
TW-01	a	0.46	0.92	0.6	0.5	2	1.02	3.18	0.32	1.4
TW-02	a	0.46	0.92	0.6	0.5	2	1.02	3.18	0.32	1.4
TW-03	a	0.49	0.98	0.6	0.5	2	1.02	3.18	0.32	1.4

1.1 PRELIMINARY HYDROLOGICAL REVIEW OF TURKWEL DAM

INTRODUCTION
As part of the series of technical studies being undertaken on options for strategic water supply, the hydrology of Turkwel Dam and its catchment were reviewed. This technical report presents the results of the study. The report number (1.1) corresponds to the number allocated to this piece of work in the list of technical studies. The results of study 1.2 (on the reliable yield of the dam)are also reported here. Turkwel Dam is one of the options for strategic water supply currently being investigated. The design figure being used for Tullow's total water requirement for the Lokichar Basin Phase 1 Development, leading into Production, is 24,000 m^3/day (0.278 m^3/s), and this is the water demand figure used throughout this report.

TURKWEL DAM CATCHMENT AREA
Turkwel Dam, owned and managed by the Kerio Valley Development Authority (KVDA) is located on the western margin of the Rift Valley, just before the river drops into the Rift Valley below. A few kilometres downstream of the dam, the river is joined by the Malmalte River (also known as the Weiwei), which drains the adjacent catchment to the south and provides significant additional flow. The river then flows north and eastwards through semi-arid lands to Lake Turkana. The combined Turkwel and Malmalte flows sustain a riparian forest totalling 40,000 ha fringing the Turkwel River along its route to the lake. This forest is utilised by local people, with some cultivation, including some irrigation from the river. Figure 1 shows the general layout.

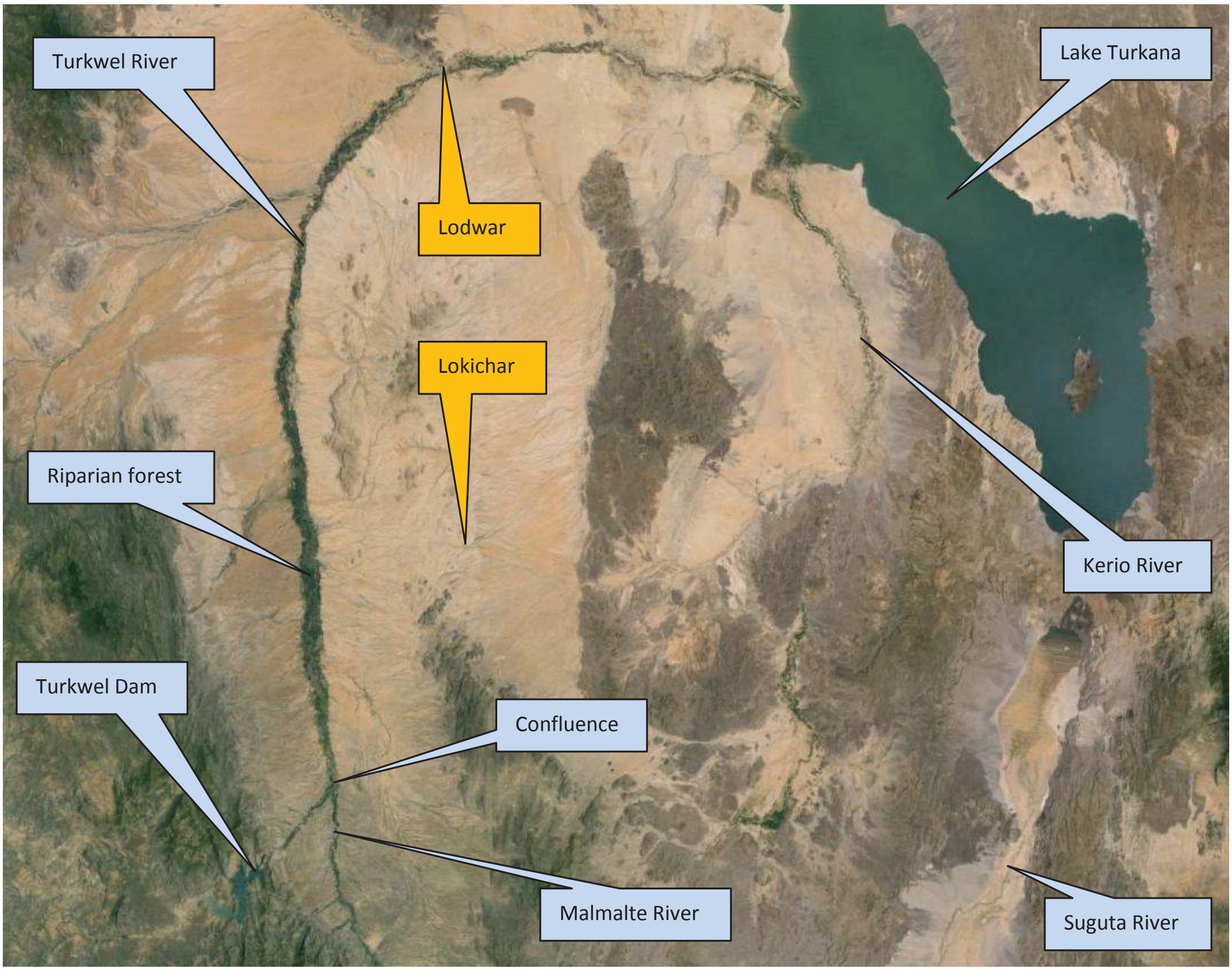


Figure 1: General layout of hydrological features
Basemap from Google Earth

The dam's total catchment area is about 5,900 km^2, broken down as shown in Table 1 and Figure 2.

Table 1: Turkwel Dam sub-catchment flow contributions

Sub-catchment	Area (km^2)	Mean annual rainfall (mm)	Flow contribution (% at dam)
Upper Suam to Kongelai	1,350	1,125	70.0
Kanyang'areng to Kanyao	1,900	680	22.5
Kanyao to Kanyao	700	925	7.5
Suam below Kongelai & Kanyao	1,950	720	Near zero
Totals (or overall average)	5,900	825	100

Source: Turkwel Dam preliminary design document extracts provided by KVDA; also for Figure 2.

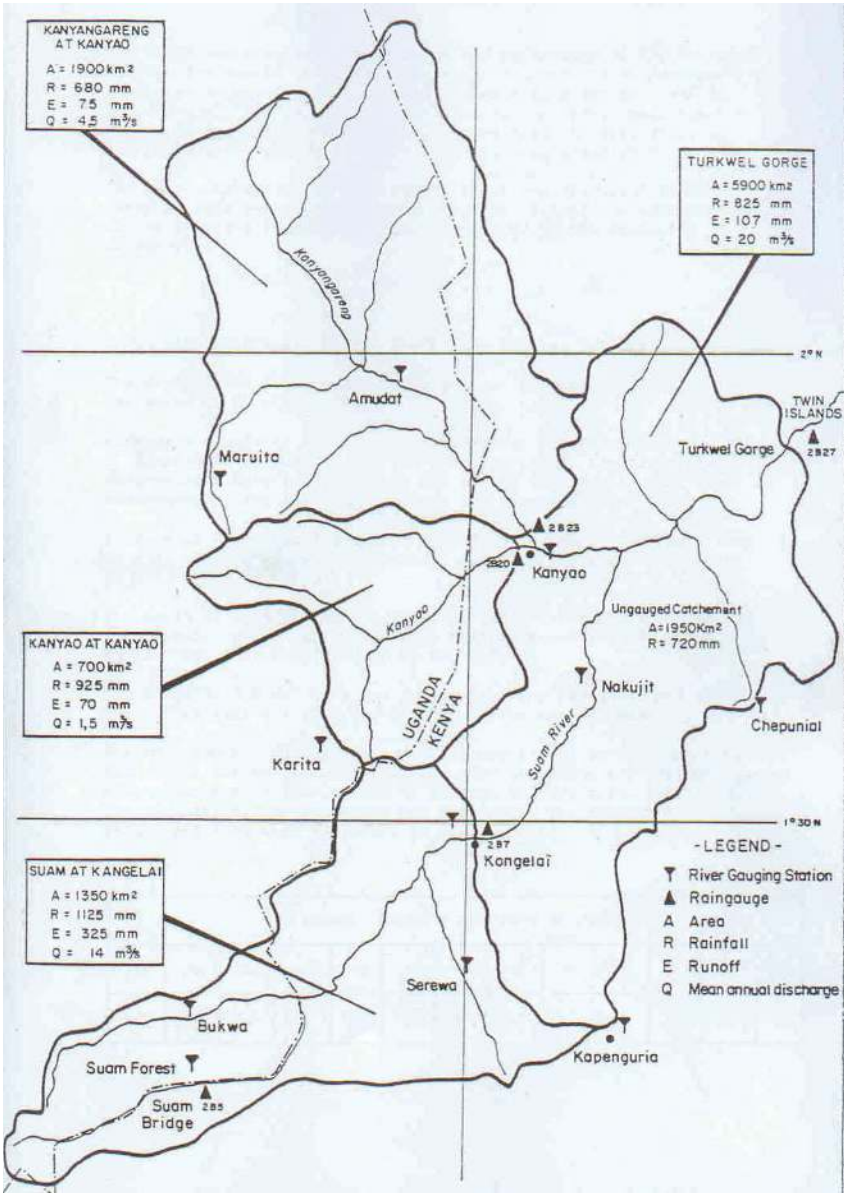


Figure 2: Turkwel Dam catchment & sub-catchments
Note that symbols for RGS and raingauge are reversed in the legend

The river's highest point is on Mt Elgon, in the far south-west of the catchment, which receives over 1,200 mm rainfall per year. At the dam, rainfall is less than half that, and by the time the river reaches Lodwar, the annual rainfall is less than 200 mm. Referring to Figure 2:

South-western sub-catchment
This is the main tributary (in terms of flow), with headwaters comprising three streams from Mt Elgon, two of which rise within Uganda. The Suam River drains 1,350 km^2 to River Gauging Station (RGS) 2B07 at Kongelai. Annual average rainfall is 1,125 mm. This sub-catchment comprises only 25% of the total catchment area at the dam, but contributes 70% of the flow at the dam.

North-western sub-catchment
This sub-catchment drains 2,600 km^2 from Karamoja in Uganda. There are two seasonal tributaries, proportioned as follows: Kanyang'areng River, 1,900 km^2 at RGS 2B23 at Kanyao, annual rainfall 680 mm, and contributing 22.5% of total flow at the dam; Kanyao River, 700 km^2 at RGS 2B20 at Kanyao, annual rainfall 925 mm, and contributing 7.5% of total flow at the dam.

Lower Suam sub-catchment: This is the catchment area from Kongelai and Kanyao down to Turkwel Gorge, with annual rainfall averaging 720 mm, but reported to contribute very little river flow to the total. Thus, whilst the majority of the dam's water inflow is generated within Kenya's boundaries, a major portion of the catchment area is in Uganda, and the Karamoja portion is a dry area characterised by large seasonal flows that can convey high sediment loads.

INFLOW ASSESSMENTS AT THE TURKWEL DAM SITE

The main hydrological reports for the Turkwel Dam date from over 30 years ago and were not available from KVDA. However, sufficient information has been gleaned from various supporting documents that were available. When Turkwel Dam was designed, considerable data manipulation was undertaken as there was very limited site-specific data available. Flow estimates varied, and the dam's final design adopted a mean annual discharge of 18 m^3/s; earlier estimates were as high as 24 m^3/s.

In 1992, the Japan International Cooperation Agency (JICA) team of Nippon Koei presented a national water master plan for Kenya, in which flow simulations were undertaken for all major river basins including the Turkwel and Kerio basins. Unfortunately, the data published for Turkwel Dam were inconsistent - the average flow in the flow duration analysis was 24.6 m^3/s, whereas the tabulated rainfall-runoff model simulation computed the naturalised mean monthly discharge to be 14.3 m^3/s. The same JICA team has updated the country's national water master plan 20 years later, in 2012, but the individual river sequences have unfortunately not been presented in their report.

The three main inflowing river gauging stations at Kongelai and Kanyao have been visited. They have not been operational for some years. Hence, there is no recent river gauging station data with which to update the dam inflow hydrology. However, reservoir operational data for Turkwel dam can be used to derive flow sequences. The Turkwel Dam flow database that has been utilised consists of the following:

- 1939 to 1978: Flows "infilled" by WLPU Consultants;
- 1978 to 1985: Measured river discharges;
- 1985 to 1991: Missing data;
- 1991 to 2012: Flows simulated from KVDA/KenGen from Turkwel reservoir operational records.

DAM OPERATION WATER LEVELS AND FLOWS

KVDA kindly provided monthly water levels for the period of dam operation from 1990 to 2014. These are plotted in Figure 3. Also plotted are the following three key reservoir operating levels, namely: the full supply level (the spillway level), at 1,150 m above sea level (masl); the optimum operating level (1,131 masl); and the minimum operating level (1,105 masl, set a few metres higher than the headrace intake). Since it was commissioned, the Turkwel Reservoir has never spilled and the full design flow expectation of 18 m^3/s has never been realised; instead, a lower throughput of 15.4 m^3/s has been recorded since 1990. The dam has however been able to generate power, albeit operating at below optimum operating level until recently.

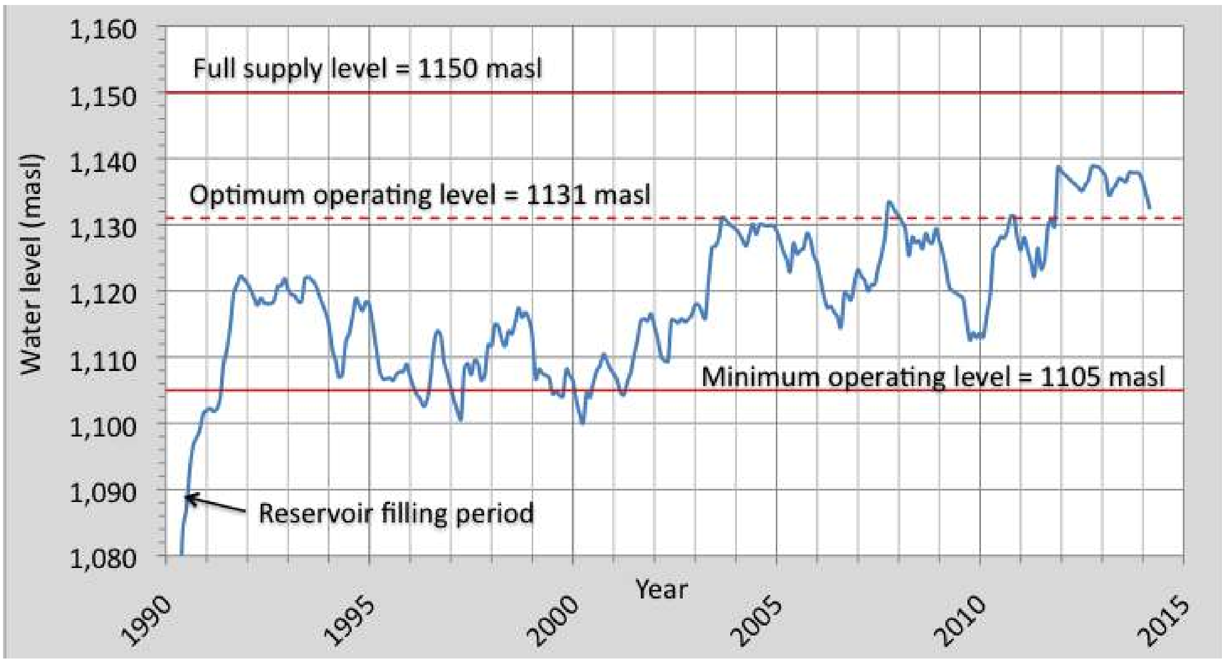


Figure 3: Turkana Dam water Levels since 1990

Two sets of discharge measurements are compiled at the dam:

1) Machine Discharge: This is the quantity of water passing through the turbines. The discharge computation methodology has not yet been provided by KVDA, but is understood to comprise an algorithm relating discharge to the average reservoir head and overall machine efficiency.
2) Test Flow: This is the reservoir inflow calculated by KVDA, and presumed to be from the spreadsheet-based reservoir water balance model incorporated within the dam monitoring procedures; the model uses a monthly time step. The net evaporation loss in each month is calculated, based on the average daily effective rainfall on the reservoir and the average daily surface water evaporation. The evaporation loss is the product of the reservoir surface area and the standard net evaporation loss value for the month in question. The daily reservoir water level is measured at the dam, and the change in reservoir storage is calculated from the day-to-day water level changes. The dam monitoring procedures include algorithms relating surface area and storage to water level. Thus the inflow is calculated from the following simple water balance equation:

   TEST FLOW = INFLOW = MACHINE.Q + EVAP - RAIN + VOL.FROM.STORAGE

The KVDA Machine Discharges and Test Flows are plotted for the period 2003-2013 in Figure 4. The 'natural' reservoir inflow is flashy (blue line), whereas turbine discharge is controlled (red line). The reservoir water level change is plotted along the top of the graph (green line), and water level high points do coincide with inflow highs, as they should.

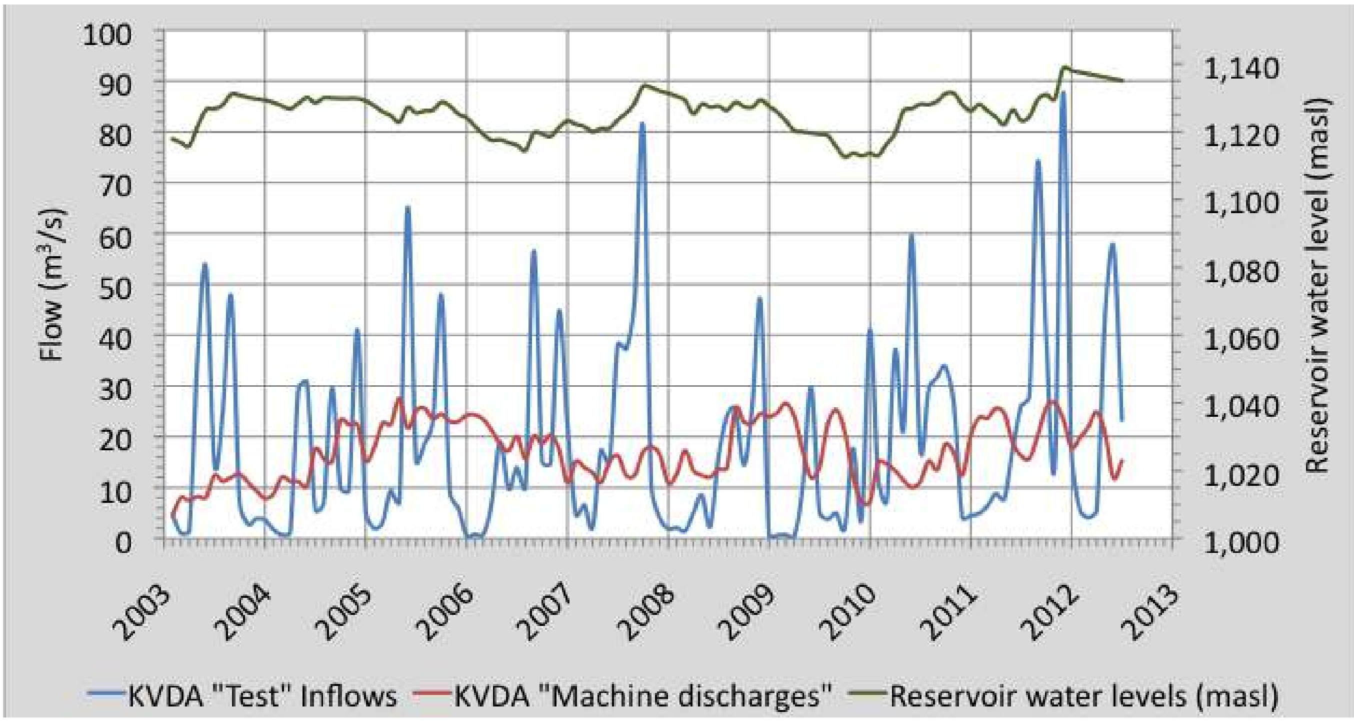


Figure 4: Turkana Dam inflows and water levels compared, 2003-2013

The cumulative 'machine' and 'test' flows are compared in Figure 5, and the cumulative flows nearly balance (within 10%). However, no machine discharge data was provided from 1991-2003, and typographic anomalies have been noted in the monthly record provided from 2003-2013, and there are also data gaps. The full daily dataset has been requested from KVDA, but a visit to the dam may be necessary to obtain this.

ANALYSIS OF MONTHLY FLOWS AT TURKWEL DAM

Turkwel's cumulative monthly runoff data series has been plotted against Lodwar cumulative rainfall in Figure 6. Although Lodwar is downstream, the two series correlate remarkably well. No major data inconsistencies are apparent.

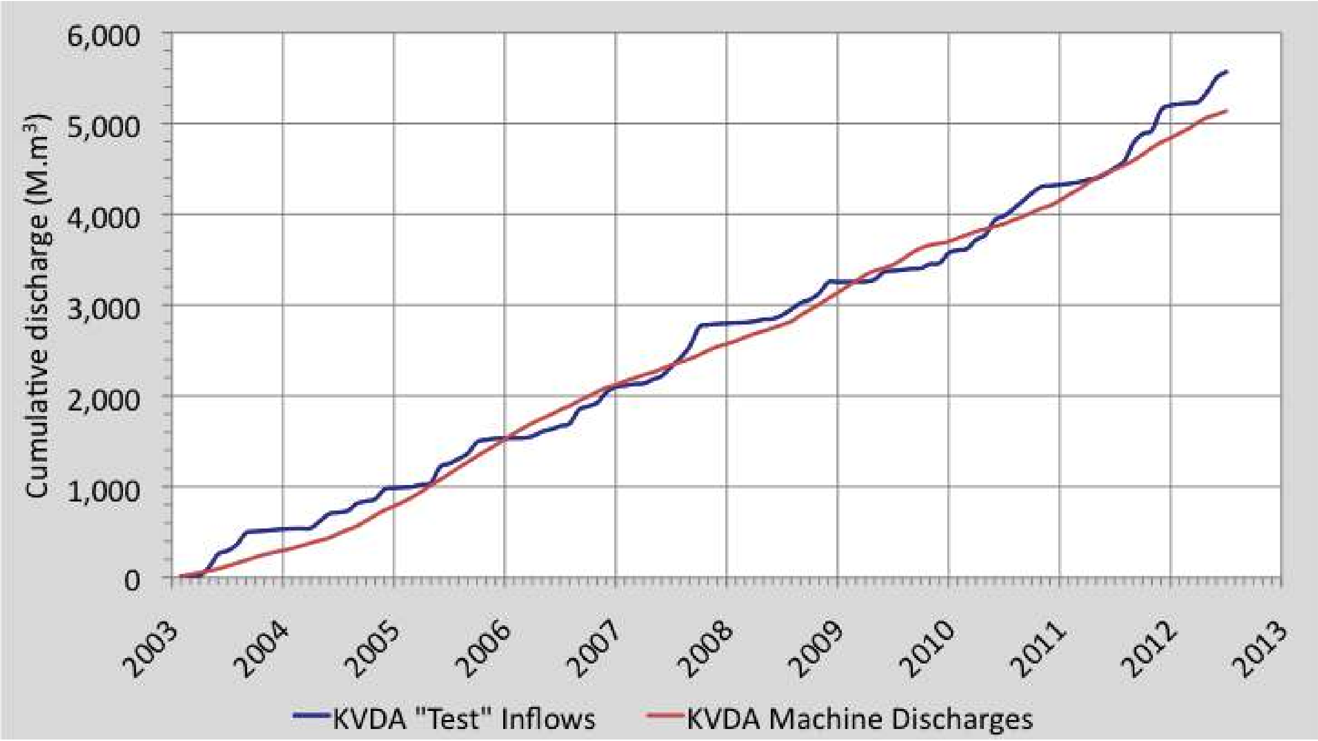


Figure 5: Turkwel Dam cumulative flow estimates compared, 2003-2013

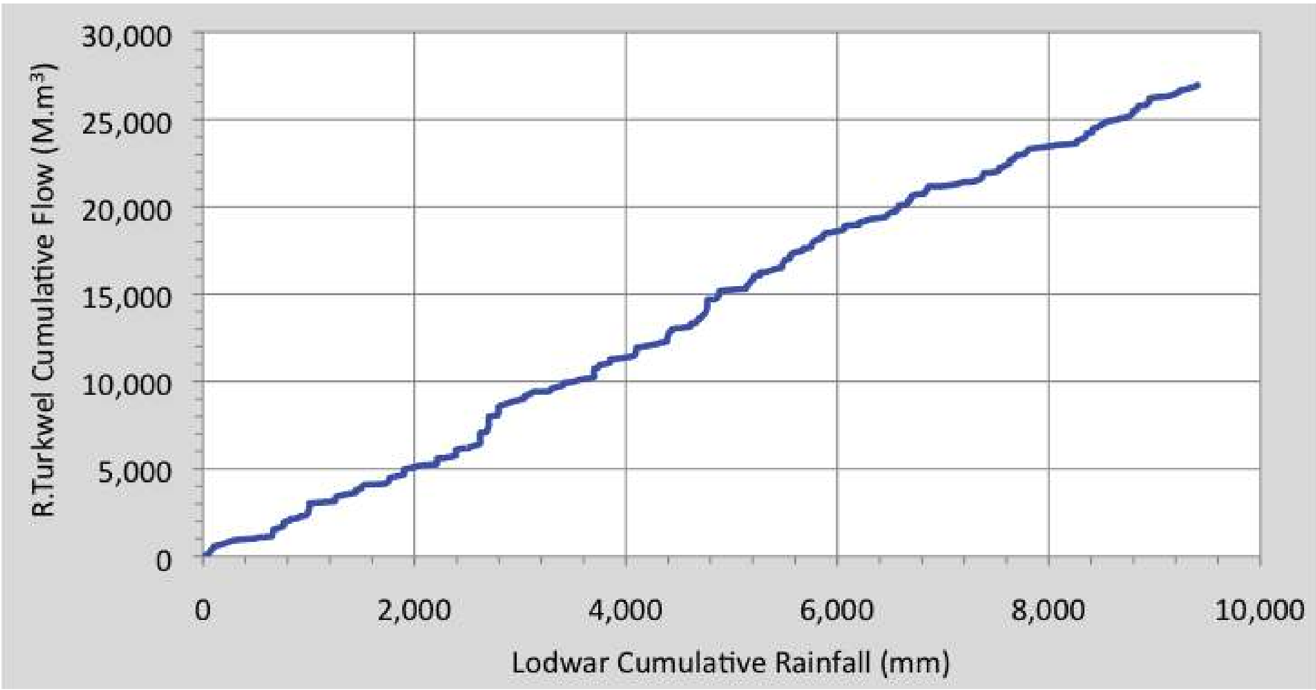


Figure 6: Cumulative Turkwel flow (at Twin Islands) and Lodwar rainfall compared, 1961-2012

Flow duration curves for the Turkwel Dam are plotted in Figure 7. The river's mean discharge of 15.4 m^3/s over the period of dam operation is also indicated (based on data for the 1991-2012 record). Note that in Figure 7, the y-axis is plotted on a logarithmic scale in order to exaggerate the critical low-flow range. The flow duration curve for the period 1939-1985 is from an infilled dataset that recorded the river to be totally dry 12% of the time (blue curve). The flow duration curve for the period 1991-2012 is similar, as would be expected, except that flows in the medium-to-high flow range are lower. In addition, this dataset does not capture the inflowing river's low flow characteristics (green curve), because this dataset has been generated from reservoir level changes that are insensitive to low flows. The full regulation effect of the dam on the river discharges is shown properly by the flow duration curve for controlled downstream releases (red curve). The high flows are dampened and the low flows are enhanced. Nonetheless, this regulated flow dataset includes downstream releases as high as 34.2 m^3/s and as low as 4.2 m^3/s.

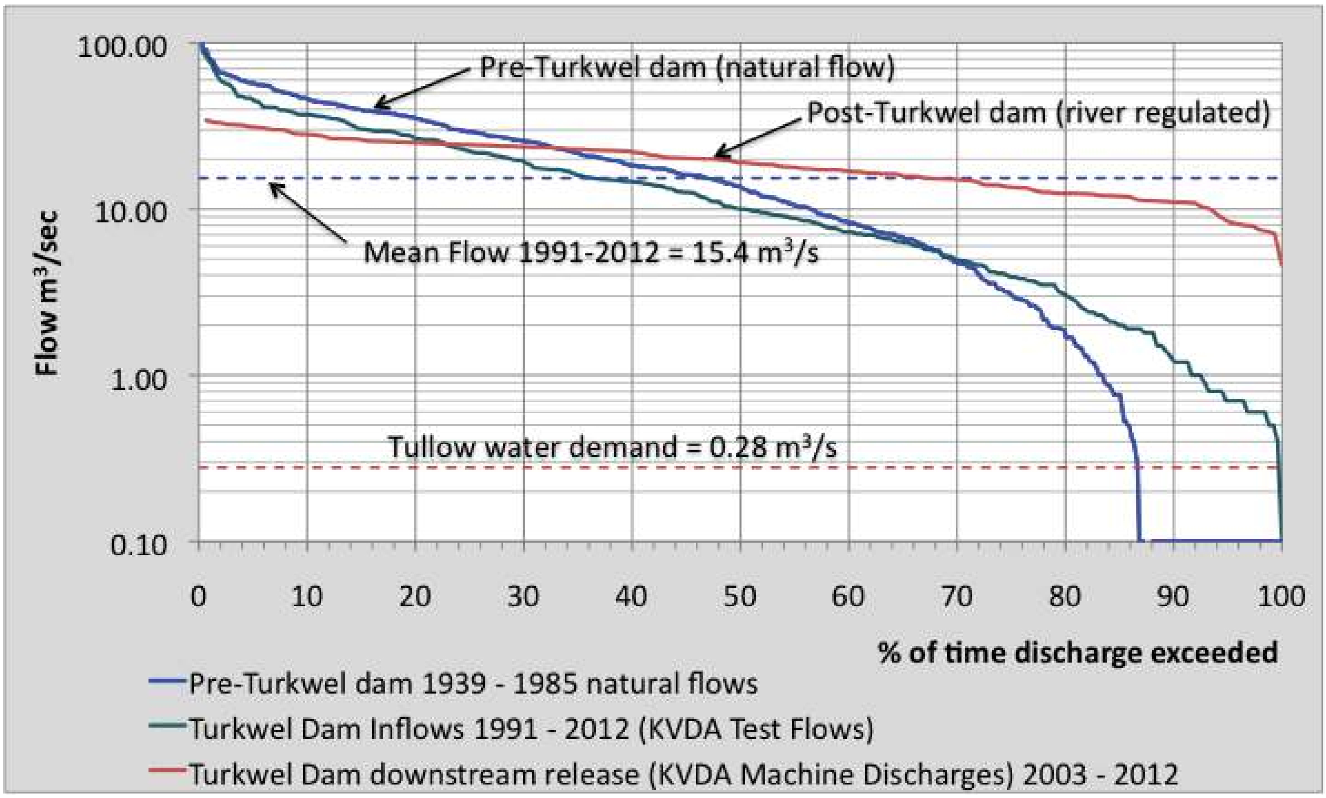


Figure 7: Flow duration curves at Turkwel Dam

The Tullow water demand line is also illustrated in Figure 7, amounting to 1.8% of the flow passing through the reservoir. This figure is not insignificant, but to put this amount into perspective, at optimum operating level, the reservoir loses 7% of river flow through evaporation alone. Expressed differently, the evaporation averages 4.9 mm/day, whereas Tullow's water demand of 0.278 m^3/s equates to 0.7 mm/day (at optimum operating level).

While the flow duration curve shows the proportion of time that a particular flow value is exceeded over the entire analysis period, flow frequency curves show the proportion of years, or equivalently the average interval between years (return period), in which the river falls below a given discharge. Flow frequency curves are preferred for assessing extreme events. The natural flow frequency curves for the Turkwel River are plotted in Figure 8. The minimum flow for various time durations was abstracted from the database by a process of moving averages. Note that the mean annual flow of 15.4 m^3/s has a return period of 2.33 years, and that annual flows ranged from a maximum 33.5 m^3/s to as little as 5.2 m^3/s. Summary results are tabulated in Table 2. Once in 25 years, the natural river can be dry for 6 consecutive months, and the lowest annual flow of 5.2 m^3/s has a return period of once in 100 years.

Table 2: Turkwel River low flow frequency analysis

Probability	Natural Flow - various durations and return periods			
	1-month (m^3/s)	3-months (m^3/s)	6-months (m^3/s)	12-months (m^3/s)
1 in 2 years	0.1	1.8	6.0	17.3
1 in 10 years	0	0	2.2	10.5
1 in 25 years	0	0	0	8.0
1 in 100 years	0	0	0	5.2

Notes: 1) Combined dataset 1940-85, and 1993-2012; 2) Data 1993-2012 missing.

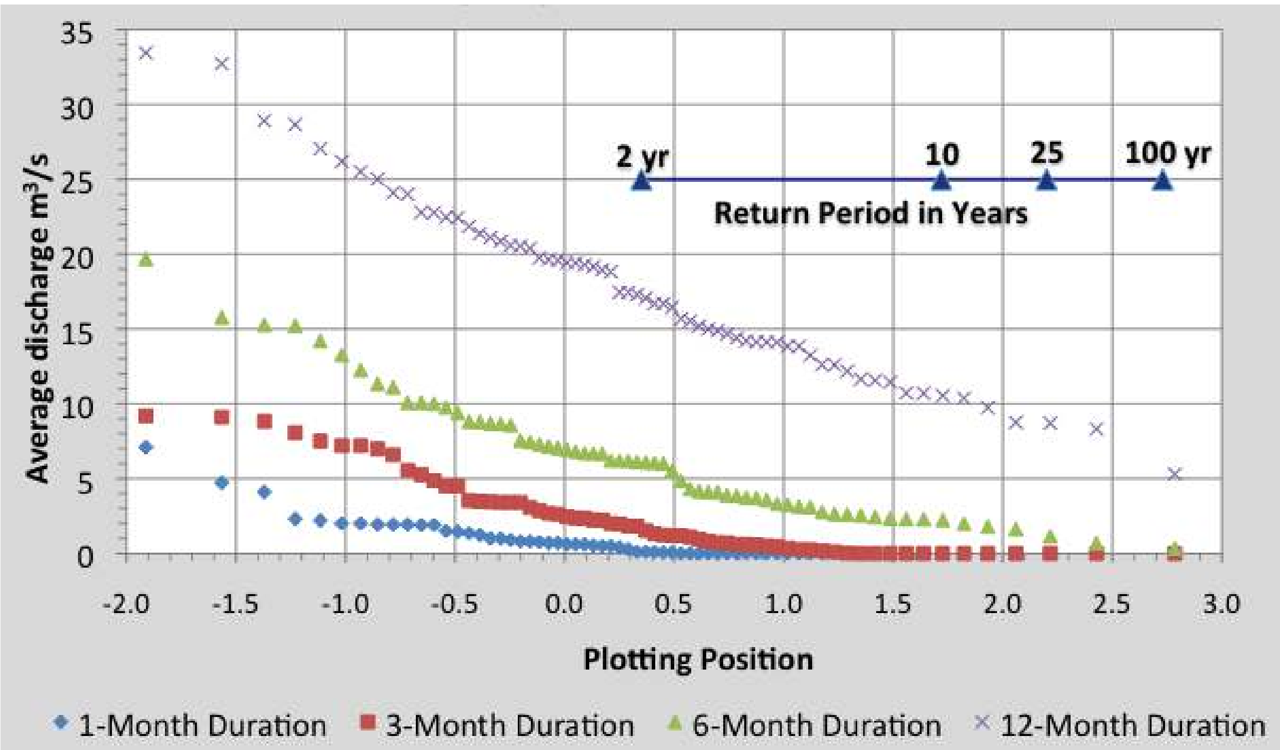


Figure 8: Turkwel River flow frequency curves for different durations (up to 12-months)

RAINFALL ON TURKWEL RESERVOIR

The Turkwel dam design assumed that an average of 650 mm would fall on the reservoir surface annually. Rainfall data is measured at the dam itself, and in the gorge below near Twin Islands where the turbine discharges are returned to the river – see Figure 9. Rainfall has in some years varied more than one might expect between two sites in close proximity. Annual rainfall has averaged 560 mm, hence less than was assumed at the time of the dam design.

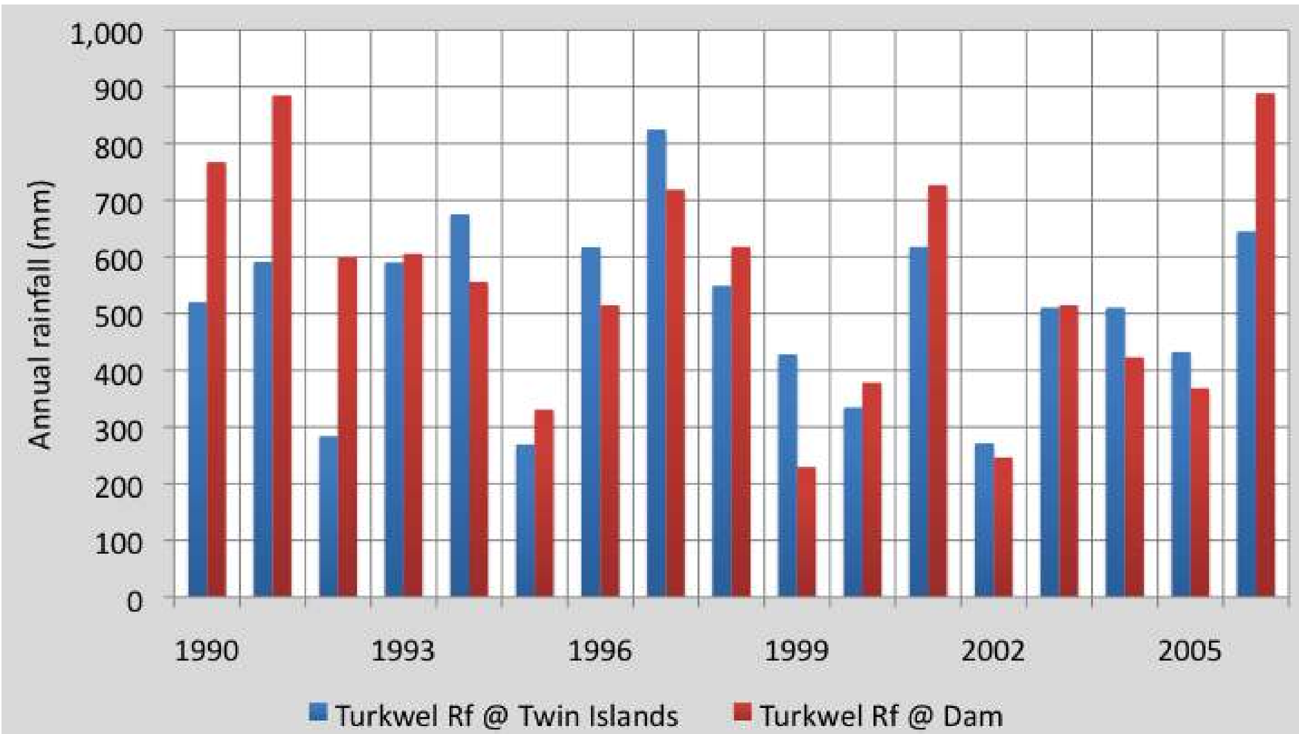


Figure 9: Annual rainfall at Turkwel Dam and Twin Islands

The Turkwel Dam rainfall data integrity has been tested with other rain gauges using double-mass curves and has been found to be compatible throughout the time period compared – see Figure 10. Recent data collection at the dam has however been fragmented with nothing up to date. The missing data is reported to be associated with periods of insecurity at the dam.

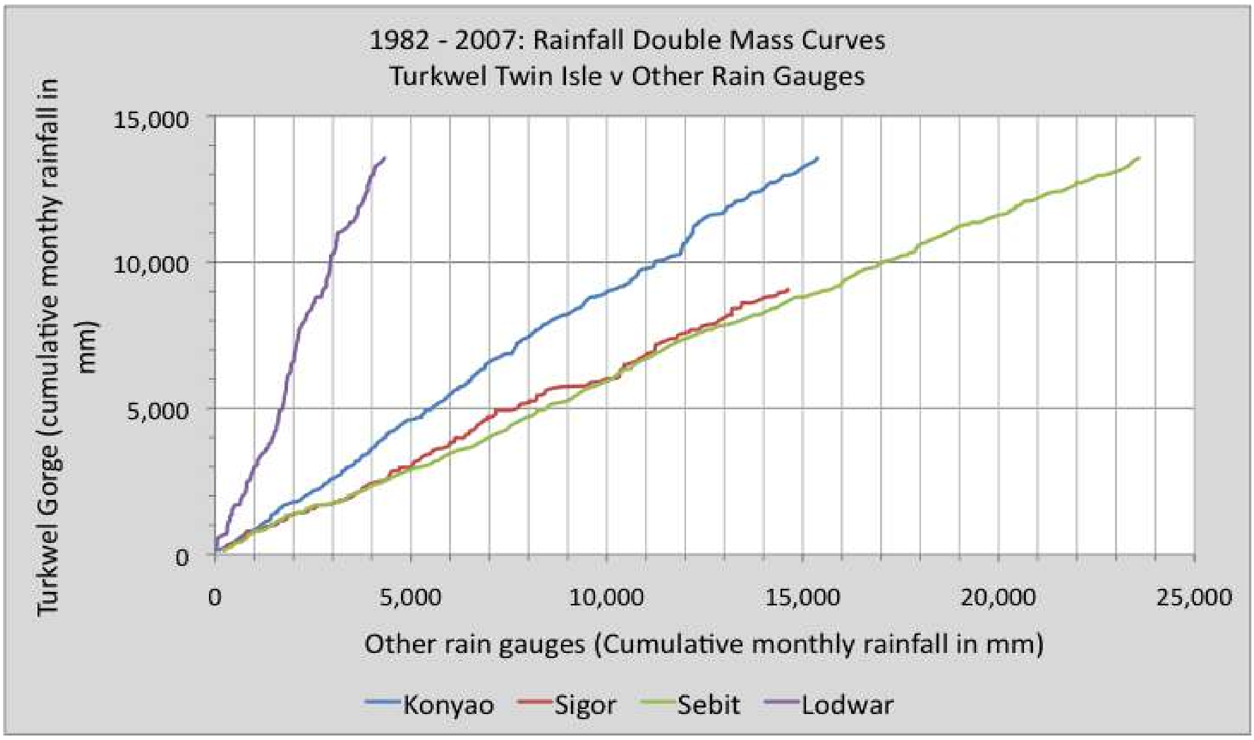


Figure 10: Cumulative rainfall at various rain gauges in the Turkwel catchment

Reasonable quality historic rainfall data series within the catchment are being sought to fully assess the trend to date. In addition, satellite-based rainfall is also being downloaded. A historic monthly data series for Sebit was the best provided, but this data is also fragmented (Sebit is north-east of Kapenguria). This data does however illustrate the high rainfall of recent years that is consistent with the rise in the dam's water level – see Figure 11.

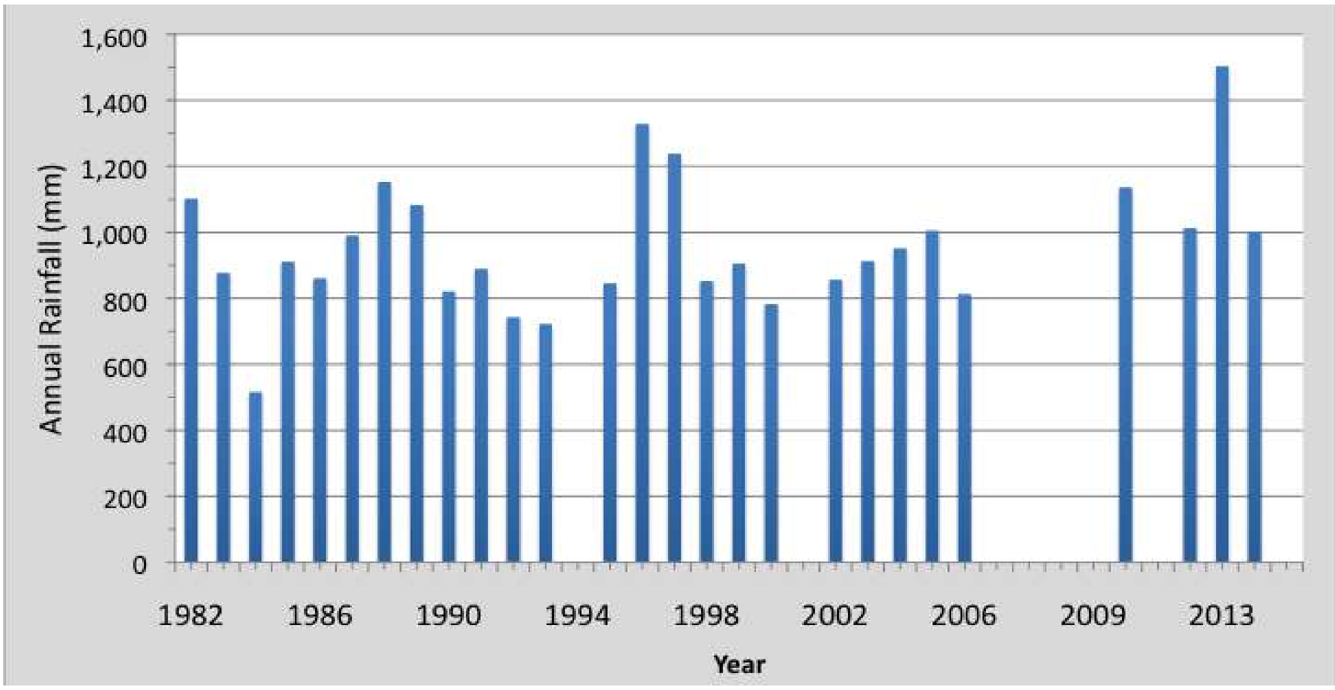


Figure 11: Annual rainfall at Sebit, north-east of Kapenguria, 1982-2015 (gaps signify missing data)

An increasing rainfall trend is apparent in the Lodwar annual rainfall downstream of the dam – see Figure 12. This graph was referenced from another study with annual data back to 1921.

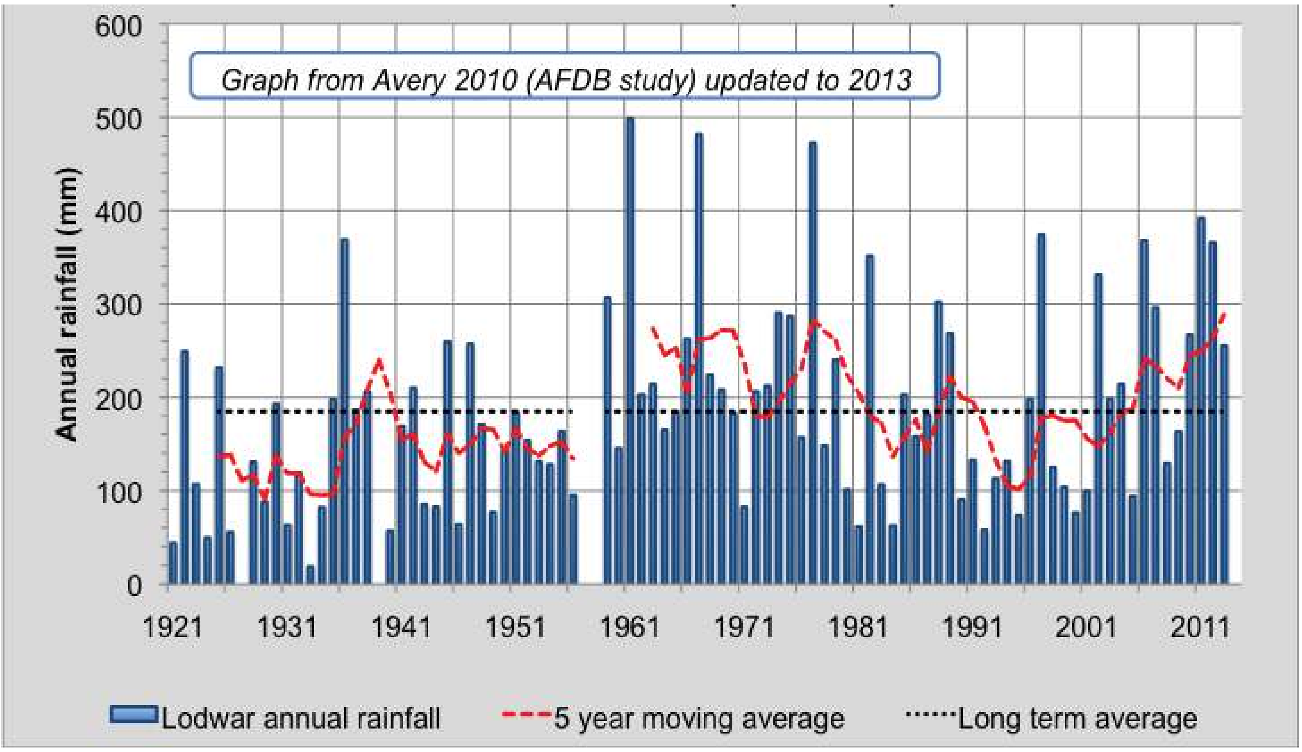


Figure 12: Lodwar annual rainfall, 1921-2013 (gaps signify missing data)

NET EVAPORATION LOSSES FROM TURKWEL RESERVOIR

Based on the assumptions built into the monthly reservoir model in the KVDA's dam monitoring procedures, the evaporation loss from the reservoir averaged about 1.13 m^3/s during the period since the dam was commissioned. During this time, the river flow has averaged 15.4 m^3/s, so the loss amounts to 7.4% of the river discharge. The dam's preliminary design utilised work done in 1968 in which the Penman formula was used to demonstrate a linear evaporation relationship with altitude. Based on this relationship, and adopting a mean altitude of 1,100 masl, the potential evaporation at Turkwel Dam was estimated to be 2,100 mm per year.

In 1988, the Ministry of Water (MoW) prepared a manual for irrigation projects for the whole of Kenya. Based on the MoW's work, Turkwel Dam falls within a zone of evapotranspiration of 2,300 mm/year. KVDA has provided some pan evaporation data for Turkwel Gorge dating from 1984 to 1998, but unfortunately there are major data gaps since 1990. The annual pan evaporation from this data averaged 2,727 mm, and ranged between 2,200 and over 3,000 mm. Assuming the evaporation pan factor to be 0.85, the potential evapotranspiration would be 2,300 mm/year, identical to the MoW figure above. Thus the potential evapotranspiration may have been higher than was assumed at the time of the design. There is of course the reality of global warming, which is affecting the entire region, and this in itself will cause evaporation losses to increase from the reservoir over time.

The preliminary dam design assumed the pre-dam baseline situation that 650 mm rainfall would fall on the reservoir area, and that 50 mm would run off. By creating the reservoir, the effective rainfall was increased by 600 mm, and the evaporation loss from the reservoir computed to be 2,100 - 600 = 1,500 mm/year. The rainfall data at the dam has been discussed earlier. Since the dam was commissioned, annual rainfall averaged 567 mm, and as mentioned, this is lower than the 650 mm that had been assumed during the design 30 years ago. Adopting the same approach as the design, the effective rainfall since the dam was commissioned was 567 – 44 = 523 mm., and the evaporation loss from the reservoir would have been 2,300 – 523 = 1,777 mm/year; see Table 3. This is higher than previously assumed.

Table 3: Evaporation from Turkwel Reservoir

Net evaporation loss from Turkwel Reservoir (mm)												
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Year*
1990	160	150	150	100	100	110	90	100	120	130	140	150	1,500
2015	190	178	178	118	118	130	107	118	142	154	166	178	1,777

Evaporation losses are a significant consequence of Turkwel Dam, especially with annual inflows being lower than had been expected. As shown in Table 4, evaporation losses would amount to 24% of the current average river inflow at full supply level, reducing to 12.5% at optimum operating level. From a water conservation perspective, it is thus advantageous to operate the reservoir at lower levels. In practice however, since commissioning over 20 years ago, the dam has only recently reached optimum operating level, although this may change in the future. Operating at lower water levels conflicts with the objective to generate hydropower, but this can be mitigated to some extent by the installation of turbines designed to operate efficiently at these lower levels. It is believed that KVDA is in the process of exploring possibilities. However, any turbine optimisations are not expected to affect the water release, as the entire river discharge passes through the turbines already.

Table 4: Turkwel dam evaporation losses

Operating level	Water level (masl)	Water surface area (hm^2)	Evaporation loss (mm/day)	Evaporation loss (m^3/s)	Evaporation loss as % MAI %
Full supply level	1,150	6,608.0	4.87	3.723	24.2
Optimum level	1,131	3,424.0	4.87	1.929	12.5
Minimum operating level	1,105	1,116.5	4.87	0.629	4.08

STORAGE WITHIN TURKWEL RESERVOIR AND SEDIMENT DEPOSITION EFFECTS

The final adopted design capacity of the Turkwel Reservoir was 1,641 Mm^3, zoned as shown in Table 5. This gross volume is equivalent to storing 3.8 years of current average flow from the Turkwel River.

Table 5: Turkwel Dam's storage zones

Storage Zone	Elevation range (masl)	Storage volume (Mm^3)
Active storage	1,105 to 1,150	1,478
Inactive storage	1,070 to 1,105	159
Dead storage	< 1,070	4
Gross storage		1,641

Based on actual sediment runoff measurements in the 1980s, the dam design assumed that catchment sediment yield into the Turkwel Reservoir would displace 10 Mm^3 per year (1,695 $m^3/km^2/yr$ or 2,373 $t/km^2/yr$). It would thus take 164 years for the catchment to deliver a volume of sediment equal to the entire Turkwel Reservoir volume of 1,641 Mm^3. The gross storage provision would enable regulation capacity in excess of the mean annual flow for nearly 100 years of operation, provided there was no increase in average sediment yield - see Figure 13.

The dam design was shown to be sensitive to the assumed sedimentation rate, with reservoir life diminishing if there is any ongoing annual increase in sedimentation rate. This is illustrated in Figure 13. According to the dam design team, an annual sediment increase of 3% per year was "not inconceivable". To put the assumed 10 Mm^3/year design sediment displacement rate into perspective, Kenya's Small Dams Manual defines a "heavy" erosion rate to be 1,500 $m^3/km^2/yr$, very similar to the figure adopted for Turkwel Dam. Global extremes have however included sediment runoff far in excess of these figures.

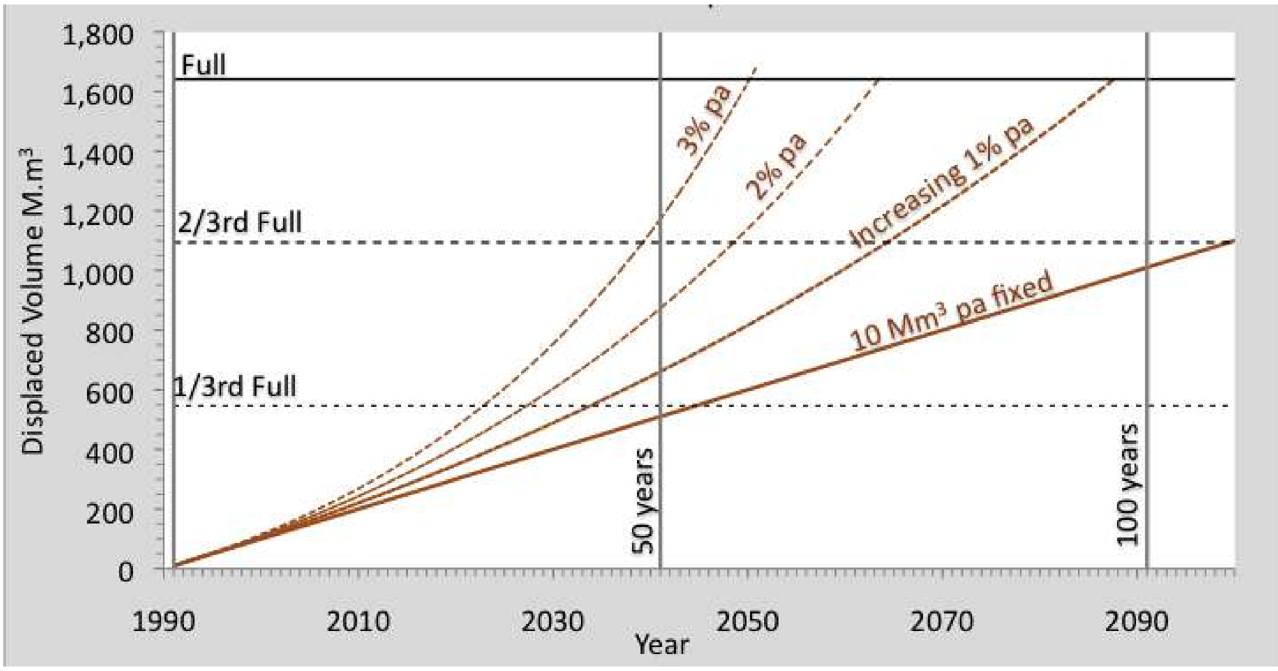


Figure 13: Sediment displacement volumes over time in Turkwel Reservoir

Figure 14: Google Earth image of Turkwel Dam delta

Google imagery in Figure 14 clearly illustrates the sandy luggas discharging into the top of the reservoir, and the slight discolouration of the water in this area is evident. Much of the sediment deposition will be occurring here, and progressing from here. The imagery also suggests degradation of the riparian zones adjoining the reservoir and inflowing rivers, probably due to livestock accessing water. Possible improved catchment protection measures can be looked into.

There is no recent sediment sampling data available for the catchment. However, as the dam has been operational for over twenty years, a bathymetric survey of the reservoir today would provide an accurate update of the design assumptions. Sediment monitoring within the reservoir was recommended as part of ongoing dam monitoring procedures. KVDA procured depth-sounding equipment, but no work has yet been done. Tullow has offered to assist KVDA undertake this necessary survey, and has requested the original baseline topographical survey for the reservoir.

RESERVOIR YIELD

The reservoir performance at various draft scenarios is illustrated in Figure 15. Drafts in this reservoir model are proportioned relative to the mean annual inflow (MAI) of 15.4 m^3/s. This reservoir model assumes no power generation until the reservoir reached 1,120 masl (as per what actually happened – see Figure 3). 87% draft represents the theoretical net maximum yield, which is the mean annual inflow less an average reservoir loss. At 87% draft, the reservoir model breached the minimum operating level more than once, which mirrors what happened in practice (see Figure 3).

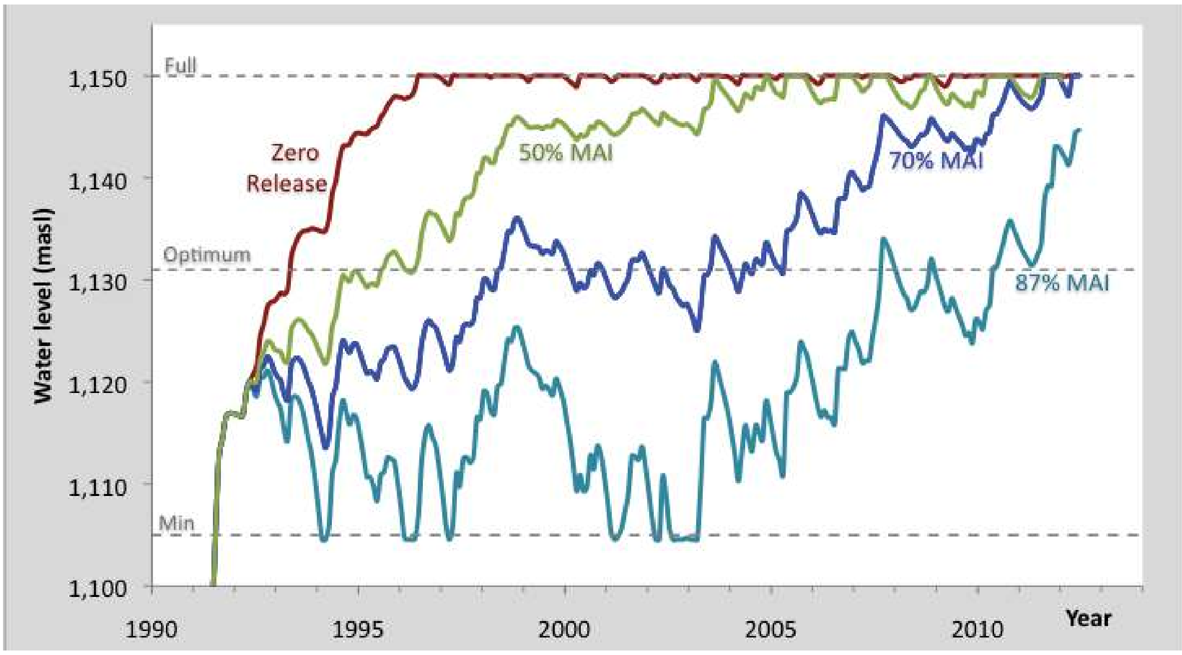


Figure 15: Turkwel Reservoir - tested with different yield (release) scenarios

Figure 16 presents a different set of scenarios whereby the reservoir was allowed to fill further before generating power. This is hypothetical. An uninterrupted fill period should never happen, as flow for downstream water users and the ecology must be sustained, but it serves to illustrate the extent to which the storage is utilised in order to sustain the maximum yield. The effect of the option of the Tullow abstraction direct from the reservoir is illustrated in Figure 17. Whereas the daily evaporation from the reservoir is 4.9 mm, irrespective of water level, the direct abstraction of 0.278 m^3/s has an effect that varies with water level, as shown in Table 6.

Table 6: Tullow water demand expressed as reservoir depth

Reservoir operating level	Depth equivalent of Tullow 0.278 m^3/s water demand (mm/day)
Full supply level	0.4
Optimum operating level	0.7
Minimum operating level	2.2

The Tullow water demand equates to 2.2-mm depth daily on the reservoir at minimum operating level. This depth is cumulative, with daily amount diminishing as reservoir surface area increases, being 0.7 and 0.4 mm per day respectively at optimum and full supply levels. The cost in terms of head loss for power generation would need to be considered for comparison with the option of taking water after it has passed through the turbines, in which case there is no impact on reservoir level. In the scenario depicted in Figure 17, the water level is up to 3.4 m lower at times.

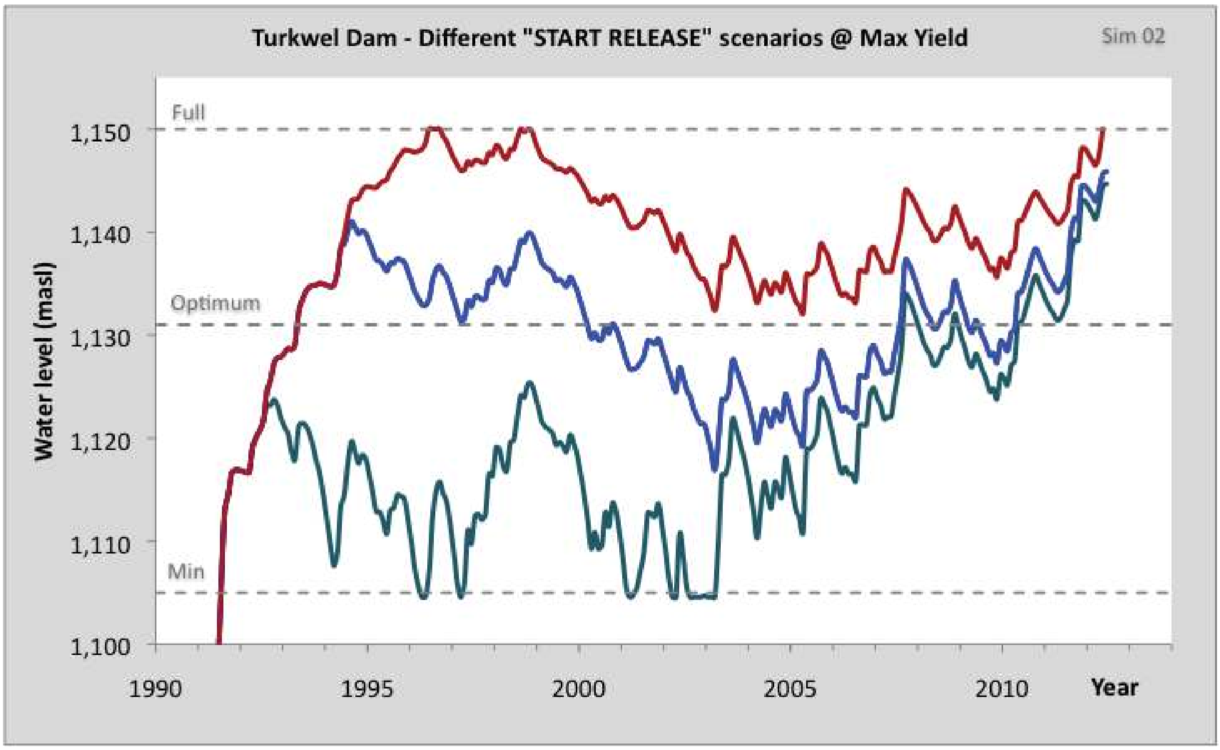


Figure 16: Turkwel Reservoir - operating at the maximum yield scenario

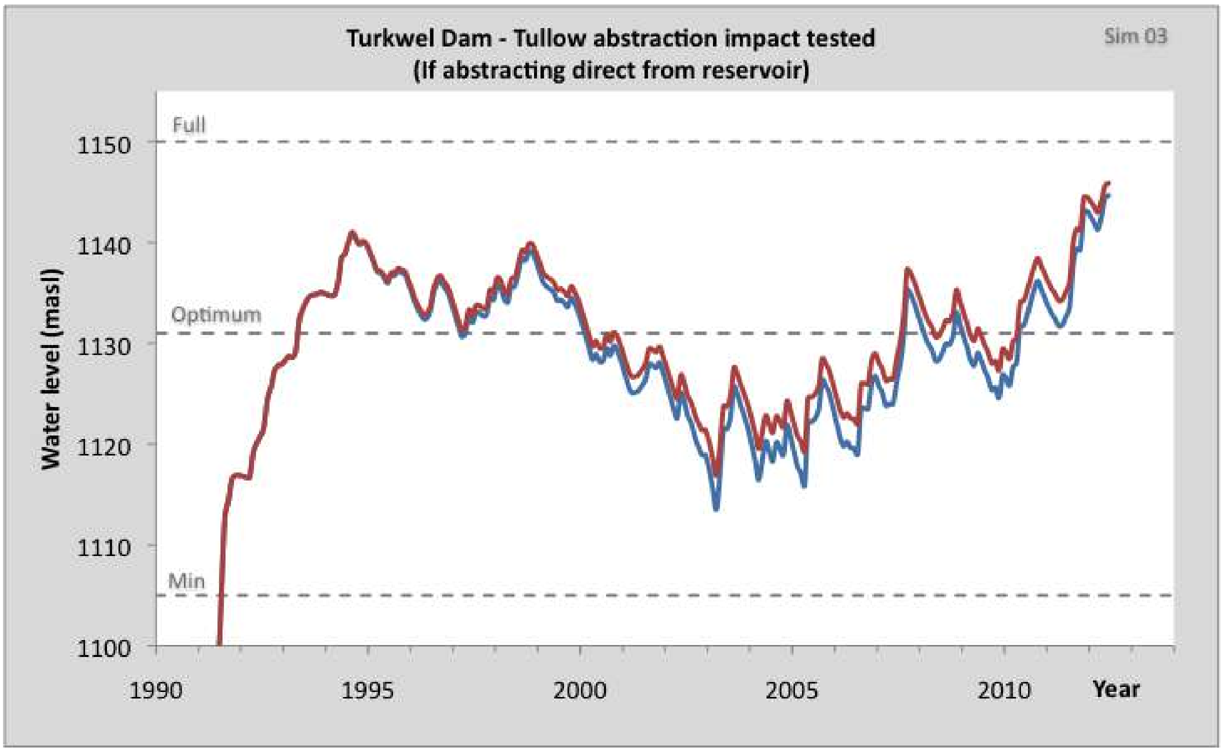


Figure 17: Turkwel Reservoir with Tullow abstraction imposed

COMPENSATION FLOW AND DOWNSTREAM WATER RELEASE

There is no compensation flow release from the dam, and the river between the dam and the turbine tailrace is dry. However, this river stretch is short, and is confined within the gorge. Some leakage does occur through the dam, and a small permanent pool exists immediately downstream (see Photo 1 on next page). The leakage from the diversion tunnel plug was measured as part of the dam's monitoring procedures. Records have been seen only between 1985-1994, and no increase in leakage was indicated, and the discharge averaged 9.65 litre/s (0.009647 m^3/s, or 834 m^3/day).

Photo 1: Plunge pool immediately below dam

The principal function of the dam is to generate power. Based on the Turkwel's average daily design flow of 18 m^3/s, the turbine water release was designed to be 36 m^3/s over 12 hours. From an ecological and downstream water-use perspective, this 12-hour release pattern is not ideal.

Some degradation of the riverbed was expected as a consequence of the dam. This is because the dam has totally arrested sediment movement down the river at this point. Any river will naturally compensate this loss through scouring of the bed and banks. The Turkwel Dam designs considered the main degradation impact zone to be up to the Malmalte River confluence not far downstream (about 18 km in a straight line). The degradation beyond the confluence would be slight, as the Malmalte would continue to provide a large proportion of the modified sediment load capacity of the lower reach (Turkwel Dam has not altered the Malmalte inflows). The dam has of course altered the natural downstream river hydrology. Flows will be regulated, and two main impacts were considered in the dam's design:

1) The behaviour of the Turkwel river aquifer would be altered, and this in turn would result in possible vegetation changes. This would primarily affect the river stretch between the dam and the Malmalte confluence, where the water table naturally fluctuated within a 1-m range. With riverbed degradation, there was potential to drop the groundwater table, which might adversely affect some of the vegetation, and lead to changes.
2) The regulated discharge in the river would lead to increases in irrigation areas and human pressure on the natural ecology.

Protection works and weirs to mitigate river degradation were recommended as part of the dam design. The implementation and effect of these measures (if any) has not yet been explored, but will be included in future fieldwork. Any new abstraction from the river would of course compound the impact of the irrigation abstractions. This aspect has been briefly addressed in this report, and will be investigated more fully. The impact of irrigation abstractions is potentially so large that any other abstractions are insignificant.

DOWNSTREAM WATER NEEDS

The Kenya Government has plans to increase irrigated areas in Turkana in order to meet food-security needs. Kenya's Vision 2030 planned a 600% increase in irrigated lands, with most of this development within the arid and semi-arid lands. Following water balance studies that revealed severe water stress arising, the planned areas have been reduced and water conservation measures recommended. The recent National Water Master Plan update lists two planned irrigation projects in Turkana, these being two proposed KVDA irrigation projects totalling 7,000 ha, as follows:

- Turkwel Dam Irrigation Project - 5,000 ha net irrigated area (currently out to tender);
- Namerit Dam Irrigation Project - 2,000 ha, said to be "100 km south of Lodwar" and "to be developed in the Turkwel River".

A recent FAO study, funded by the EU and undertaken by Ocra Consultants, investigated the irrigation potential along the Kerio and Turkwel Rivers in Turkana. Ocra determined the Turkwel River to be discharging on average 12.8 m^3/s, and with the Malmalte River (Photo 2) contributing on average 7.8 m^3/s, Ocra concluded that there is a total of 19.8 m^3/s "to be shared amongst users". Later in their report, Ocra adopted a Turkwel flow of 15 m^3/s. The Ocra study has assumed that 50% of the Turkwel flow (7.5 m^3/s) would suffice to meet "domestic, livestock and ecological maintenance" water needs, and that the balance of 7.5 m^3/s "is available for irrigation". Based on this figure, it was concluded that there is potential to increase the present irrigated area along the Turkwel River from the present 1,753 ha to 10,000 ha. The figures presented by Ocra are "net" requirements. It is presumed that the KVDA irrigation development plans are in general encompassed within the 10,000 ha mooted by the FAO study. It is worth noting that the economic viability of these irrigation projects was not clearly established by the Ocra study.

Photo 2: Malmalte River at Kainuk Bridge

There are also irrigation schemes in progress in the lower Turkwel area from highly-productive boreholes drilled into the Napuu aquifer near Lodwar (presumably being recharged indirectly by the Turkwel River). The FAO study mentions, but did not investigate, the irrigation development potential of the much-hyped UNESCO/RTI Turkana aquifers. The National Water Master Plan update also mentions the UNESCO/RTI Turkana aquifer finds, and observes as others have done, that clarifications are needed on the various assumptions leading to the potential aquifer water yields that have been claimed. Ocra/FAO recommend that the Water Resources Management Authority (WRMA) fulfils its obligation to prepare a Water Allocation Plan, and in view of the ambitious irrigation development plans mooted for the Kerio and Turkwel Rivers, this is clearly urgent.

By constructing irrigation schemes, one form of vegetation is replaced with another. The net water "loss" will depend on the nature of the vegetation change, and will principally comprise the irrigation application losses. These losses can be appreciable, being typically 50% in furrow irrigation systems, perhaps more. Assuming the potential 10,000 ha falls entirely within the existing vegetated riparian zones, the associated water loss equates to 3.75 m^3/s. In comparison, the Tullow water demand is a fraction of this amount. Thus in terms of downstream water demands:

- The riparian vegetation/forest zones down to Lake Turkana were estimated during the dam design as totalling 39,390 ha, and to sustain these areas was estimated to require 25 m^3/s of water. This data will need to be updated, but is indicative of the environmental flow requirements of the river.
- The Ocra/FAO studies assumed that only 50% of the river is required to meet domestic, livestock and ecological maintenance requirements. For the entire river to the lake, this would amount to 9.9 m^3/s, almost one-third the figure estimated by the dam design team for ecology alone.
- The Ocra/FAO irrigation expansion would result in losses of 3.5 m^3/s.

- The Ocra study does not consider the irrigated areas potentially arising from the UNESCO/RTI Turkana aquifer pronouncements. If any of these potential areas tap the Turkwel river water, even if indirectly, they would be additional to the Ocra 10,000 ha.

The potential Tullow abstraction amount of 0.278 m^3/s is equivalent to the water required by a riparian or vegetated area totalling about 415 ha. The abstraction's immediate impact zone would be from the dam to the Turkwel/Malmalte confluence. At the time of the dam design, the riparian forest within this section totalled 1,370 ha, and there was another 2,006 ha along the Malmalte to the confluence. The combined area extending down to Katilu totalled 6,748 ha. It is intended to inspect these areas in the field.

DEMOGRAPHIC & CLIMATE CHANGE
It is beyond the scope of this report to quantify the climate and long-term changes that will affect the dam, but it is worth mentioning the emerging scenarios. The entire Rift Valley Catchment Area population is forecast to increase 53% between 2010 and 2030 – see Table 7. Water demand, with irrigation included, will increase 318%, and the Water deficit/Water demand ratio will exceed 40% in 2030, which will put the Rift Valley Catchment Area into the "under severe water stress category".

Table7: Rift Valley statistics

Rift Valley Catchment Area statistics[1]			
	2010	2030	Increase
Population (millions)	4.86	7.45	53%
Water demand (irrigation excluded)	214	419	96%
Water demand (irrigation included)	357	1,494	318%
Available water resources[4]	2,559	3,147	23%
Water deficit[2]	92	867	842%
Ratio: Water demand / Water resource[3]	14%	47%	
Ratio: Water deficit / Water demand	26%	58%	

Footnotes:
(1) National Water Master Plan, JICA, 2013;
(2) Annual Water Deficit for probability 1 in 10 yrs for domestic and industrial uses, and 1 in 5 yrs for irrigation;
(3) If ratio Water demand / Water resource > 40% = "under severe water stress" (OECD [1]);
(4) Groundwater component fixed at 102 Mm^3/yr throughout (UNESCO/RTI Turkana aquifer announcement seen too late and assumptions deemed by JICA to require "clarification").

If it is decided that Turkwel Dam will be pursued as the principal water source for the Tullow oilfields, the long-term hydrological prospects of Turkwel Dam should be assessed by means of a hydrological model that offers climate change modules (for example HYSIM developed by Water Resource Associates). This possibility has been broached in discussions, and data collection is currently being approached keeping in mind this next stage of consolidating the water supply options.

As mentioned above, rainfall patterns are changing, and temperature is increasing. Rainfall increases are to an extent offset by the increased evaporation that results from increasing temperature. The main likely eventuality is increasing runoff with increasing rainfall compounded by the ongoing catchment degradation. Warnings of degradation were made in the 1980s whilst the dam was under design, and the ongoing catchment degradation is very evident at the key gauging station for the project, RGS 2B07 at Kongelai, whose river gauging cableway infrastructure has largely collapsed into the river due to erosion by floodwaters increasing the waterway area and down-cutting the channel (see Photos 3 and 4).

Catchment degradation is a consequence of land pressure, and the associated poor land-use practices are often attributable to constraints arising from extreme poverty. Increased runoff results in increased erosion, and hence sediment runoff, as mentioned earlier in this report. As part of ongoing work on this assignment, Tullow's GIS department is assisting by investigating imagery from which past land-use changes and degradation trends can be mapped.

The National Water Master Plan has forecast the available water resource in the Rift Valley Catchment Area increasing 23% by 2030 (in Table 7). Hence a long-term increase in annual runoff into Turkwel Dam seems likely. At the same time, an increase in sediment runoff is also likely, and this does need to be investigated. However, the dam design did intentionally include very large allowances for sediment accumulation to ensure that it is a long time before the reservoir's active storage zone is compromised.

Photo 3: River Turkwel River gauging station RGS 2B07 at Kongelai

Note river down-cutting with stilling-well pipe now stranded. Lowest staff gauge at left missing altogether.

Photo 4: River Turkwel RGS 2B07 at Kongelai

Note widening of the river, and the cableway foundation slab on far bank now collapsed into the river.

CONCLUSIONS

Turkwel Dam was originally designed as a multi-purpose scheme, and hydrologically, its storage reservoir is indeed a viable water source for the strategic water supply that Tullow Kenya requires. KVDA, the dam owner and operator, has reacted positively to this suggestion and has fully cooperated with this study.

The Tullow water demand is a very small proportion of the Turkwel river flow, and amounts to a fraction of the evaporation loss from Turkwel Reservoir. There will be a small reduction in river flow, estimated to equate roughly to the water used by 415 ha of riparian forest, or a similar-sized irrigation scheme. However, with climate changes forecast in the National Water Master Plan, the river flows will increase by 2030 and more than offset the small reduction arising from the potential project abstraction.

If the water is abstracted below the dam, there would be no impact on the reservoir operation for power generation. If the water is abstracted directly from the reservoir (Photo 5), the reservoir water level would be reduced, thus reducing the power generated. However, by optimising reservoir water levels at a lower level, water losses to evaporation would be reduced.

Photo 5: Reservoir behind Turkwel Dam

The potential impact zone downstream of the dam encompasses the Turkwel River and its important riparian zone, and Lake Turkana (Photo 6), an endorheic lake that is the terminus for the Turkwel and other rivers. This will be the subject of further study and will be covered in a future technical report.

Photo 6: Lake Turkana from Eliye Springs

ACKNOWLEDGEMENTS
The Kerio Valley Development Authority's cooperation is gratefully acknowledged and thanks are due to the Managing Director, Mr David Kimosop and his team of technical officers. The Consulting Engineer engaged by Tullow for this assignment is registered with the Engineers Board of Kenya, and is licensed by the Ministry of Water & Irrigation in various categories including water supply and hydrology, and in addition is licensed by NEMA.

10 OPTIMUM INTAKE LOCATION AT TURKWEL DAM

INTRODUCTION
This paper discusses the main options for a water intake location at Turkwel Dam, which has been selected as the preferred option for strategic water supply. An initial assessment of the intake options was reported in August 2015 (see Technical Report 1), with three main options presented: a) the reservoir above the dam; b) an underground surge chamber; and c) the tailrace discharge canal. The surge chamber was ruled out, so the main options remain the reservoir or the tailrace. Since that report was written, the historical record of water levels in the reservoir and the way in which the dam is operated have been analysed in detail and the findings to date are summarised in this paper.

MAIN INTAKE OPTIONS
First, a reminder of the basic layout of the dam and associated facilities (Figure 1):

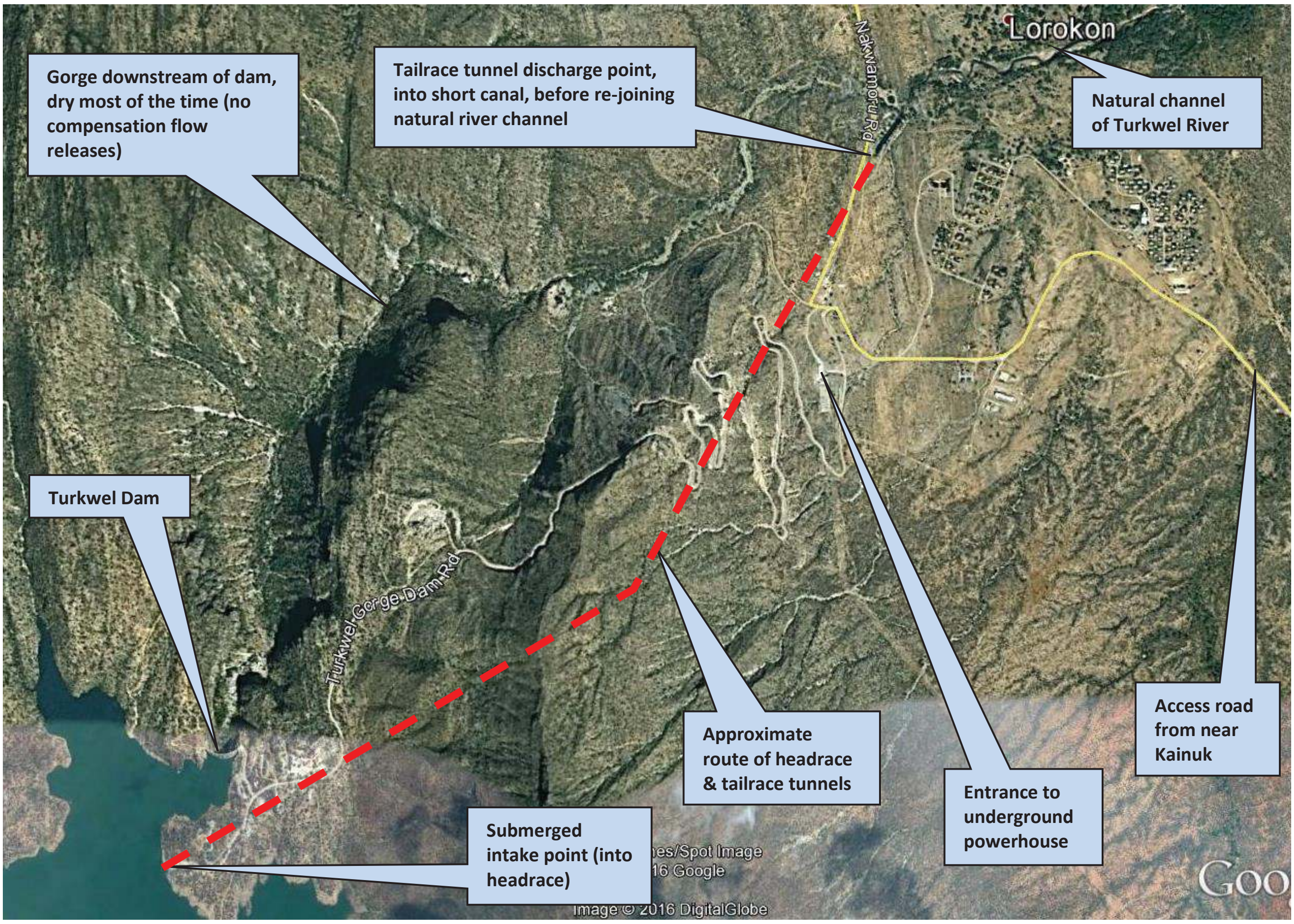


Figure 1: Layout of Turkwel Dam, associated facilities and the Turkwel River channel

Tailrace intake option
The tailrace tunnel discharges into a short canal (about 200 m long), which leads the flow back into the natural river channel (Figure 1). There is plenty of space on either side of the canal, so constructing a sump for the pump intakes, connected to the canal, would be relatively straightforward and inexpensive. These are the main reasons why Xodus recommended this as their preferred location for the make-up water station ("Turkwel Dam Make-up Water Study", Report L-100282-S00-Y-REPT-002, Xodus Group, December 2015).

Reservoir intake option

One of the other options considered by Xodus in the same report was an intake location at the upstream end of the reservoir (Figure 2). However, the most practicable location for an intake in the reservoir would be a floating pontoon somewhere near the dam, able to rise and fall with the fluctuating water levels. The pipeline would follow the dam access road (visible on Figure 1) and then drop down the escarpment, passing close to the tailrace discharge. The reasons why a location near the dam is preferable are summarised in Figure 2.

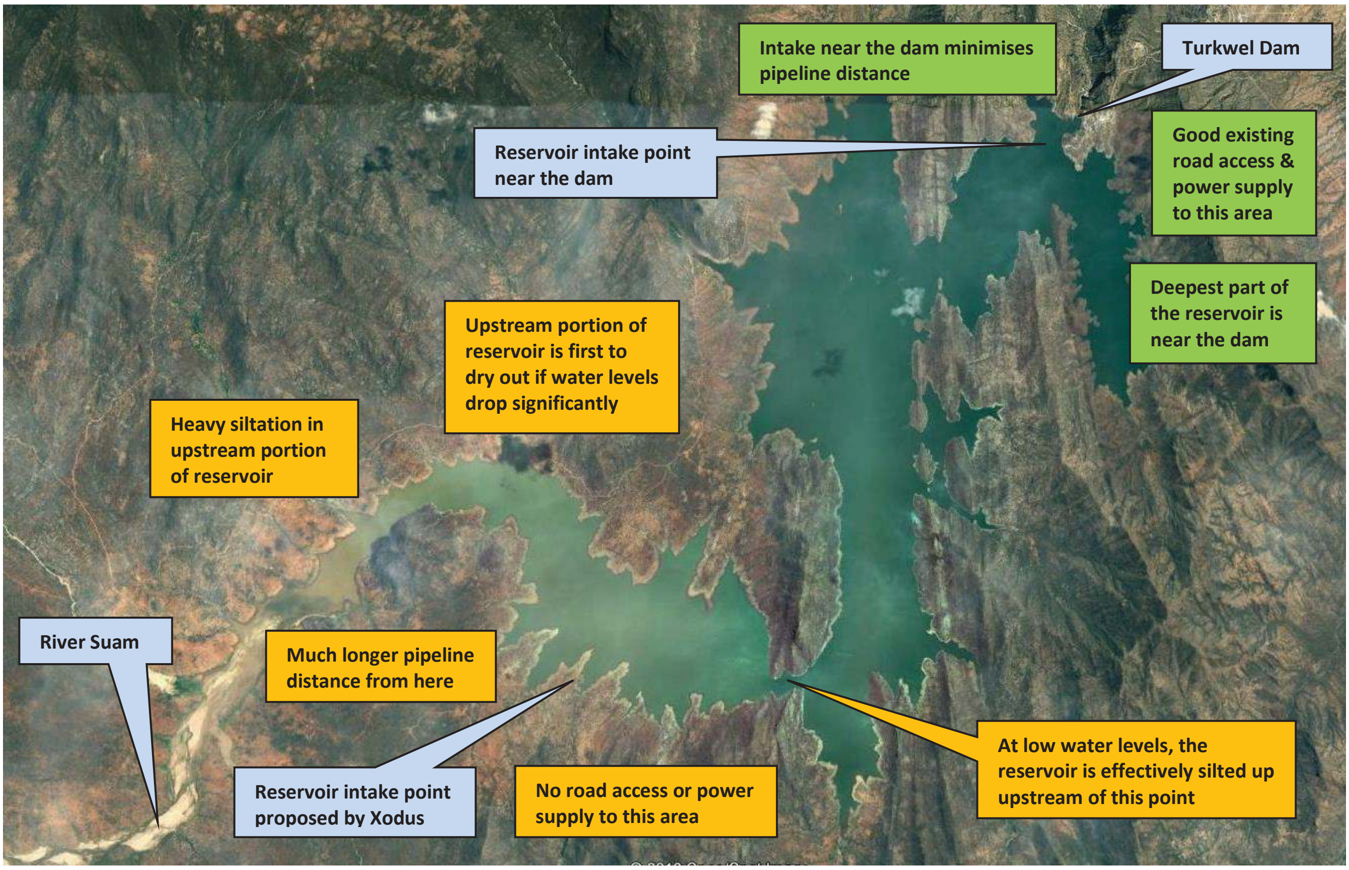


Figure 2: Alternative intake locations in the reservoir

RESERVOIR WATER LEVELS & STORAGE

Turkwel Dam is a concrete-arch dam built in a narrow gorge, commissioned in 1991, with a maximum generating capacity of 106 MW and a quoted total reservoir volume of 1.6 billion m^3. The photograph in Figure 3 shows the face of the dam, and it can be seen that there are four un-gated spillway openings and below the water line there is a low-level sluice for compensation flow and reservoir scouring. The low-level sluice would normally be used to release compensation flows downstream, but this is rarely done. In practice therefore, all water passing downstream does so through the turbines, so the natural channel between the dam and the tailrace discharge point is dry the vast majority of the time. Also, the low-level sluice would normally be fully opened periodically to make sure the mechanism is still working and to scour sediment accumulating behind the dam, but again, this is rarely, if ever, done. Some key elevations are as follows (all in metres above sea level, masl):

Maximum water level in reservoir:	1,154.5
Full supply level (spillway crest):	1,150
Highest ever water level to date in reservoir (in late 2012):	1,139
Average water level in reservoir (1991-2016):	1,119
Minimum operational level of water (for power generation):	1,105
Level of top of submerged intake to headrace tunnel:	1,098
Level of invert of submerged intake to headrace tunnel	1,094
Low-level sluice in face of dam (drain-down level):	1,070
Typical downstream pool water level:	1,036

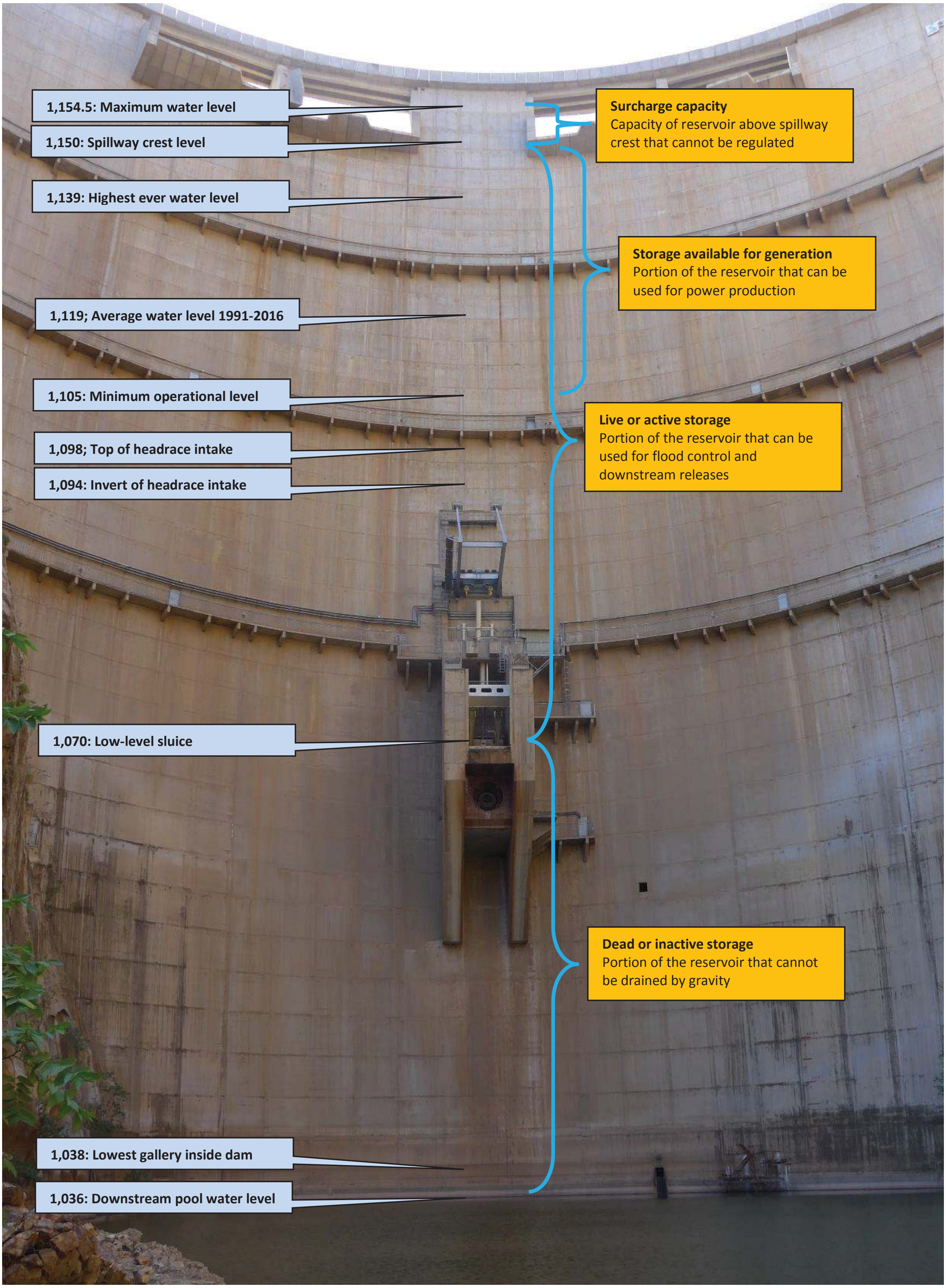


Figure 3: Summary diagram of elevations of key features at Turkwel Dam *(all figures metres above sea level)*

Historical records of water levels in the reservoir since it was constructed have been obtained and quality controlled and are shown in Figure 4, about which the following key points can be noted:

- The dam has never spilled since it was constructed; in fact, it took until September 2003 for the optimum generating water level to be reached, and the highest water level ever recorded, in October 2012, was still 11 m below the spillway crest level.
- Ignoring the initial period of filling immediately after construction, the water level has dropped below the minimum operational water level on eight separate occasions, sometimes for several months, the longest period being over six months in the first half of 2000 (the minimum operational water level is the level below which the dam can no longer generate electricity).

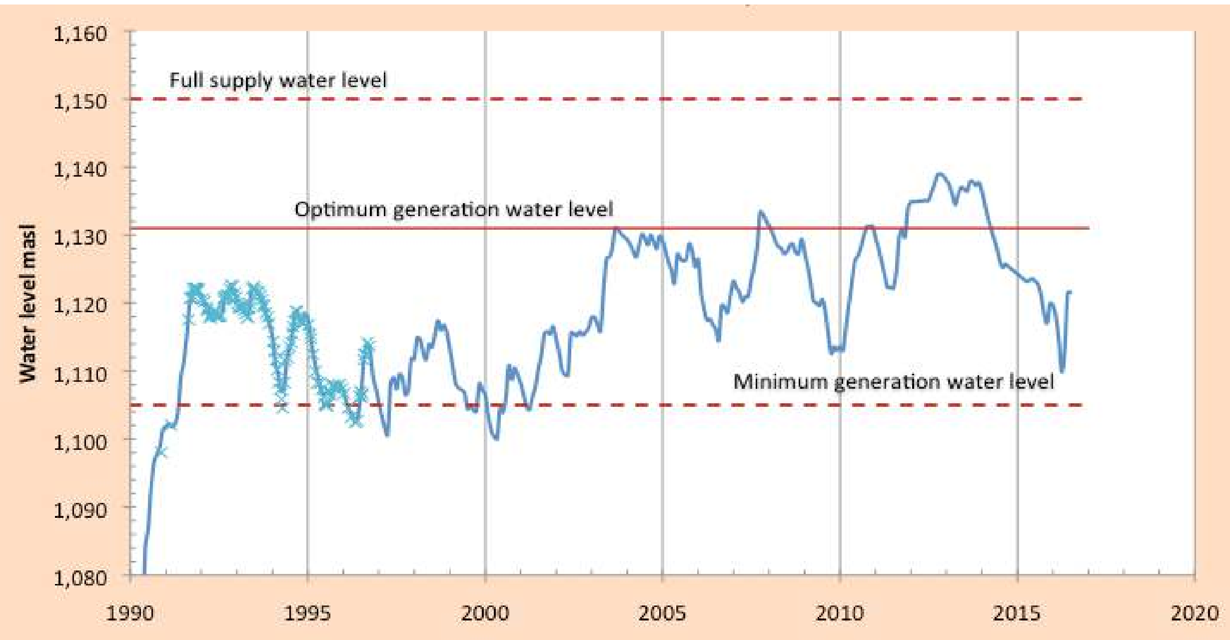


Figure 4: Historical water levels for Turkwel reservoir, 1990 to 2016

An alternative way of presenting the water level data is shown in Figure 5 - a water-level duration curve, derived by ranking the daily water level readings from highest to lowest, ignoring the actual dates, and plotting them.

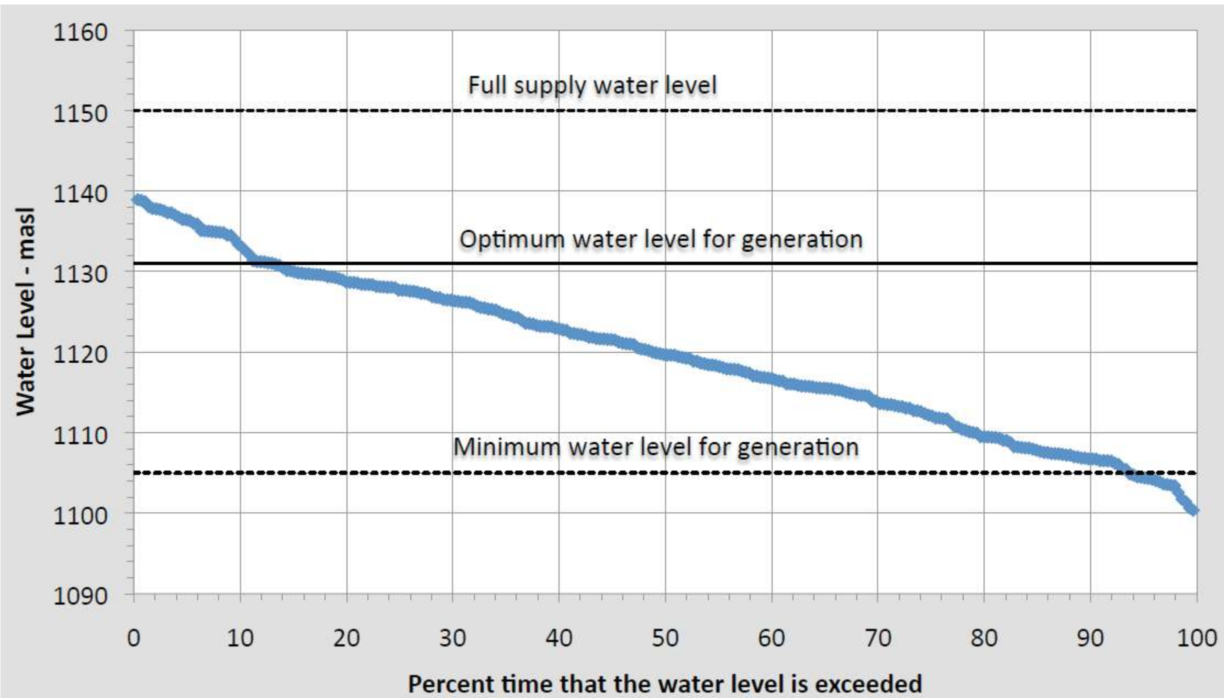


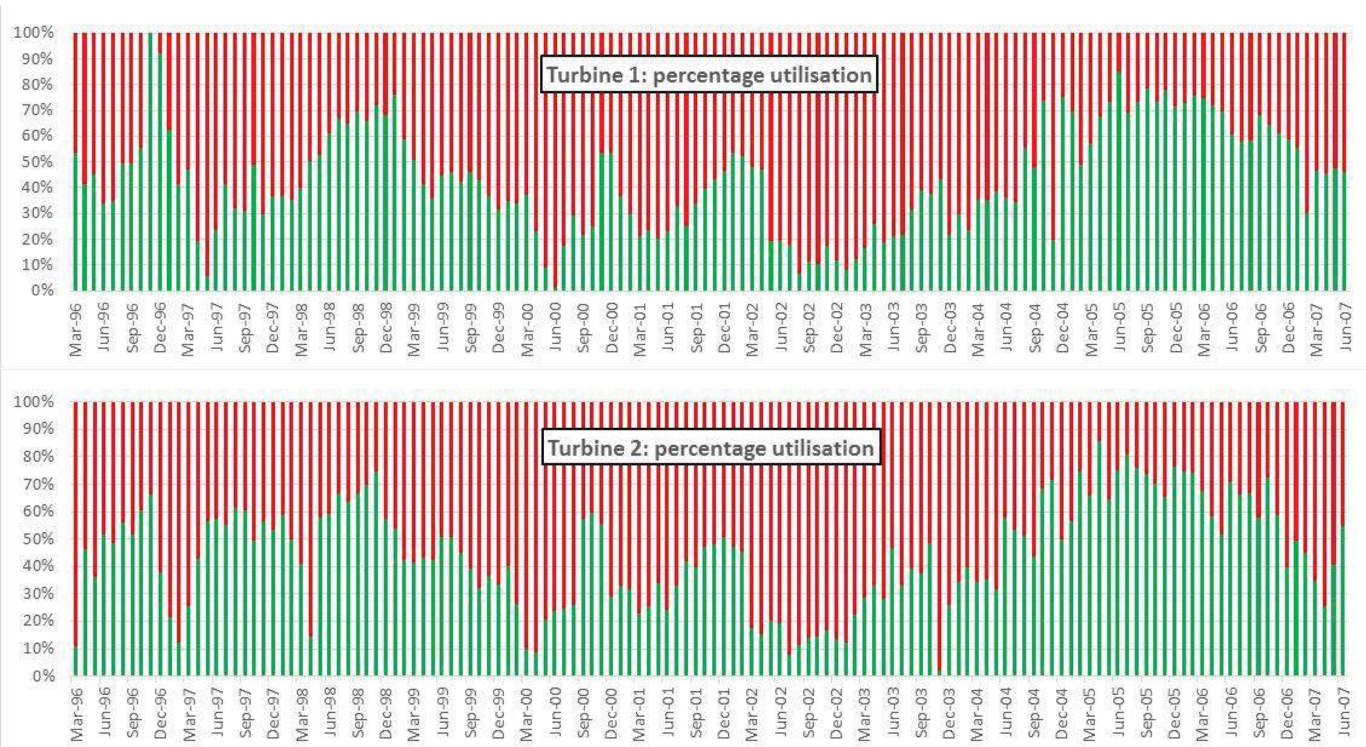
Figure 5: Water level duration curve for Turkwel reservoir, 1992 to 2016

Figure 5 shows the percentage of time, for the period 1992 to 2016, that a certain water level is exceeded. It can be seen that the minimum operational water level (1,105 masl) was exceeded about 94% of the time, or in other words, since 1992, the water level has been below the minimum operational water level for about 6% of the time. Ignoring the electricity generation regime, this represents the magnitude of the historical risk of water not being available at the tailrace discharge canal. Work will continue in 2017 on estimating the future risk over the lifetime of the South Lokichar oilfield, taking into account factors such as climate change, reservoir sedimentation and water resources development plans for the hydrological catchment above and below the dam.

ELECTRICITY GENERATION REGIME

Although Turkwel Dam was originally intended to be a multi-purpose project for hydro-power, irrigation, fisheries, river regulation and leisure activities, in practice it has only been used for electricity generation. As mentioned above, all water passing downstream does so through the turbines (because the low-level sluice in the face of the dam is rarely used), so downstream flows are entirely governed by the electricity generation regime. In other words, any benefits in terms of river regulation are incidental and if the turbines are shut down for any reason, no flow passes downstream.

Turkwel Dam is owned by the Kerio Valley Development Authority (KVDA), but the electricity generation is undertaken by the Kenya Electricity Generating Company Ltd (KenGen). There are two turbines at Turkwel Dam, with a combined capacity of 106 MW. The power is transmitted along a 220-kV transmission line, feeding directly into the national grid. The average monthly operating hours for the turbines vary throughout the year, depending on seasonal demand for electricity. In the event of power shortfall from other generating stations, Turkwel can be called upon to boost output to make up the deficit, but these calls are unpredictable. Figure 6 shows KenGen data on hours of operation for the period March 1996 to June 2007, in the form of percentage utilisation. Over that period, Turbines 1 and 2 were on average operating for 44% and 45% of the time (just over 10 hours per day), respectively. For example, a recent operating sequence was as follows (observed during a site visit in July 2016): during daylight hours on a weekday, a single turbine was running, generating about 40 MW; there was total turbine shutdown with zero water discharge all day Sunday until nightfall; during the evening hours on all days including Sunday, two turbines were operating from 19:00 until 22:30; on all days, there was no power generation overnight between 22:30 and 06:30, so water discharge was zero over that period.



(Green bars = average monthly percentage of time that turbine is operating)

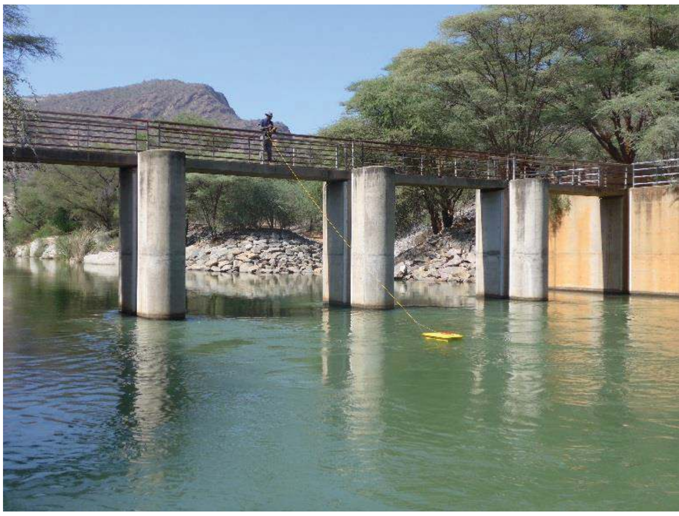
Figure 6: Percentage utilisation of the turbines at Turkwel Dam, March 1996 to June 2007

It was mentioned earlier that when the water level in the reservoir drops below the minimum operational water level, generation of electricity ceases. However, comparison of Figures 4 and 6 reveals that in early 2000, when the water level was below the minimum operational level for several months, generation of electricity still continued, albeit at a reduced rate. This suggests that the minimum operational level is not used as a strict cut-off point. Interestingly, the fact that the dam has never spilled, even though the turbines are only operating less than half the time, could imply that either the dam was overdesigned or the turbines are being operated more than was originally intended. Work is continuing to collect and analyse more data on the electricity generation regime and its inter-relationship with reservoir water levels.

The main implication of the electricity generation regime just described for the choice of water intake location at Turkwel Dam is that an intake abstracting from the tailrace discharge canal would on average only be able to pump for about 45% of the time, and there may be occasions when the tailrace canal is dry for extended periods. Having said that, an advantage of the tailrace canal as an intake location is that the generation of electricity would not be affected by the water abstraction. With an intake in the reservoir behind the dam, any water abstraction would lower the water level, which would theoretically reduce the amount of electricity able to be generated. However, for the quantity of water required by Tullow, this effect is likely to be insignificant. For example, at a typical reservoir water level of 1,120 masl, the surface area of the reservoir is about 22 x 10^6 m^2. An abstraction rate of 7,000 m^3/day (the projected average water demand over a 25-year lifetime of oil production) would lower this water level by about 0.3 mm per day. Compare this to the average loss of water by evaporation from Turkwel reservoir, which is about 4.9 mm per day. Further analysis will be done on quantifying this effect.

TAILRACE CONFIGURATION

It has been suggested that there is sufficient water storage in the tailrace tunnel and discharge canal to cover interruptions in water flow through the turbines, so the tailrace canal cross-sections and longitudinal profile have been investigated. The tailrace canal is an excavated trench about 200 m long and 20 m wide. The tailrace tunnel discharges into the canal underwater and the tunnel exit is not normally visible. At the downstream end of the canal is a hydraulic control structure that doubles as a footbridge (see photo below left, looking upstream). Just downstream of the control structure, the channel constricts before tumbling down some small rapids (see photo below right, looking upstream) to re-join the original river channel.




Concrete stoplogs are stored nearby (see photo below left), which can be slotted into grooves on the control structure (see photo below right), forming a dam to raise the water level in the tailrace canal. The structure is designed to impound water up to near the deck level of the footbridge, a clear height of about 6 m. The original purpose of the impoundment structure was to raise the water up to the command water level to gravity-feed an irrigation offtake canal on the north bank. The irrigation scheme was never implemented, so the stoplogs have never been deployed. Plans for such an irrigation scheme have recently been revived by KVDA and a feasibility study has been undertaken.

When the turbines are running, the channel is full of fairly fast-flowing water (see photo below left, looking downstream), but when both turbines are shut down, the water level in the tailrace canal drops dramatically (see photo below right, taken from a similar vantage point). The constriction and its associated shingle bed, visible in the photo below right, are the hydraulic control governing the water levels in the tailrace canal.

The cross-sectional depth profiles of the tailrace canal were measured in July 2016, at a time when both turbines were shut down and there was only a trickle of water passing downstream, which meant that the water level was constant throughout the depth-measurement exercise. Water depths were measured using a ‘Qliner 2’ acoustic doppler current profiler, manufactured by OTT Hydromet (see photos below). Measurements of cross-sectional depth profiles were taken at seven locations, evenly spread along the length of the tailrace canal, starting at the footbridge and working upstream; the results are shown in Figure 7.

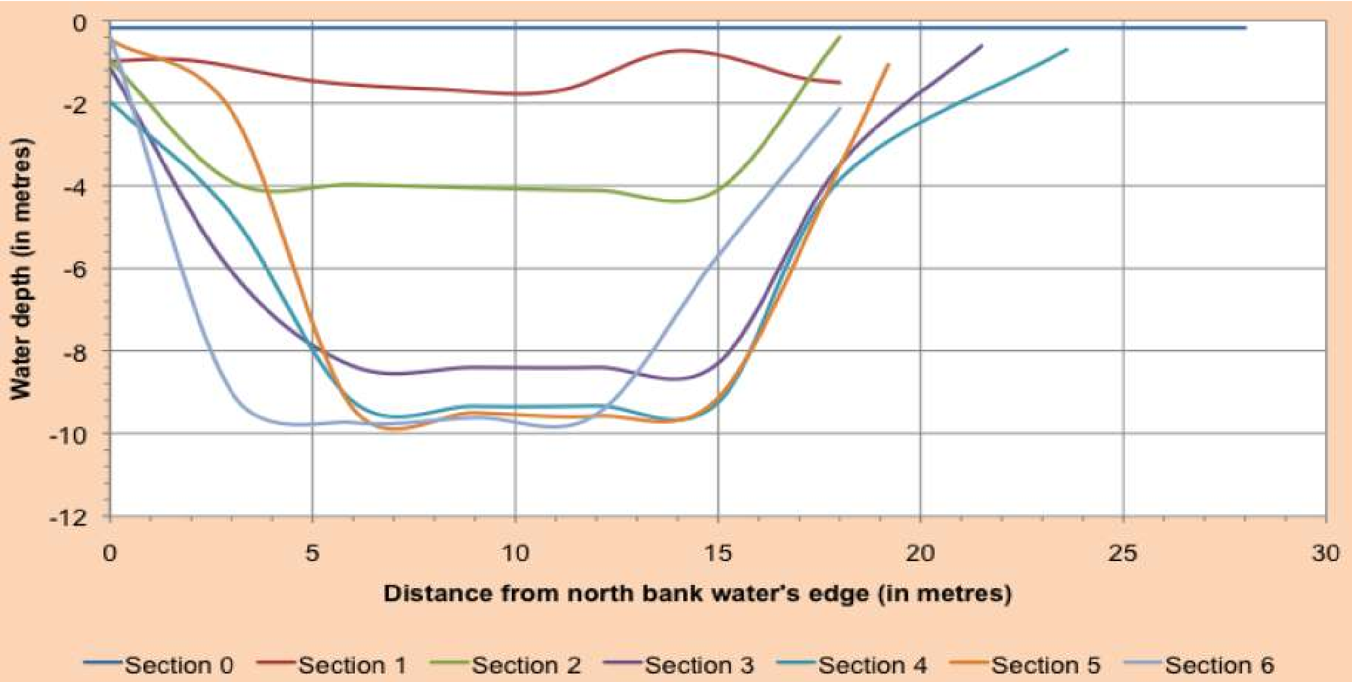


Figure 7: Tailrace canal cross-sections, measured at zero flow (with footbridge at Section 0)

Figure 7 shows that the ponded water (at zero flow) in the upstream half of the tailrace canal is between 9 and 10 m deep, reaching that depth at a distance of about 5 m from each bank. The pond depth reduces progressively downstream as the footbridge is approached. Under zero-flow conditions, the water depth under the footbridge itself is less than 20 cm. Integrating these results, the volume of ponded water in the tailrace canal at zero flow is about 14,200 m^3. The potential extra storage between the zero-flow pond level and the underside of the footbridge is about 20,740 m^3 (an added height of approaching 6 m); thus the theoretical maximum storage with stoplogs in place would be about 35,000 m^3. Taking into account the need to maintain adequate submergence for the pump intakes, this equates to about a day's worth of water supply at an abstraction of rate of 24,000 m^3/day (the design peak rate currently being used). Allowing for additional storage in the tailrace tunnel itself (the dimensions and gradient of which have not yet been ascertained), this might be sufficient to cover the overnight turbine shutdowns, but is certainly not enough storage in the event that the turbines shut down for long periods.

VARIATIONS ON THE TAILRACE OPTION
There are several variations on the tailrace option, including the following:

Further downstream
An intake could be constructed just below the point where the tailrace discharge re-joins the natural river channel. In principle, compensation flow releases could then be made through the low-level sluice in the face of Turkwel Dam to cover the periods when the turbines are shut down. However, the following issues should be noted:

- As mentioned earlier, the low-level sluice is rarely, if ever, used and its functionality is now doubtful. In fact, data from a preliminary depth-sounding exercise in the reservoir behind the dam suggest that the inlet to the sluice may now be buried under accumulated silt. Even if the sluice could be made to work again, water from this level in the reservoir is likely to be very dirty, and extensive desilting and clarification treatment would be required.
- Water released through the low-level sluice has not passed through the turbines, so the same discussion applies about depriving the turbines of water.
- If the irrigation plans are implemented, it is likely that the offtake for the irrigation command canal would be where it was originally intended to be – at the tailrace canal – and a downstream Tullow intake would therefore be vulnerable.

Additional storage
Another variation would be to construct bank-side water storage near the tailrace, fill it up whenever the turbines are running, then pump continuously from the bank-side storage along the delivery pipeline. The volume of the storage pond would be a simple factor of the design turbine shut-down period, but there may still be occasions when the storage is insufficient to cover long shut-down periods. In a sense, bank-side storage is just duplicating the function of Turkwel reservoir itself, so this is only really a sensible option if designed to cover relatively short shut-down periods. Detailed analysis of the frequency and length of shut-down periods will continue.

Turbine bypass
A variation has been suggested whereby water passes down the headrace and out of the tailrace even when the turbines are shut down. The concept is as follows: generation of electricity is supposed to stop when the reservoir water level reaches 1,105 masl, the minimum operational water level; however, this is still 11 m above the invert of the opening to the headrace tunnel (at 1,094 masl). Using the relationship between reservoir water level and reservoir volume derived by the original designers, it can be estimated that there is storage of about 108,000,000 m^3 between the water levels of 1,105 and 1,094 masl. Even allowing for evaporation losses, this represents plenty of storage to maintain the design peak abstraction of 24,000 m^3/d for extended periods (months if not years). Unfortunately, it has now been established that there is no bypass around the turbines in the underground powerhouse, so when both turbines are shut down, there is no way to continue releasing water via the headrace and tailrace. This option is therefore not viable.

CONCLUSIONS
There remain two main options for water intake location at Turkwel: an intake at the tailrace discharge canal; and a floating intake in the reservoir itself, near the dam, able to rise and fall with fluctuating water levels. The pros and cons of these two main options can be summarised as follows:

OPTION: TAILRACE	
PROS	CONS
Water has already been used for electricity generation, so Tullow abstraction does not deprive the turbines	Poor security of supply – water supply dries up whenever the turbines are shut down for more than a few hours
Simple engineering; quick to construct	Intermittent supply implies oversized pipeline and pumping systems to achieve design quantity delivered to CPF
Stable water level at intake and therefore pumping head	Vulnerable to future changes in electricity generating regime and potential irrigation schemes

OPTION: RESERVOIR (NEAR DAM)	
PROS	CONS
100% security of supply – abstraction can continue even when water level drops below minimum operational level	Abstraction from reservoir deprives the turbines of water, so strong justification will be required
Potential for gravity flow to CPF, once water has been pumped over high point in dam access road	Challenging engineering, especially coping with fluctuating water levels and pipeline descent of steep escarpment
Insulated from any future changes in electricity generating regime & water releases for irrigation or compensation flow	Wide range of variation in pumping head as reservoir water level fluctuates

From the point of view of security of supply and insulation from future changes to the way the dam is operated, it is clear that the reservoir intake option is the best. However, the final decision depends on the trade-off between various factors: security of supply; capital cost; operating cost; and continuity of water injection at the oilfields. These trade-offs need to be looked at in more detail during FEED.

STRATEGIC WATER SUPPLY FOR DEVELOPMENT - TURKWEL DAM OPTION
THE SOUTH LOKICHAR DEVELOPMENT AND OTHER WATER DEMANDS
AN OBJECTIVE PERSPECTIVE AND WAY FORWARD BY SEAN AVERY
OCTOBER 2018

INTRODUCTION

The first 5 years of oil production (Years 0 to 5) in the South Lokichar Development will on average require 13,600 m^3/d (0.157 m^3/s) of water, with a peak daily demand 13,700 m^3/d. [1] The following 20 years of oil production (Years 6 to 25) will on average require 5,000 m^3/d (0.058 m^3/s) of water. This is less than half the amount required during the first 5 years, albeit with a peak daily demand 11,500 m^3/d.[1] The estimates include a community water requirement assessed by Tullow amounting to 636 m^3/d (ibid.). [1]

This report compares the South Lokichar water requirement with other water demands that are dependant on the Turkwel water resource. The impact of the South Lokichar abstraction on Turkwel's water levels is presented again from the previous detailed work reported by the Consultant in 2015.

[1] Tullow Document No. T-KE-DEV-STG-0003 dated 26 February 2018.

TURKWEL DAM FLOW RELEASE AND MALMALTE COMBINED FLOW (TULLOW CONSULTANT'S WORK IN PROGRESS)

The average annual Turkwel dam flow release + River Malmalte combined flow = 21 m^3/s (estimate).[2 3]

In addition, there are flood influxes from all catchments between Turkwel dam and the lake (not quantified in this short report). On the other hand, the Malmalte future flows will be reduced by upstream irrigation developments.

Figure 1: Turkwel and Malmalte confluence

[2] Strategic Water Supply for Development, Turkwel Dam Option, Field Reconnaissance Report 2, Turkwel Reservoir & Hydrology – Sept/Oct 2013, by Dr. Sean Avery, Tullow Consultant.
[3] Strategic Water Supply for Development, Turkwel Dam Option, Preliminary Hydrological Review, by Dr. Sean Avery, Tullow Consultant, September 2015.

RIPARIAN WATER NEEDS DOWNSTREAM FROM TURKWEL DAM TO LAKE TURKANA

The River Turkwel flows 260 km from the dam tailrace to the lake. In contrast to the semi-arid plains, the riparian aquifers sustain a "green belt" along both banks (delineated in Figure 2). This vegetated riparian zone is an attractive resource that has long been heavily impacted by agricultural activities. The main areas are upstream of Lodwar, the largest being at Katilu, but also downstream in the vicinity of the Turkwel delta. And with Turkana County's population growing at over 6% per annum, the pressure on these zones and the associated water resources is increasing.

The river channel is wide and sandy and there are appreciable "bed losses". These "losses" occur via surface evaporation and through recharge into the riverine aquifer. The channel is often dry in the lower reaches nearing the lake. Thus, the combined Turkwel and Malmalte average annual river discharge of 21 m^3/s is a reasonable indicator of the annual riparian water needs.

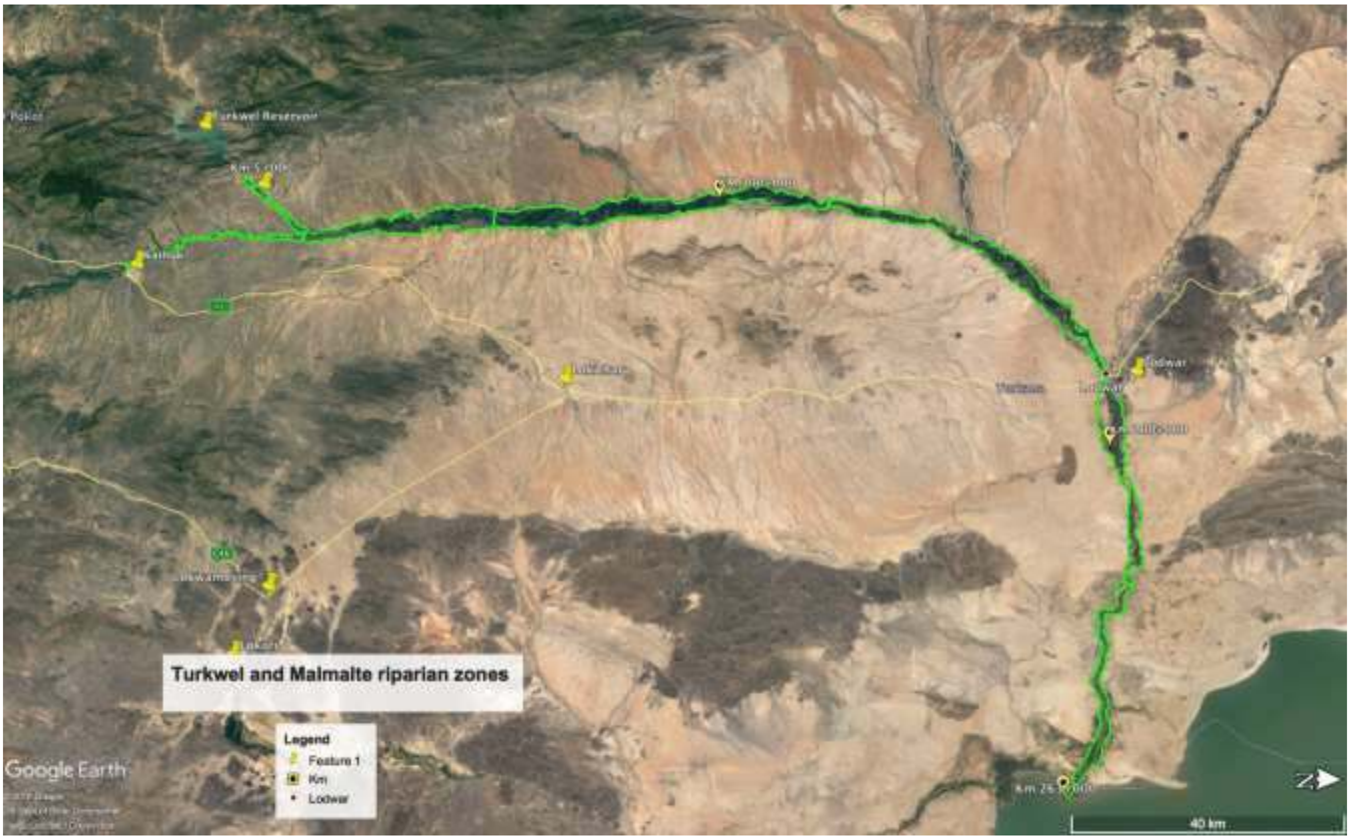


Figure 2: River Turkwel's "green belt"

WATER DEMAND ALONG LOWER TURKWEL (TULLOW CONSULTANT'S WORK IN PROGRESS)

An FAO sponsored study in 2013 has reported 1,753 ha existing under irrigation along the Turkwel river, with potential to increase this to 10,000 ha.[4] The estimated associated river water abstractions now and in future are as follows:

- Current irrigation area of 1,753 ha requiring 1.22 m^3/s.
- "Potential" irrigation area >= 10,000 ha requiring 6.95 m^3/s.

Also, in 2013, KVDA consultants studied the proposed Lower Turkwel Irrigation Project.[5] This envisaged a sugar plantation of cultivable area 22,100 ha, on the left bank not far from the tailrace. This project was not reported by FAO's team, and its potential irrigation area is thus additional to FAO's estimates. The KVDA scheme proposes to utilise the entire Turkwel dam flow release and in addition proposes to take supplementary water direct from the Turkwel reservoir (since it was believed there is spare capacity within the reservoir). The scheme's water requirement was computed to be:

- Lower Turkwel Irrigation Scheme area 22,100 ha requiring 18 m^3/s.

There is insufficient water for the above projects, and major abstractions would have serious consequences downstream. The scheme proposals are indicative of very ambitious government expectations from the River Turkwel.

The existing irrigation schemes are developed on areas cleared from within the riparian vegetation belt bordering the river. The crops thus replace existing vegetation. Irrigation waters are abstracted through gravity intakes on the riverbank and are conveyed to the schemes through open canals. With irrigated crop development, the vegetation water demand will adjust according to the difference in transpiration between natural vegetation and introduced crops. Shallow-rooted crops will transpire less water than deep-rooted trees. But on the other hand, the open irrigation canals and furrows increase evaporation losses, and the clearance of trees exposes the soils to solar radiation. This results in higher evaporation losses. The water efficiency of furrow irrigation schemes can be as low as 20%, and hence such schemes can be very water-wasteful.[6]

The government's recent Napuu drip irrigation project near Lodwar has developed 160 ha of land. KVDA's recent pilot centre pivot irrigation project has developed 370 ha, with 2,470 ha planned if successful. These schemes are assumed to embraced within the 10,000-ha potential proposed by the FAO study.

Compared to the above irrigation areas, the Tullow-estimated "following 20 years" long-term water requirements for the South Lokichar Development are equivalent to the water requirement of an irrigated area of only 83 ha.

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[4] FAO / Ocra Consultants, Opportunities and Threats of irrigation development in Kenya's Drylands, Vol.VI Turkana County, 2013.
[5] Kerio Valley Development Authority (KVDA), Lower Turkwel Sugar Irrigation Project, WAPCOS, 2013.
[6] Lake Turkana and Lower Omo: Hydrological Impacts of major dam and irrigation developments, University of Oxford, Vol. I, by Dr. Sean Avery, October 2012 http://www.africanstudies.ox.ac.uk/lake-turkana-and-lower-omo-hydrological-impacts-major-dam-and-irrigation-developments

Figure 3: Irrigation intake from the River Turkwel (north bank of Turkwel)

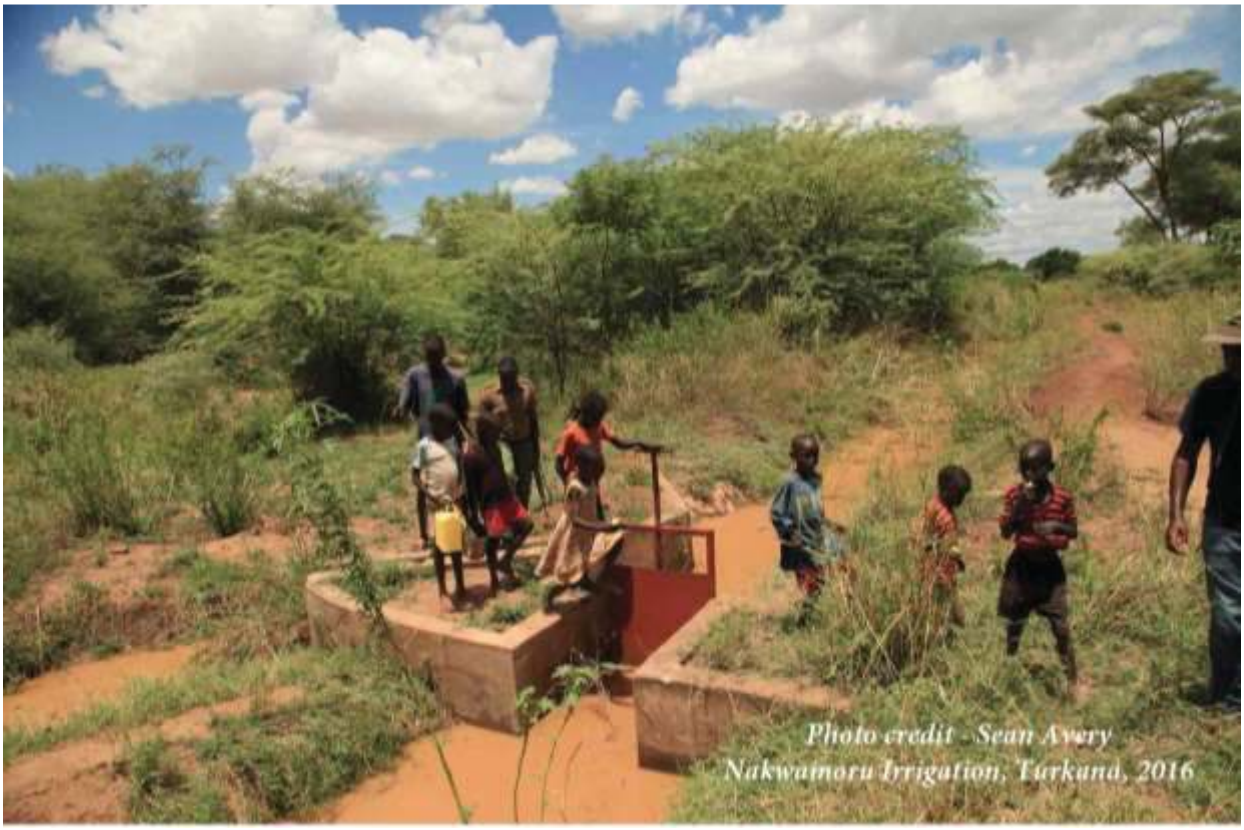

Figure 4: Nakwamoru Irrigation Scheme

Figure 5: Napuu Drip Irrigation Scheme

TURKWEL RIVER DOMESTIC & LIVESTOCK WATER NEEDS (TULLOW CONSULTANT'S WORK IN PROGRESS)

A preliminary estimate of human population along the river in 2017 = 172,000 people (without Lodwar Town).[7]

Water demand inclusive of livestock in 2017 = 0.099 m^3/s (a rough estimate).

Domestic and livestock water demands along the Turkwel are insignificant compared to irrigation requirements.

Figure 6: Artesian borehole water source

[7] The Consultant has based the population estimate on the 2009 national census for sub-locations adjoining the river without attempting at this point to exactly delineate the population reliant on the river zone.

LODWAR TOWNSHIP WATER SUPPLY REQUIREMENTS

Lodwar Town draws its water supply entirely from boreholes near the banks of River Turkwel. These boreholes will benefit from recharge by water infiltrating underground from the riverbed. With flow regulation provided by the Turkwel dam releases, the river at Lodwar is effectively perennial these days, unless flows are interrupted by shutdown of the dam's turbines for operational reasons.

The Lodwar water supply requirements are estimated below, and are greater than the South Lokichar development's water requirements.

Lodwar's Year 2017 water supply demand = 0.116 m^3/s (measurements published in REACH project documents).[8]

Lodwar's Year 2030 water supply demand = 0.247 m^3/s (estimated at 6% per annum demand growth).

Figure 7: Lodwar Water Supply borehole

[8] Haynes et al., REACH Working Paper, Weather and climate knowledge for water security: Institutional roles and relationships in Turkana, September 2017.

TURKWEL RESERVOIR WATER LEVEL SIMULATION – IMPACT OF ABSTRACTION [3]

The evaporation loss from Turkwel reservoir at optimum operating level amounts to 4% of inflow, and this loss increases as water level rises (Table 1). In contrast, the South Lokichar development's water requirement in the "First 5 years" is equivalent to 1.02% inflow, dropping to 0.38% in the "following 20 years" (Table 2).

Table 1: Evaporation loss as % Turkwel inflow

Turkwel reservoir operating levels	Evap Loss m^3/s	Evap Loss as % Turkwel Inflow
Minimum operating level 1105 masl	0.629	4.1%
Optimum operating level 1131 masl	1.929	12.5%
Full supply level 1150 masl	3.723	24.2%

Table 2: South Lokichar water requirement as % Turkwel inflow

South Lokichar water requirements	Water Requirement m^3/s	Water Requirement as % Turkwel Inflow
First 5 Years	0.157	1.02%
Following 20 Years	0.058	0.38%

If water is abstracted direct from the Turkwel reservoir, the water level will be lowered slightly, and there will be an associated small reduction in generating output (Figure 8). The graph is a simulation of the reservoir operation using actual machine discharges that were derived from power generation records. [3] These records were availed by KVDA from 1993-2016. An update is within the Tullow Consultant's work in progress along with calibration of those machine discharges.

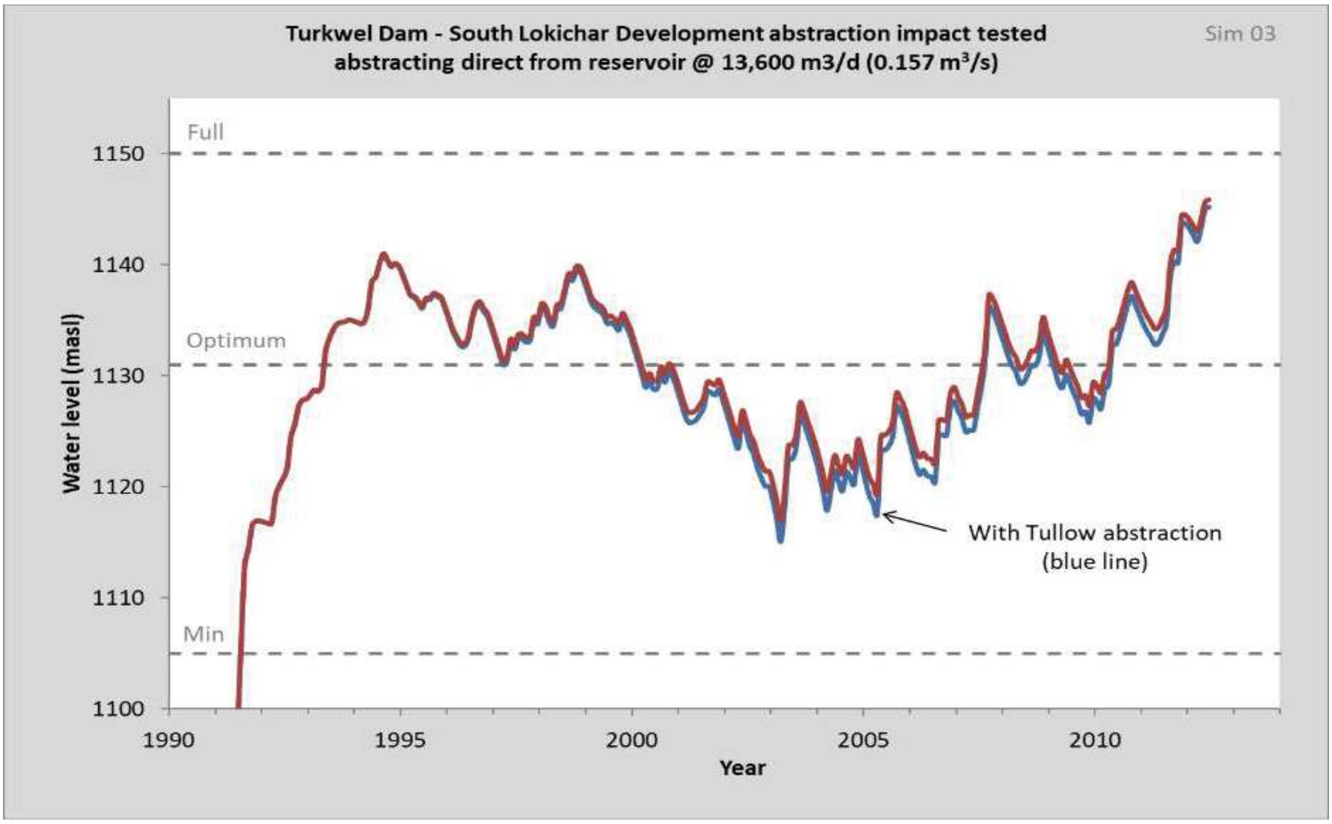

Figure 8: Turkwel reservoir water level simulation

LOWAAT DAM PROJECT NEAR LOKORI

Although not within the Turkwel Basin, the proposed Lowaat Dam project on the Kerio River is an interesting development to the south of the South Lokichar development area. The selected project dam site is located a short distance upstream from Lokori. The scheme aims to supply 0.2 m^3/s for water supply and 17.4 m^3/s for irrigation purposes. This yield was determined based modelling as recent actual data does not exist. The modelled mean annual discharge at the site is 50% higher than Turkwel dam produces. This may be optimistic, as the Lowaat dam catchment area is only slightly larger. There are also irrigation projects existing and planned in the upper basin, all of which will utilise water.

A large dam project like this would obviously take years to implement. The economic feasibility will first need to be verified through a period of baseline data collection, which will take time. But if this project was implemented in some form, it would provide a supplementary water harvesting source within a marginalised dry area, and it would be a possible backup to South Lokichar in the future.

The important but defunct river gauging station at Lokori was amongst the sites recommended by the Consultant for rehabilitation. Operationalising that gauging station should be a national and county priority, and is an objective that Tullow can support.

SUMMARY OF WATER DEMANDS

The biggest water demand in Turkana County will potentially be from irrigation schemes. Nationally, irrigation schemes are expected to account for 81% of Kenya's water demand by the year 2030.[9] The projected national water deficit in 2030 is expected to be 74% of total water demand.

The irrigation schemes along the River Turkwel will utilise a significant proportion of that river's water balance, and would potentially empty the river. And the river flows in Turkwel's main downstream confluence, the River Malmalte, will in turn be affected by irrigation developments, in this case largely upstream from Kainuk.

Notwithstanding the preliminary nature of water demand figures in this report, in comparison with the other huge water demands, the South Lokichar oilfield development water requirement amounts to a negligible proportion of the Turkwel water balance. It equates to a fraction of the water already evaporated constantly from the Turkwel reservoir surface.

Table 3: Summary of preliminary individual lower Turkwel water demand points

Water Demand Item	Amount of water required (m^3/s)	Expressed as a multiple of Year 6-25 South Lokichar water demand
South Lokichar Development's 20-yr production demand [a]	0.058	-
Turkwel reservoir's average evaporation loss @ Opt. Op. WL	1.929	33.3
Turkwel dam's average flow release + Malmalte flows	23	371
Lodwar Water Supply in Year 2017	0.116	2.0
Lodwar Water Supply forecast for Year 2030	0.247	4.3
Turkwel baseline riparian / irrigation water needs	23	371
Turkwel riparian population water needs	0.099	1.7
Turkwel potential irrigation abstractions [b]	6.950	120
Lower Turkwel Irrigation scheme	14.9 (18.0) [c]	Near 100%

Notes:
[a] Includes community water supply needs.
[b] KVDA Lower Turkwel sugar irrigation project not included.
[c] 14.9 = WAPCOS estimate of Turkwel turbine throughput. 18.0= WAPCOS total yield estimate.

[9] Irrigating Kenya's drylands – food for thought, by Sean Avery, Nov. 2013. A crop agriculture "Discussion Brief" prepared for the Regional Learning and Capacity Building Initiative for Vulnerable Dryland communities (REGLAP now DLCI), funded by ECHO, http://www.dlci-hoa.org/?s=avery

DISCUSSION AND RECOMMENDATIONS

This report demonstrates the many factors contributing to the lower Turkwel water balance, all of which were anticipated by the Consultant, and embraced within the intention of the Consultant's contract with Tullow. This work was foreseen as a long-term ambitious but necessary plan of work, and it was accepted by Tullow as such. Working papers are being produced, but the only "deliverable" is to establish final confidence in the water resource in order justify investment in the necessary infrastructure. The importance of that foundation work plan to the South Lokichar development is inescapable, and significant progress has been achieved in spite of frustrations.

Although the South Lokichar water demand is small, the development is increasingly prominent in the county's public eye. With the regional challenges of food security, and with the water demands arising, all water resources are under pressure. There will inevitably be increasing pressure on groundwater resources too. As noted in Kenya's national water masterplan, there is a major water deficit already arising in Kenya.

Lake Turkana is the ultimate "health indicator" of the basin's entire water resource exploitation. As recommended long ago and accepted by Tullow, the lake monitoring initiated by the Consultant is in Tullow's interests. The Consultant's expertise in this area was the reason Tullow invited the Consultant's engagement in the first place. It is strongly recommended that Tullow readily supports the Consultant's ongoing efforts to validate the baseline database. The request is to access data that Tullow staff have confirmed can be processed at very little cost from within. It is strongly recommended that this work be authorised.

Surface water runoff in Kenya's Rift Valley catchments is forecast to increase 50% over the coming decades. This is a mixed blessing as it is invariably an indicator of catchment degradation, which is a national concern. The direct impact of faster runoff response to storm rainfall includes increased erosion, deterioration in water quality, and reduction in the economic life of costly reservoirs through sedimentation. The bathymetry work on Turkwel has been an important step towards quantifying those impacts, as were the Consultant's intentions to broaden the perspective through encompassing data from similarly affected regional lakes including nearby Lake Baringo. That work is ongoing, but is being delayed by belated internal bureaucracy concerning equipment procured solely for this task. The Consultant's recommendations on this work front are strongly reiterated here.

The importance of efforts to restore the river gauging network is strongly re-iterated. That data is vital to firmly establish the feasibility of the water resource to supply the South Lokichar development. The planned data collection is required for the climate change modelling that has also been programmed. There have been delays beyond the Consultant's control, but the need for that work is not diminished in any way.

THE WAY FORWARD

The work is being undertaken by a locally-based consultant with international accreditations, including membership of an international network whose expertise in water resources and hydrology is exceptional.[10] The Consultant has almost four decades of personal hands-on experience in Turkana, and he is fully licensed and gazetted by the Kenya government to undertake the services required. However, this year Tullow commitment to the work plan has wavered, for whatever internal reasons, and a decision needs to be made before all momentum is lost. And if Tullow considers that the Consultant's judgement needs to be questioned at every step, that service provision needs to be reconsidered.

[10] See website: www.watres.com

TECHNICAL MEMORANDUM

DATE 20 Sept 2019 **Reference No.** 1433956.628_V.2

TO Paul Mowatt, TKBV

CC Rachel Lansley, Harvey Rich, Anna Goodwin

FROM Andrew Morsley **EMAIL** amorsley@golder.com

FOUNDATION STAGE DEVELOPMENT: HYDROTESTING WATER MANAGEMENT PHILOSOPHY

Introduction

Following a request from TKBV on 5 September 2019 for Golder Associates (UK) Ltd (Golder) to set out a hydrotest philosophy to complement the Foundation Stage Development Project Description, this document has been prepared as a guide for TKBV to develop a hydrotest water management philosophy for the project. This philosophy has been prepared with reference to the following documents:

- IFC Performance Standard 3 – Resource efficiency and pollution prevention (2012);
- IFC EHS Guideline for Onshore oil and gas development (20107);
- IFC EHS Guideline for Environmental Water Conservation (2017); and
- IFC EHS Guideline for Environmental Wastewater and Ambient Water Quality (2017).

Hydrotesting

Hydrostatic testing ("Hydrotesting") of equipment and pipelines involves pressure testing with water to detect leaks and verify equipment and pipeline integrity. There will be a requirement to source and discharge hydrotest water for the water pipeline between the Turkwel reservoir and the Central Processing Facility (CPF) in South Lokichar, as part of the Foundation Stage Development.

Surface water (from the Turkwel reservoir) and permitted abstracted groundwater have been identified as the potential water sources for hydrotest water for the water pipeline. Water is a very limited resource in Kenya and any water resource, whether it is surface water from the dam or groundwater, is a potential source of drinking water or has potential for use in irrigation. In the case of the former the water will also be a valued ecological resource. Any abstraction must therefore be managed to minimise impacts on any existing "downstream" users.

Discharge of spent hydrotest water will be restricted to discharge to evaporation ponds, thereby reducing the potential to impact any surface water flow regimes, groundwater levels or surface or groundwater quality. Chemical additives (e.g. corrosion inhibitors, oxygen scavengers and dyes) are often added to hydrotest water to prevent internal corrosion or to identify leaks. Chemical treatment of the test water is not envisaged at this stage given the material of construction of the pipelines is cement-lined ductile iron or carbon steel. If chemical additives are included, the discharge philosophy will be discharge to evaporation ponds, or if the water is to be reused for dust suppression, to treat the wastewater to meet relevant Kenyan standards.

A hydrotest water management philosophy will be developed for the water pipeline. The Kenyan regulatory regime will guide each hydrotest plan and the plan will include all permits required for water abstraction, storage and discharge. Some of the key Kenyan regulator drivers behind water conservation and protection (which will apply to the abstraction and discharge of water used for hydrotesting) are:

- The Kenya Water Act (2016) – relates to water resource ownership, and the regulation of water use and management. It presents requirements associated with permission to abstract groundwater, consideration of existing users, promoting the conservation of water, and preventing the pollution of the water environment.
- Kenyan Government Environmental Management and Coordination Act (EMCA) (1999) and Amendments (2018) – relates to the requirement have licences for certain activities (such as discharges) and to pollution offences and penalties.
- Kenyan Government Environmental Management and Coordination Act (Water Quality) Regulations (2006) – relates to the provision of protection to the water environment and prevention of water pollution by prohibiting discharge of effluent into the environment contrary to the established standards.

Water Reduction and Reuse

The objective of IFC Performance Standard 3 is to promote more sustainable use of resources. During a project's life-cycle, an operator should consider the baseline conditions of the area and apply technically and financially feasible resource efficiency and pollution prevention principles/techniques that are best suited to avoid or minimise adverse impacts on human health (e.g. water supply availability) and the environment.

Although it is recognised that not all test water will be able to be reused, reuse should be encouraged before discharge, evaporation or other potential disposal routes that could be construed as a loss or waste of water. The following measures should be considered with respect to water conservation:

- Testing should be undertaken in short sections, so less water is needed at any one time.
- The same hydrotest water should be used for tests on multiple sections - test water should be collected once each section has been tested and reused for the next. Treatment/filtering may be required to make sure the test water is suitable for re-use in the next section of pipe.
- If possible, the same water should be used for water pipeline testing water and oil pipeline testing water, although this is unlikely under the current construction schedule due to the length of time between installation of the different pipelines.
- Once the final testing has been completed, further water reuse should also be considered.
- Before re-use, water should first be collected, tested and treated if required. Depending on the quality of the water, reuse could include grey water for toilets, floor washing water, vehicle washing, dust suppression, or cleaning of construction equipment.
- Reuse, or storage before disposal, may require holding a facility (e.g. pond or tank). Losses (e.g. evaporation or leaks) from such facilities should be minimised.

Water Disposal

Disposal could be to land (soakway or evaporation pond) and would need appropriate approval under the appropriate Kenyan permitting regime; any wastewater disposal should be undertaken with cognisance of Kenya legislation and the nature of the receiving environment. Sensitive receptors in the receiving environment could include both ecological and human receptors. The following measures should be considered with respect to water disposal:

- Discharge location selection and rates should be managed to limit the potential for increased erosion or flooding (e.g. at a controlled rate and use of erosion control measures).
- Sediment control measures should be used, where required, to protect aquatic biota, water quality, and water users from the potential effects of discharging.
- Pollution prevention control should be implemented. The water quality (chemistry and physical parameters) of the discharge will have to be suitable for the chosen discharge location.
- A discharge method statement and monitoring programme should be developed.
- The monitoring locations should be selected with the objective of providing representative monitoring data.
- Monitoring of discharge quality should be undertaken before discharge. This may be required to meet permit requirements for volume and quality. Discharge monitoring should target parameters of concern.
- The temperature of the discharged water should not cause an unacceptable increase in the temperature of the receiving water environment.
- Monitoring should be conducted by trained individuals who are following monitoring, record-keeping procedures and using properly calibrated and maintained equipment.
- Monitoring data should be analysed and reviewed at regular intervals and compared with appropriate environmental standards, so that the requirement for any necessary actions can be identified and those actions can be taken.

Anna Goodwin
Senior Hydrogeologist

Andrew Morsley
Associate

AG/AM/gg

GOLDER

TECHNICAL MEMORANDUM

DATE 16 October 2019 **Reference No.** 1433956.636_B.0

TO Paul Mowatt, Tullow Kenya BV.

CC Oliver McCredie, Rachel Lansley, Anna Goodwin

FROM Richard Lansley, Andrew Morsley **EMAIL** amorsley@golder.com

ESTIMATE OF RADIUS OF INFLUENCE OF ABSTRACTIONS

Background

The Project are proposing to obtain 1,560 m^3/day of water from 10 groundwater borehole sources to provide make-up water to the project for a period of 18 months in advance of an alternative supply coming on-line.

In this technical memorandum is presented an assessment of the potential radius of influence of these abstractions and hence the potential impact of the proposed abstraction on sensitive water receptors. Sensitive water receptors are considered to include wells, waterholes, hand dug wells and sand dams and hand dug wells in the ephemeral riverbeds. It is considered, for the purpose of this assessment, that if a discernible drawdown is observed at surface this would have a negative impact on these sensitive receptors.

Description of Wellfield

The locations of the 10 abstraction wells are shown on Figure 1. All the wells are located in proximity to watercourses in the catchment of the River Kalabata.

To meet the short-term make-up water demands it is proposed to extract groundwater from the boreholes at the rates presented in Table 1. Of the boreholes listed in Table 1 four are currently in active use and are pumped at the approximate rates shown in Table 1.

Table 1: Historic and proposed groundwater abstraction rates (m^3/day)

Well	August 2019 Rate	September 2019 Rate	Proposed Rate
Kengomo 1	-	-	130
Kengomo 2	-	-	100
Nakukulas 9	89	103	200
Kaeng'akalalio C	-	-	90
Nabolei	-	-	90
Ngamia East	79	67	240
Nakukulas 10	142	148	170

Well	August 2019 Rate	September 2019 Rate	Proposed Rate
East Lokichar WBHC	214	249	170
Ekunyuk	-	-	180
Ewoi	-	-	190

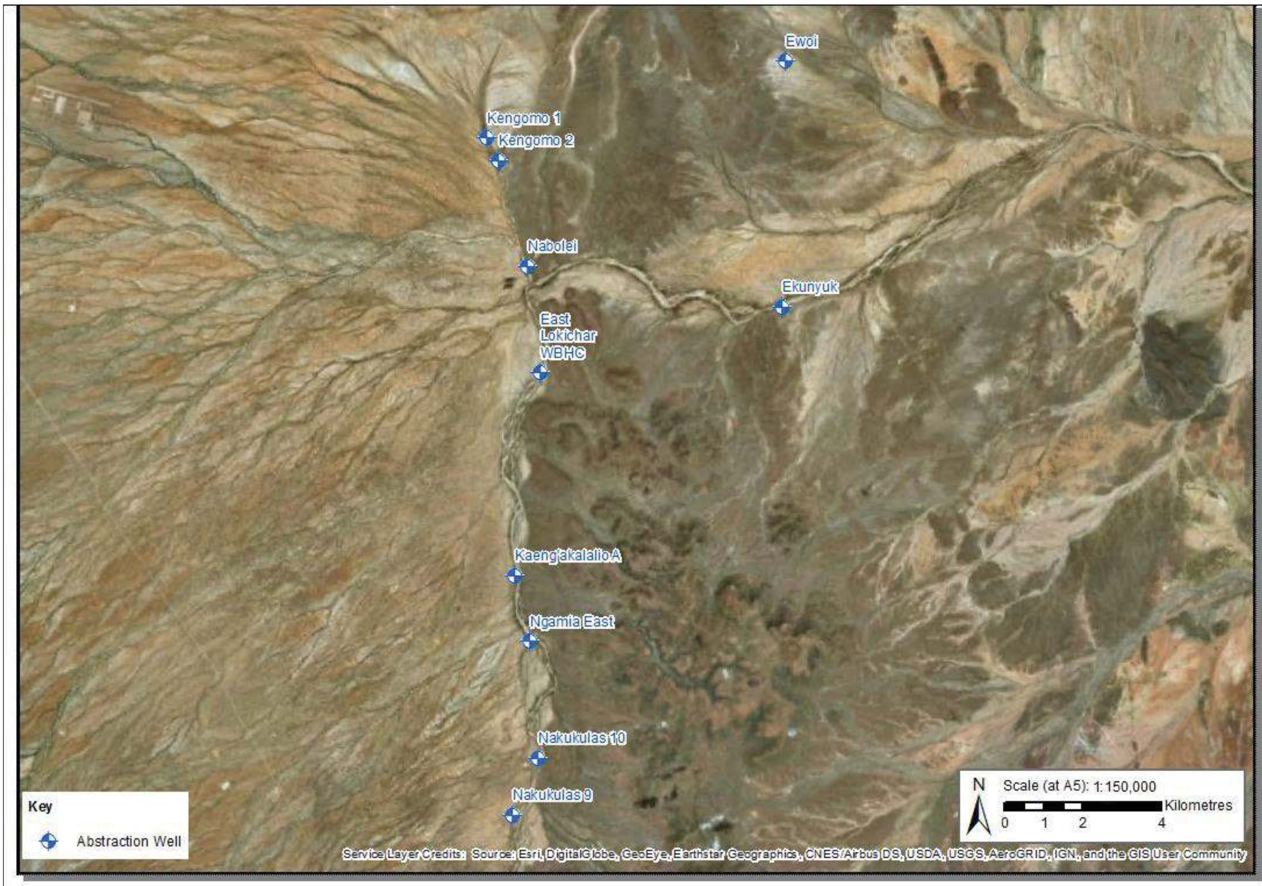

Figure 1: Map of borehole locations (The location of Kaeng'akalalio C has been plotted in place of Kaeng'akalalio A as the exact coordinates are unknown)

Based on the records provided for the wells by Tullow it is noted that they are drilled through the Plio-holocene alluvial deposits and weathered bedrock to target water strikes in multiple geological units. Insufficient data exist to indicate whether the targeted groundwater forms discrete aquifer units. For, the purpose of, this interpretation it is assumed that abstracted groundwater comes from an unconfined source and hence drawdown would be experienced at surface in response to pumping. A summary of the minimum dip to groundwater (inferred to be rest water level) reported geology and construction details of the abstraction wells are detailed in Table 2. The rest water level ranges from 4.06 m and 23.77 m below ground level which could indicate that shallow groundwater sources are dependent on perched ephemeral groundwater and not the deeper sources targeted by these boreholes.

Table 2: Well geology and construction summary

Well	Min dip to water	Depth	Reported geology of response zone	Depth Top	Depth Bottom	Length of Screen	Drilled Diameter
Kengomo 1	23.77	130	Highly Fractured Basalts	100	130	30	203
Kengomo 2	23.28	206	Weathered Basalts	140	206	66	203
Nakukulas 9	16.93	66	Decomposed Granites	33	36	3	242
				39	42	3	
Kaeng'akalalio C	16.18	Data unknown					
Nabolei	15.47	100	Weathered Rocks	75	78	3	242
				81	84	3	
				87	93	6*	
Ngamia East	7.45	Data unknown					
Nakukulas 10	4.06	63	Decomposed Granites	27	30	3	242
				42	45	3	
East Lokichar WBHC	8.43	Data unknown					
Ekunyuk	10.45	252	Volcanics	174	252	78	203
Ewoi	16.83	180	Fractured sandy sediments	120	180	60	203

* 3 m reported in Completion Report however interval range indicates 6 m.

The results of a number of pumping tests have been made available to Golder by Tullow. Where well completion data are available the pumping test data have been analysed using the Neuman unconfined method for the analysis of the pumping and recovery phases within the test interpretation package Aqtesolv® to calculate a Transmissivity and Specific Yield for each test. Well completion data and total depth are not known for Kaeng'akalalio C (test pumping data also applies to Kaeng'akalalio A) and East Lokichar, however the recovery of the pumping test has been interpreted using the Cooper Jacob method by considering the drawdown across one log interval of time to provide a first order transmissivity.

The results of the analyses are presented in Table 3.

Table 3: Test Pumping Analysis Results

Well	Transmissivity (m^2/s)	Specific Yield
Kengomo 1	7.05×10^{-5}	0.036
Kengomo 2	9.55×10^{-5}	0.5
Nakukulas 9	No data available	
Kaeng'akalalio C*	4.17×10^{-6}	0.1^
Nabolei	4.08×10^{-5}	0.1
Ngamia East	No data available	
Nakukulas 10	No data available	
East Lokichar WBHC	2.50×10^{-4}	0.1^
Ekunyuk	3.27×10^{-5}	0.5
Ewoi	3.73×10^{-5}	0.1

* Well completion data and total depth are not known for Kaeng'akalalio C (test pumping data also applies to Kaeng'akalalio A)

^ Specific Yield is applied at 0.1 when not output by the analytical method.

The radius of influence after pumping for 18 months can be estimated using Equation 1 (Cooper-Jacob, 1946):

$$R_0 = \sqrt{2.25\, T \frac{t}{S_y}}$$

Where: R_0 is radius of influence at time t; T is transmissivity; t is time elapsed since the start of pumping; and, S_y is the Specific Yield.

Based on the transmissivity and specific yield values presented in Table 3 the radius of influence after 18 months of pumping has been calculated (Table 4). As a sensitivity analysis the lower bound for specific yield of 0.02 from Fetter (1997) has been used to provide a more conservative assessment of the radius of influence. The calculated results are detailed in Table 4.

Table 4: Estimate of Radius of Influence

Well	Calculated Radius of Influence (m)	Sensitivity Analysis of Radius of Influence (m)
Kengomo 1	460	610
Kengomo 2	140	710
Kaeng'akalalio C*	70	150
Nabolei	210	470

Well	Calculated Radius of Influence (m)	Sensitivity Analysis of Radius of Influence (m)
East Lokichar WBHC	520	1,150
Ekunyuk	83	420
Ewoi	200	450

For the three wells that pumping test data has not been available a qualitative methodology has been applied to provide an indicative radius of influence in comparison to the estimates for the other wells. The completion reports for Nakukulas 9 and Nakukulas 10 provide a summary of drawdown after a 24 hour constant rate test. Based on this data it is inferred that a drawdown of 5 m and 7 m respectively was observed at a pumping rate that was comparatively high compared with the other boreholes considered. The completion report for these wells identifies the geology to comprise decomposed granite. Based on the assumption that the hydraulic conductivity of the decomposed granite is equivalent to a well graded sand, it is assumed that the hydraulic conductivity is 1×10^{-3} m/s. The response zone of both Nakukulas 9 and Nakukulas 10 is 6 m, hence the transmissivity at the well is calculated to be 6×10^{-3} m^2/s. Using the same approach as above this provides an indicative radius of influence after 18 months of pumping of approximately 2,500 m assuming a specific yield of 0.1 and of approximately 5,600 m using the sensitivity analysis specific yield of 0.02.

There is no completion report or test pumping data for Ngamia East however it is still possible to estimate indicative well performance based on known abstraction rate and level response. It is known that in 2015 the well was abstracted at a rate of around 192 m^3/day and during 2018 and 2019 the pumping rate was reported to be 79 m^3/day and 61 m^3/day respectively. Drawdown in 2015 was in the order of 45 m and in 2019 is in the order of 30 m. In terms of the drawdown to pumping rate relationship, Kengomo 1 and 2 are the most similar hence an indicative radius of influence in the order of 500 and 750 m is inferred at the estimate and sensitivity analysis respectively.

It is noted however that these wells are currently in production and the increase in pumping rate for Nakukulas 9, Nakukulas 10 and Ngamia East is proposed to be an increase of 100%, 260% and 15% respectively. As a first order estimate, this would mean that the amount of drawdown currently observed within the existing radius of influence may increase proportionately.

A presentation of all estimates of radius of influence are presented on Figure 2. It should be noted that no account has been taken of interference effects between abstractions of the influence of geological boundaries which may result in increased drawdowns and radius of influence.

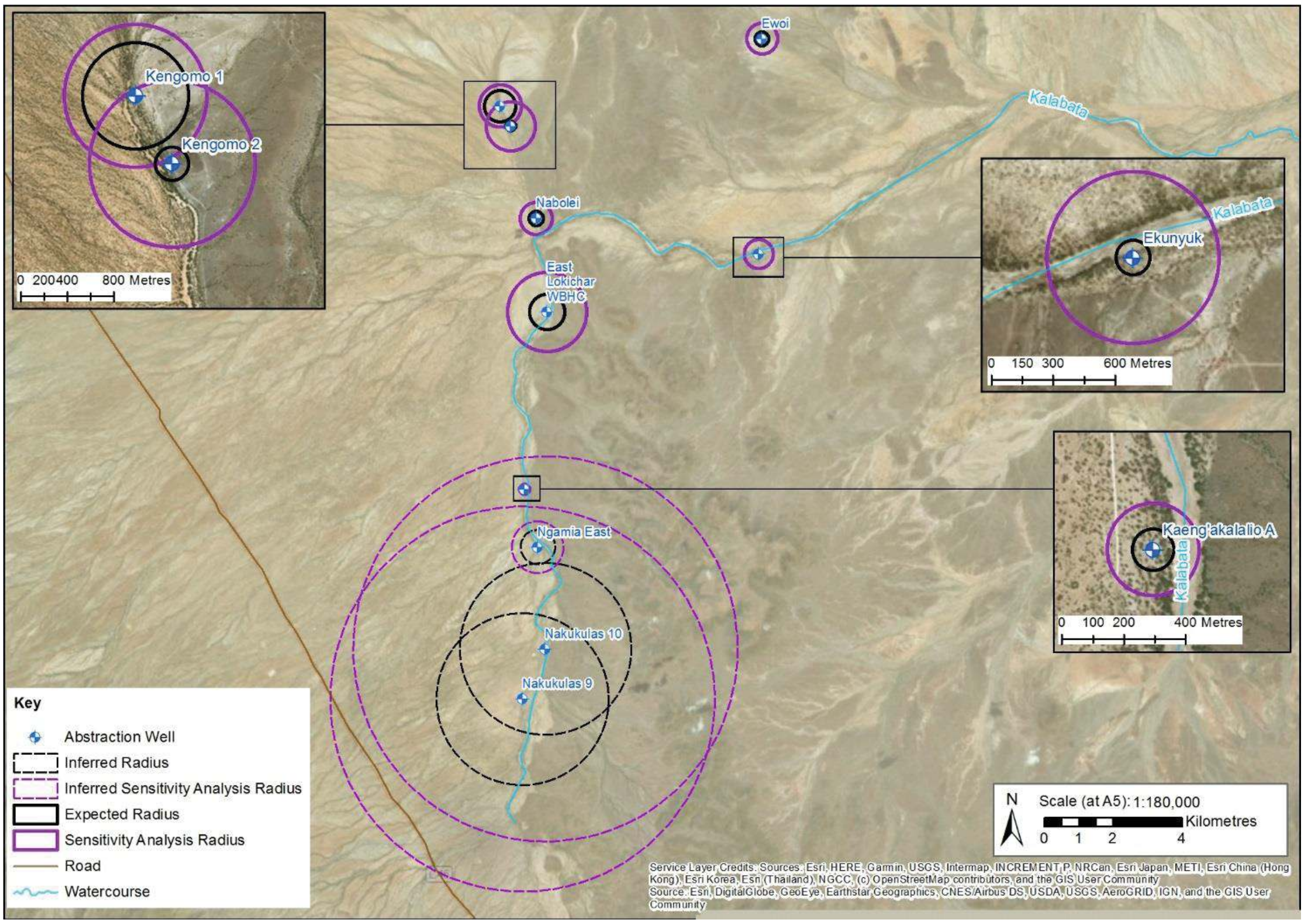

Figure 2: Calculated radius of influence after 18 months

An estimate of the in well drawdown has been completed by comparing the proposed rate against the test pumping rate and drawdown experienced during the pumping test. It is noted that the drawdowns relate to tests that were of shorter duration than the period of abstraction proposed. The estimated drawdown in the pumping wells is presented in Table 5.

Table 5: Indicative Drawdown of Operational Wells

Well	Proposed Utilisation Rate (m^3/day)	Estimate of pumping well drawdown (m)
Kengomo 1	130	35
Kengomo 2	100	16
Nakukulas 9	200	3
Kaeng'akalalio C*	90	52
Nabolei	90	25
Ngamia East	240	Insufficient data to determine
Nakukulas 10	170	3

Well	Proposed Utilisation Rate (m^3/day)	Estimate of pumping well drawdown (m)
East Lokichar WBHC	170	7.7
Ekunyuk	180	84
Ewoi	190	76

Impact Assessment

Based on the calculations presented above it is considered likely that any abstractions within 200 m of any of the abstraction wells considered may be derogated as a result of abstraction from the Tullow wells. The most significant combination of drawdown and radius of influence is at Kengomo 1 where a drawdown of 5 m is estimated at a distance of 200 m by considering a log drawdown relationship between the estimated pumping well drawdown of 35 m and radius of influence of 460 m.

The rest water level observed in the 10 abstraction boreholes ranges from 4.06 m and 23.77 m below ground level which could indicate that shallow groundwater sources are dependent on perched ephemeral groundwater and not the deeper sources targeted by these boreholes. Hence those sources, such as hand dug wells and sand dams, which rely on shallow ephemeral groundwater sources may not be significantly impacted

Summary and Conclusions

A summary of available data has been prepared and used to provide a first order estimate of the radius of influence of abstractions. In general, those abstractions with a larger radius of influence will have the least drawdown.

There may still be the requirement for monitoring and mitigation through providing an alternative supply of water to users of shallow waters such as hand dug wells, luggas and open waterholes.

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Biodiversity

D4

TECHNICAL MEMORANDUM

DATE 22 April 2020 1433957_645

TO Paul Mowatt, Tullow

CC Andrew Morsley, Mervyn Mason

FROM Peter Kimberg **EMAIL** pkimberg@golder.com

APPROACH TO CRITICAL HABITAT ASSESSMENT

1.0 INTRODUCTION

The purpose of this Technical Memo is to clarify the approach taken in the critical habitat assessment (as required by the International Finance Corporation (IFC) Performance Standard 6.

2.0 BACKGROUND

For the purposes of implementation of this Performance Standard, habitats are divided into modified, natural, and critical. Critical habitats are a subset of modified or natural habitats (IFC, 2012).

2.1 Critical Habitat Criteria

Critical habitat criteria are areas of high biodiversity value and form the basis of any critical habitat assessment. The criteria for identifying areas of high biodiversity value are:

- **Criterion 1:** Habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species;
- **Criterion 2:** Habitat of significant importance to endemic and/or restricted-range species;
- **Criterion 3:** Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
- **Criterion 4:** Highly threatened and/or unique ecosystems; and/or
- **Criterion 5:** Areas associated with key evolutionary processes (IFC, 2012).

In addition, projects that are located within internationally and/or nationally recognised areas of high biodiversity value may require a critical habitat assessment. Examples of internationally and/or nationally recognised areas of high biodiversity value, as relevant to the project, include:

- Areas that meet the criteria of the IUCN's Protected Area Categories Ia, Ib and II; and
- Key Biodiversity Areas (KBAs), which encompass Important Bird and Biodiversity Areas (IBAs) (IFC, 2019).

The IFC requires mapping of critical habitats in the landscape of the project's area of influence in order to inform the applicability of Performance Standard 6 (IFC, 2019).

For projects located in critical habitats, the project proponent must ensure that external experts with regional experience are involved in the critical habitat assessment (IFC, 2019).

2.2 Critical Habitat Thresholds

To facilitate decision-making, numerical thresholds are defined for the first four critical habitat criteria (i.e., CR/EN species; endemic/restricted-range species; migratory/congregatory species; threatened and unique ecosystems) (IFC, 2019).

2.2.1 Criterion 1: Critically Endangered and Endangered Species

The thresholds for Criterion 1 are:

a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units[1] (GN16) of a CR or EN species);

b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a); and

c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

2.2.2 Criterion 2: Endemic / Range Restricted Species

In the IFC PS6 Guidance Notes (IFC, 2019) endemic and range restricted are treated as synonyms, and range restricted species are defined as species that have a limited Extent of Occurrence (EOO). Limited EOO is defined as follows:

- For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO less than 50,000 square kilometres (km^2); and
- For aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to a 500 km linear geographic span (i.e., the distance between occupied locations furthest apart) (IFC, 2019).

The threshold for Criterion 2 is:

a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

2.2.3 Criterion 3: Migratory and Congregatory Species

Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (IFC, 2019). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis (IFC, 2019).

Thresholds for Criterion 3 are:

a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle; and

[1] The IUCN Biodiversity Areas standard uses the following definition for reproductive unit: "the minimum number and combination of mature individuals necessary to trigger a successful reproductive event at a site". In the case of bird species such as a vulture five reproductive units would comprise 5 mature females and a mature male. For plant species five reproductive units would comprise five reproductive individuals.

b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

2.2.4 Criterion 4: Highly Threatened or Unique Ecosystems

Highly threatened or unique ecosystems are identified based on assessments conducted at the national/regional level, carried out by governmental bodies, recognised academic institutions and/or other relevant qualified organisations (including internationally recognized NGOs) (IFC, 2019).

The thresholds for Criterion 4 are the following:

a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for the IUCN status of CR or EN.

b) Other areas not yet assessed by the IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

2.2.5 Criterion 5: Key Evolutionary Processes

The structural attributes of a region, such as its topography, geology, soil, temperature, and vegetation, and combinations of these variables, can influence the evolutionary processes that give rise to regional configurations of species and ecological properties (IFC, 2019). In some cases, spatial features that are unique or idiosyncratic of the landscape have been associated with genetically unique populations or subpopulations of plant and animal species

For Criterion 5, there are no numerical thresholds. Critical habitat determination is based on best available scientific information, knowledge of the project area and expert opinion.

3.0 STUDY AREA

The biodiversity assessment used the biophysical Area of Interest (AoI) which comprises the areas of potential direct and indirect effects during operations and construction of the Project, based on analysis completed in the ESIA. The critical habitat assessment was based on a wider ecologically appropriate area of analysis in order to determine the presence of critical habitat for each species and to assess whether the critical habitat overlaps with the Project's AoI.

4.0 CRITICAL HABITAT ASSESSMENT

IFC PS6 (IFC, 2012) stipulates that the critical habitat assessment be conducted in consultation with external experts with regional experience. The list of external specialists consulted in this assessment is provided in Table 1.

Table 1: External specialists consulted in the critical habitat assessment

Discipline	Specialist	Role
Flora	Mr. John Kimeu	Botanist - NMK
Mammals	Mr. Bernard Agwanda	Mammologist - NMK
Bird	Ms. Philista Malaki	Avifaunal specialist - NMK
Reptiles	Mr. Victor Wasonga	Herpetologist - NMK
Invertebrates	Mr. Morris Mutua	Entomologist - NMK

Discipline	Specialist	Role
Fish	Mr. Dickens Odeny	Aquatic specialist - NMK

4.1 Identification of Potential CH Receptors

The first step of the critical habitat assessment was the identification of potential critical habitat species based on the list of species observed during the baseline assessment (Table 2). Taxa were selected for inclusion in the critical habitat assessment based on the IFC PS6 criteria listed in section 2.1.

4.1.1 Flora Assessment

Two range-restricted plant species (EOO < 50,000 km^2) were identified during the baseline assessment (Table 2). Populations of *Euphorbia turkanensis* were identified at various locations along the proposed make-up water pipeline route. *Blepharis turkanae* is a range restricted plant species (EOO of 10,138.7 km^2) previously only known from only 4 locations in the Lake Turkana region (Luke et al., 2015). During the baseline assessment it was recorded at Ewoi, to the east of the Project's AoI.

4.1.2 Avifaunal Assessment

Six potential critical habitat species were recorded during the baseline assessment (Table 2). This included two CR species, African White-backed Vulture (*Gyps africanus*) and Rüppell's Vulture (*Gyps rueppelli*), and two EN species, Lappet-faced Vulture (*Torgos tracheliotos*) and Steppe Eagle (*Aquila nipalensis*) (Table 2).

A further two species are listed as VU (Table 2). Tawny Eagle (*Aquilla rapax*) is listed as VU by the IUCN (2019), and Lesser Kestrel (*Falco naumanni*) by the Kenyan Wildlife Conservation and Management Act (KWCMA, 2013) (Table 2). According to the IFC PS6 Guidance Notes (IFC, 2019) species that are listed nationally/regionally as VU can be included if it can be shown that the AoI supports globally important concentrations of these species. and that the loss of these populations would result in a change in their IUCN Red List status to EN or CR (IUCN, 2019).

4.1.3 Mammal Assessment

Three potential critical habitat species were recorded during the baseline survey (Table 2). African Elephant (*Loxodonta africana*) and Leopard (*Panthera pardus*) are listed as VU by the IUCN, and the Striped Hyaena (*Hyaena hyaena*) as Near Threatened (NT) (IUCN, 2019). All three species are listed as EN by the Kenyan Wildlife Conservation and Management Act (KWCMA, 2013). According to the IFC PS6 Guidance Notes (IFC, 2019) inclusion of species that are listed nationally/regionally as CR or EN should be considered on a project-by-project basis in consultation with competent professionals. Based on an assessment of available literature, and consultation with Mr Bernard Agwanda, a mammologist from the National Museum of Kenya (NMK) in Nairobi, it was decided to include all three species for assessment under Criterion 1. In East Africa, populations of all three species have seen substantial declines over the last few decades.

4.1.4 Herpetofaunal Assessment

The Turkana Toad (*Sclerophrys turkanae*) is a range-restricted species that was recorded in the Kalabata River in the vicinity of Amosing during the baseline assessment (Table 2). Its presence in the AoI represents a range extension for this species, however, even with this extension its EOO remains < 50,000 km^2 qualifying it as a candidate for critical habitat status.

4.1.5 Invertebrate Assessment

During the baseline assessment, a single specimen of a previously undescribed beetle species in the genus *Omophron* was recorded in the Kalabata River in the vicinity of the village of Loperot (Table 2). As this species is only know from a single location and is new to science, it qualifies for assessment of critical habitat status in terms of Criterion 2 (Table 2).

4.1.6 Fish Assessment

Two range restricted fish species were recorded in the Turkwel River during the baseline assessment (Table 2). Both species were previously believed to be restricted to Lake Turkana and their presence in the Turkwel River represents a range extension. Being range restricted both species qualify for critical habitat assessment in terms of Criterion 2 (Table 2).

Table 2: List of potential critical habitat species recorded during the biodiversity baseline surveys

Common name	Scientific Name	WCMA (2013)	IUCN (2019)	CMS (2019)	KWS (2019)	CITES (2019)	EOO	Comment
Plants								
	Blepharis turkanae	Unlisted	VU	-	-	-	10,138.7 km^2	Only known from 4 locations in the vicinity of Lake Turkana (Luke et al., 2015).
	Euphorbia turkanensis	Unlisted	Unlisted	-	-	II	Based on literature sources < 50,000 km^2	Type locality is 1.5 km south-west of Lokichar, and the species is known from a limited distribution at a small area of north-west Kenya.
Birds								
Lappet-faced vulture	*Torgos tracheliotos*	VU	EN	I	Yes	II	34,200,000 km^2	Only a small, very rapidly declining population remains, owing primarily to poisoning and persecution, as well as ecosystem alterations. Observed on two occasions during the biodiversity baseline field surveys.
African white-backed vulture	*Gyps africanus*	NT	CR	I	-	II	23,400,000 km^2	Considered to be extinct along the border between Uganda & Kenya including the project area, Nasolot and South Turkana (BI, 2019). Confirmed as present in the AoI.
Rüppell's vulture	*Gyps rueppelli*	NT	CR	I	-	II	14,200,000 km^2	Faces similar threats to other African vultures, listed as CR due to severe declines in parts of its range (BI, 2017). Confirmed as present in the AoI in December 2019.

Common name	Scientific Name	WCMA (2013)	IUCN (2019)	CMS (2019)	KWS (2019)	CITES (2019)	EOO	Comment
Steppe eagle	*Aquila nipalensis*	Unlisted	EN	I	-	II	10,800,000 km^2	Has undergone extremely rapid population declines across parts of its range. Large distributional range across Africa and Asia.
Lesser kestrel	*Falco naumanni*	VU	LC	I	Yes	II	24,800,000 km^2	Underwent rapid population declines from 1950 onwards but recent evidence indicates a stable or slightly positive population trend overall during the last three generations. Wide geographic range that covers most of Africa and Asia.
Tawny eagle	*Aquila rapax*	Unlisted	VU	II	-	II	52,700,000 km^2	Evidence for very rapid declines in this species from across its African range. Distributional range is large and covers much of Sub-Saharan Africa and parts of Asia.
Mammals								
African elephant	*Loxodonta africana*	EN	VU	II	Yes	I	Based upon literature sources > 50,000 km^2	The Kerio Valley elephant population (which includes Nasolot and South Turkana) is regarded as the largest in western Kenya and is regarded as a discrete management unit. The highest density of this population is found in the north, in the vicinity of Nasolot and South Turkana protected areas. Census data shows a decrease in 59.6% in this population between 1997 and 2010. Based on Edebe et al., 2010, the Nasolot-South Turkana-Rimoi-Kamnarok elephant population faces the greatest poaching threat of any elephant population in Kenya.

Common name	Scientific Name	WCMA (2013)	IUCN (2019)	CMS (2019)	KWS (2019)	CITES (2019)	EOO	Comment
Striped hyena	*Hyaena hyaena*	EN	NT	-	Yes	III	Based upon literature sources > 50,000 km^2	Present throughout its range at very low densities. Major threat is persecution. Able to tolerate moderately high human density if not actively persecuted.
Leopard	*Panthera pardus*	EN	VU	II	Yes	I	Based upon literature sources > 50,000 km^2	Populations have become reduced and isolated, and they are now extirpated from large portions of their historic range.
Herpetofauna								
Turkana Toad	*Sclerophrys turkanae*	Protected	DD	-	Yes	-	Based on literature sources calculated at 15,892 km^2	Previously only known from two localities in north-central Kenya: Loiengalani on the south-eastern shores of Lake Turkana, and Uaso Nyiro River in the Samburu Game Reserve. Recorded from the Kalabata River at Amosing during the baseline assessment.
Invertebrates								
Ground beetle	*Omophron* sp.	Unlisted	Unlisted	-	-	-	< 50,000 km^2	Previously undescribed beetle species recorded in the Kalabata River near to Loperot during the baseline assessment. Only known from a single location.
Fish								

Common name	Scientific Name	WCMA (2013)	IUCN (2019)	CMS (2019)	KWS (2019)	CITES (2019)	EOO	Comment
	Haplochromis turkanae	Unlisted	LC	-	-	-	< 500 km linear distance	Range extension, previously only known from Lake Turkana.
	Haplochromis macconneli	Unlisted	LC	-	-	-	< 500 km linear distance	Range extension, previously only known from Lake Turkana.

Notes:

- = not assessed

4.2 Threshold Assessment

The potential critical habitat species were assessed individually for each critical habitat criterion in order to verify whether they meet the thresholds for critical habitat status as per IFC PS6.

4.2.1 Flora Assessment

The results of the flora critical habitat threshold assessment are shown in Table 3.

Several individuals of *B. turkanae* were recorded at Ewoi beyond the eastern boundary of the AoI. It was recorded in rocky hill habitat that is largely situated beyond the eastern border of the AoI. Given that it was previously only known from 4 other locations, the individuals recorded at Ewoi could very likely represent >10% of the global population and thorough searches and it is believed that further searches in similar habitats east of the AoI are likely to yield >10 individuals. It therefore qualifies for critical habitat status although the critical habitat does not overlap with the AoI.

In contrast, *E. turkanensis* colonies were recorded at various locations between Lokichar and the Malmalte River in an area that overlaps with the proposed water pipeline route (Figure 2). With several confirmed colonies and a type locality situated within the AoI, *E. turkanensis* meets the threshold for critical habitat status with >10% of the global population and >10 individuals recorded (Table 3).

This assessment was compiled in conjunction with Mr John Kimeu, a botanist employed by the NMK, who has extensive knowledge and experience of vegetation assessments in Turkana County. The locations of known *E. turkanensis* colonies and critical habitat is shown in Figure 2.

4.2.2 Avifaunal Assessment

The results of the avifaunal critical habitat threshold assessment are shown in Table 4.

Three of the six bird species identified as potential CH species met the threshold (Table 4). Lappet-faced, African White-backed and Rüppell's Vultures were recorded during the biodiversity baseline surveys (Figure 1). The extent of critical habitat for these species is shown in Figure 3.

Lappet-faced Vultures were observed on two occasions during the biodiversity baseline surveys, most recently in December 2019 (Table 2, Figure 1). In 1992, the global population of this species was estimated at 5700 individuals. By 2016 the population had declined by 80% giving an updated global estimate of 1,140 individuals (BirdLife International, 2019). The threshold for critical habitat status would therefore be 6 individuals (0.5% of 1,140). Three individuals were observed over the course of the baseline surveys and it is believed that further surveys in previously inaccessible areas such as the riparian habitat along the Malmalte and Turkwel rivers may produce further individuals and potential nesting sites. Lappet-faced Vultures breed in tall acacia trees and are sensitive to human disturbance particularly when nesting. It is believed that the unrest associated with cattle raids along the Malmalte River and the avoidance of this area by most of the population may have provided ideal nesting habitat for Lappet-faced Vultures along with the confirmed presence of large herbivores in this area. Based on this assessment Lappet-faced Vultures qualify for critical habitat status in terms of IFC PS6 Criterion 1 (Table 2).

A total of 10 African white-backed Vultures were observed during the biodiversity baseline surveys. Most recently, 8 individuals were seen south of Amosing during the December 2019 Kalabata survey (Table 4, Figure 1). In 2018, the global population was estimated to be 270,000 with a rate of decline of 90% over three generations (i.e., 55 years) (BirdLife International, 2018). Based on the 2018 figures the threshold for critical habitat status would be 1,350 individuals (0.5% of 270,000). Given that the global population is known to be declining it is possible that the threshold value is also substantially lower than 1350. This species has similar nesting behaviour to the Lappet-faced Vulture, with a preference for tall acacia trees. It is possible that this species may be nesting along remote parts of the Malmalte and Turkwel rivers and in areas such as South Turkana and Nasolot NRs with higher densities of wildlife. Based on this assessment the African white-backed Vulture meets the threshold for critical habitat status in terms of IFC PS6 Criterion 1 (Table 2).

The first observation of Rüppell's Vulture during the biodiversity baseline surveys was in December 2019, when two individuals were seen, together with African White-backed and Lappet-faced Vultures south of Amosing (Figure 1). In 1992, the global population of Rüppell's Vulture was estimated at 22,000 individuals, with a rate of decline of 97% over three generations (i.e., 56 years) (BirdLife International, 2017). Based on these figures the global population in 2020 may be as low as 660 individuals with a threshold for critical habitat status of 3 individuals. Given that 2 individuals were sighted in December 2019 Rüppell's Vulture meets the threshold for critical habitat status in terms IFC PS6 Criterion 1 (Table 2). Rüppell's Vulture is a cliff nesting species and further surveys along the ridge separating Turkwel Dam from the rest of the AoI and in Nasolot NR may confirm the presence of a breeding colony.

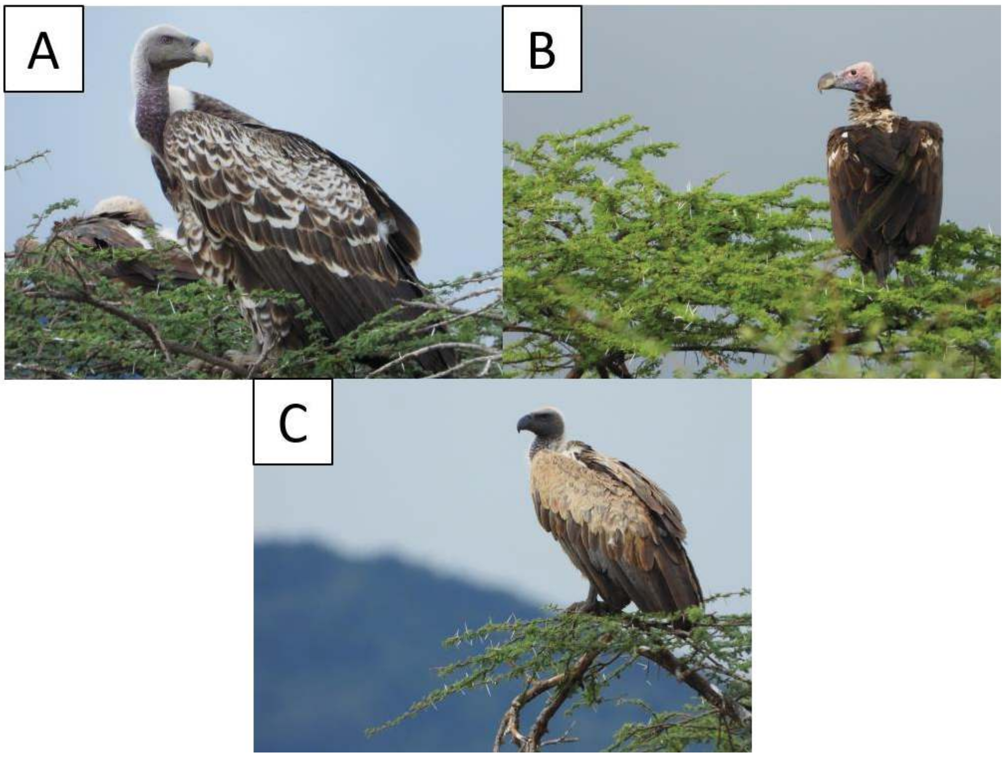

Figure 1: A) Rüppell's vulture B) Lappet-faced vulture and C) African white-backed vulture observed at a sighting south of Amosing during the December 2019 Kalabata field survey

Table 3: Critical habitat threshold assessment – flora

Scientific Name	Extent of Occurrence (EOO)	Criterion 2: Threshold	Does this plant qualify for CH status
Blepharis turkanae	10,138.7 km^2 (Luke et al., 2015)	Areas that regularly hold ≥ 10% of the global population size AND ≥ 10 reproductive units of a species.	**Yes**, only recorded at Ewoi to the east of the AoI. Given that it was previously only known from 4 locations, the plants at Ewoi may well constitute ≥ 10% of the global population. Therefore, this plant qualifies for critical habitat status.
Euphorbia turkanensis	Based on available literature EOO is substantially smaller than 50,000 km^2	Areas that regularly hold ≥ 10% of the global population size AND ≥ 10 reproductive units of a species.	**Yes,** known distributional range overlaps largely with AoI and several colonies have been identified along the proposed water pipeline route. Likelihood that the AoI holds ≥ 10% of the global population is very high. Therefore, it meets the threshold for critical habitat status.

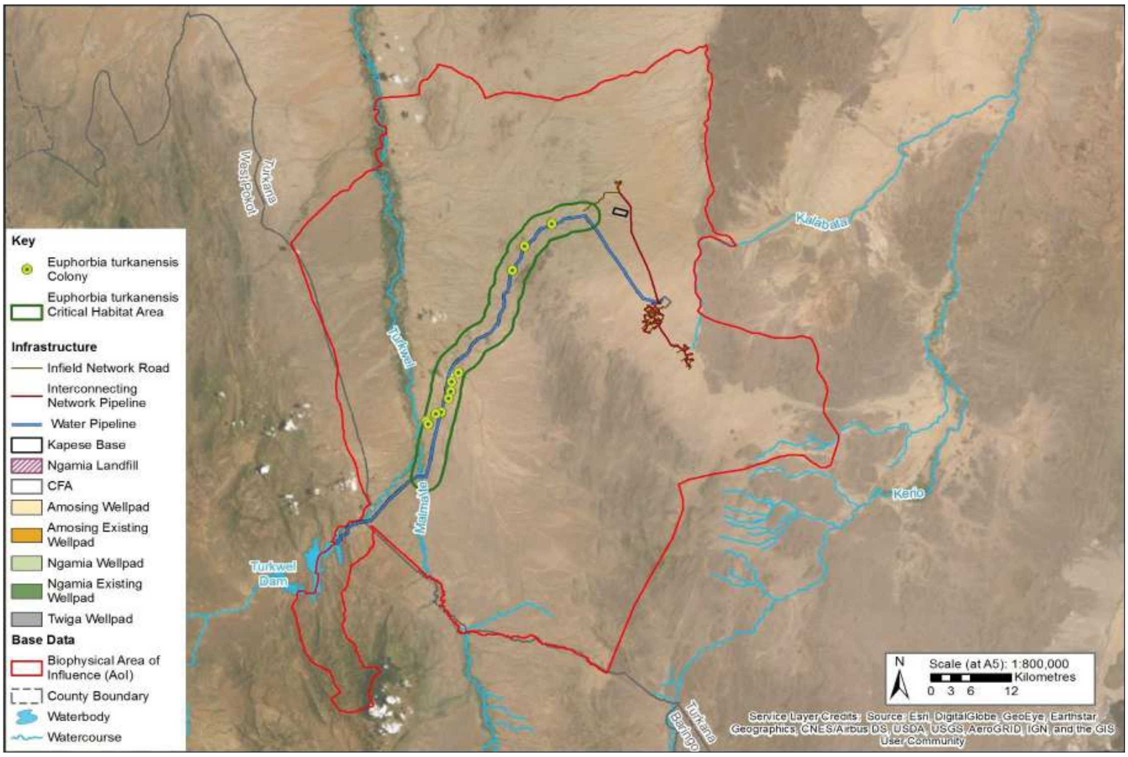

Figure 2: Locations of known *E. turkanensis* populations and critical habitat

Table 4: Critical habitat threshold assessment - avifauna

Common name	Scientific name	Global population estimate	0.5% of Global Population (Criteria 1 threshold)	Does population in AoI meet threshold for critical habitat
Lappet-faced vulture	*Torgos tracheliotos*	Estimate of 5,700 in 1992 with an estimated global decline of 58% calculated in 2019 (Birdlife International, 2019). Updated estimate of global population = 1,140 individuals.	6	**Yes.** Two sightings of 3 individuals over the course of the biodiversity baseline surveys indicates an established population within the critical habitat area of analysis.
African white-backed vulture	*Gyps africanus*	270,000 (BirdLife International, 2018)	1350	**Yes.** Ten individuals observed during the biodiversity baseline assessment confirming the presence of an established population within the critical habitat area of analysis.
Rüppell's vulture	*Gyps rueppelli*	Estimate of 22,000 in 1992 (BirdLife International, 2017). Estimate of global decline of 97% gives an updated global population estimate of 660 individuals.	3	**Yes,** 2 individuals observed in the AOI during the December 2019 biodiversity baseline survey. Cliff nesting species which may be nesting along the ridge separating Turkwel Dam from the remainder of the AOI and in mountainous parts of Nasolot NR.

Common name	Scientific name	Global population estimate	0.5% of Global Population (Criteria 1 threshold)	Does population in AoI meet threshold for critical habitat
Steppe eagle	*Aquila nipalensis*	50000 (lowest estimate)	250	**No**, a single observation of 2 individuals during the biodiversity baseline means it is unlikely that the population within the critical habitat area of analysis meets the Criteria 1 threshold.
Lesser kestrel	*Falco naumanni*	61,000 (lowest estimate)	305	**No**, a single observation was observed at Ngamia 3 in Nov 2015. It is unlikely that the population size within the AoI meets the Criteria 1 threshold.
Tawny eagle	*Aquila rapax*	100000 (lowest estimate)	500	**No**, observed in low abundance at various locations and times throughout the biodiversity baseline. Unlikely that the population size within the AoI meets Criterion 1 threshold of 500 individuals.

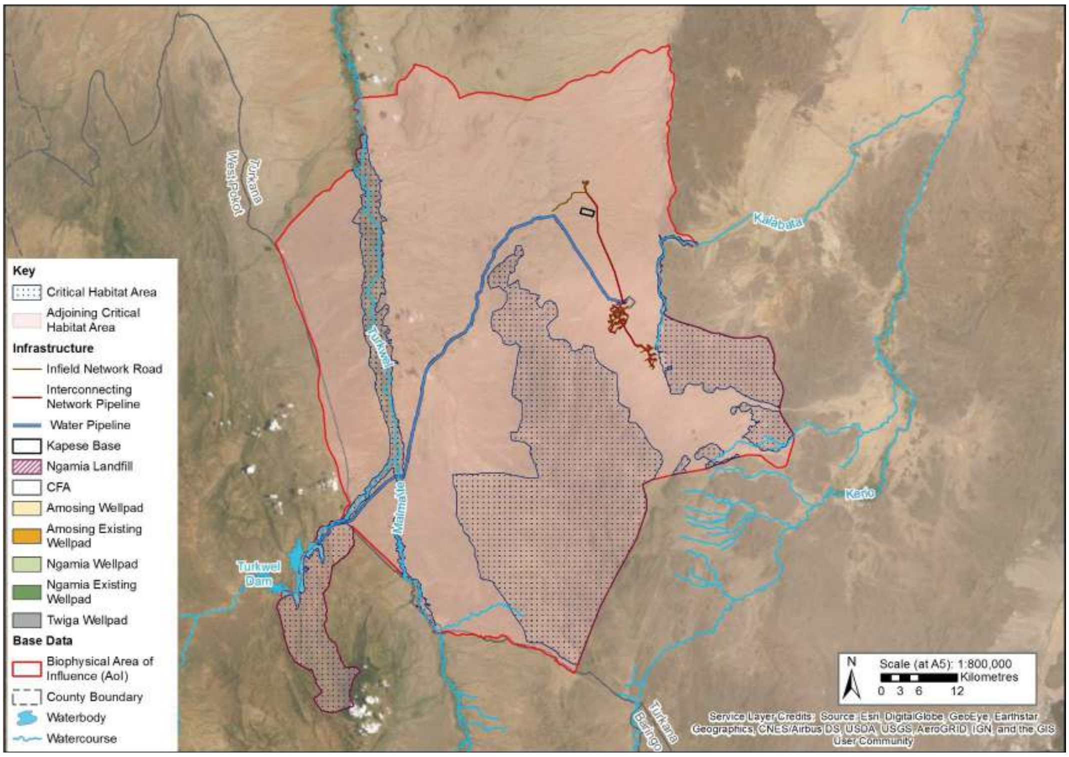

Figure 3: CH for 3 vulture species, Leopard and Striped Hyena within the AoI

4.2.3 Mammal Assessment

The Nasolot-South Turkana-Rimoi-Kamnarok elephant population is considered to be a discrete management unit that has decreased substantially in the past and continues to face a considerable poaching threat. Based on these factors and in consultation with Mr. Bernard Agwanda from the NMK, a regional expert with experience in Turkana County, it was decided to assess the critical habitat status based on the regional population rather than on the global population. Six hundred and sixty-two elephants were counted in the Nasolot-South Turkana-Rimoi-Kamnarok ecosystem during the 2015 Great Elephant Census Project (Chase et al., 2016). Most elephants in this region are found in the Nasalot and South Turkana NRs in the north and the Rimoi and Kamnarok NRs to the south (Chase et al., 2016). In 1990 Kenya Wildlife Service (KWS) estimated that 400 elephants utilized Nasolot and South Turkana NRs with another 100 in Rimoi and Kamnarok (Edebe et al., 2010). Based on the 2015 estimate of the Nasolot-South Turkana-Rimoi-Kamnarok elephant population the threshold for critical habitat status is 3 individuals. Although no elephants were observed during the baseline survey, relatively little time was spent at the Malmalte River due to the security situation. Evidence of recent elephant activity was evident during the June and December 2019 visits to the Malmalte River. Based on this assessment the African elephant population within the critical habitat area of analysis qualifies for critical habitat status in terms of IFC PS6 Criterion 1 (Table 5).

The elephant critical habitat was mapped based on the movements of four elephants fitted with radio collars and tracked over the period December 2017 to February 2019 (Ihwagi & Douglas-Hamilton, 2017). The elephant CH within the AoI is shown in Figure 4.

Based on the IUCN (AbiSaid, & Dloniak, 2015) the global population of Striped Hyaena ranges in number from 5,000 to 9,999 individuals and is known to be decreasing. If the precautionary principle is applied and the lower population estimate used, the 0.5% threshold for CH status is 25 individuals (Table 5). Four Striped Hyaena were recorded over the course of the baseline assessment within the Acacia/Commiphora/Euphorbia stunted bushland/thicket and Wooded ephemeral stream vegetation communities. Given the confirmed presence and the number of individuals recorded Striped Hyaena meet the threshold for critical habitat status in terms of IFC PS6 Criterion 1 (Table 5).

Global population estimates for Leopard (*Panthera pardus)* are widely variable. The IUCN Red List states that there are no robust estimates of the total number of mature individuals (Stein et al., 2020). However, it is known that the population in East Africa has seen substantial range declines over the past three generations (i.e., 22.3 years) (Stein et al., 2020). No Leopard were recorded or observed over the course of the baseline assessment; however, it is known to occur in Nasolot NR which overlaps with a portion of the Project AoI (KWS, 2020). Given the uncertainty about the global population and the decline of the East African population, the precautionary principle is applied, and Leopard afforded critical habitat status (Table 5).

Critical Habitat for leopard and striped hyaena is shown in Figure 3 and is divided into core areas, representing the refuge areas where these species are believed to spend most of their time, and where dens are likely to be situated, and adjoining areas representing areas that these species are known to move through but where they are unlikely to reside for extended periods of time due to higher human density and conflict with pastoralists.

4.2.4 Herpetofaunal Assessment

A single Turkana Toad was recorded in the vicinity of the Kalabata River near to Amosing 3 in June 2016. An additional survey was conducted in December 2019 in order to collect data on the distribution and habitat preferences of this species within the AoI. However, no additional specimens were collected. Prior to the biodiversity baseline surveys, the Turkana Toad was only known from two locations in northern Kenya. Very little is known about the population status, habitat preferences, geographic range and conservation status of this species (IUCN SSC Amphibian Specialist Group, 2016). Given the paucity of information on this species the precautionary principle is applied, and this species is assigned CH status (Table 6).

A map showing the location of Turkana toad critical habitat within the AoI is shown in Figure 5.

4.2.5 Invertebrate Assessment

An additional survey was conducted in December 2019 in order to collect data on the distribution and habitat preferences of the unknown Omophron sp. however no additional specimens were collected suggesting that this species is either present in low abundances or that its lifecycle or ecology makes it less susceptible to collection by means of conventional trapping methodologies such as light traps. Based on the limited information on this species and the fact that it is currently only known from a single location the precautionary principle is applied and this species is assigned critical habitat status in terms of Criterion 2.

A map showing the location of the critical habitat for the *Omophron* sp. within the AoI is provided in Figure 6. The critical habitat comprises the Kalabata riverbed and riparian habitat.

4.2.6 Fish Assessment

Two range-restricted fish species were recorded in the Turkwel River during the June 2019 field survey. Both *Haplochromis turkanae* and *H. macconneli* were previously only known from Lake Turkana. Their presence in the Turkwel River therefore represents a range extension for both species. Despite the extension of their range, the geographic span of both species remains below the 500 km Criterion 2 threshold. The habitat of both species therefore qualifies for critical habitat status.

A map showing the location of the critical habitat of the two fish species is shown in Figure 7 and includes the mains stems of the Malmalte and Turkwel rivers.

Table 5: Critical habitat threshold assessment - mammals

Common Name	Scientific Name	Global population estimate	0.5% of Global Population (Criteria 1 threshold)	Does population in project area meet threshold
African elephant	*Loxodonta africana*	662 individuals in the Nasolot-Turkana-Rimoi-Kamnarok ecosystem in 2015 (Chase et al., 2016).	3	**Yes,** based on the application of the Criteria 1 threshold to the population of the Nasolot-Turkana-Rimoi-Kamnarok ecosystem and the confirmed presence of more than the threshold number in the Nasolot and South Turkana NRs.
Striped hyena	*Hyaena hyaena*	5000 (IUCN, 2019)	25	**Yes,** 4 individuals recorded over the course of the baseline assessment. Based on the confirmed presence and the presence of an abundance of suitable habitat this species is assigned critical habitat status.
Leopard	*Panthera pardus*	Widely divergent estimates, population unknown. Known to have declined precipitously in East Africa over the last 3 generations (22.3 years) (Stein et al., 2020).	?	**Yes,** not recorded during the baseline however known to occur in Nasolot NR which overlaps with the Project AoI. Given the uncertainty about global population size and declining population in East Africa the precautionary principle is applied and this species is assigned critical habitat status.

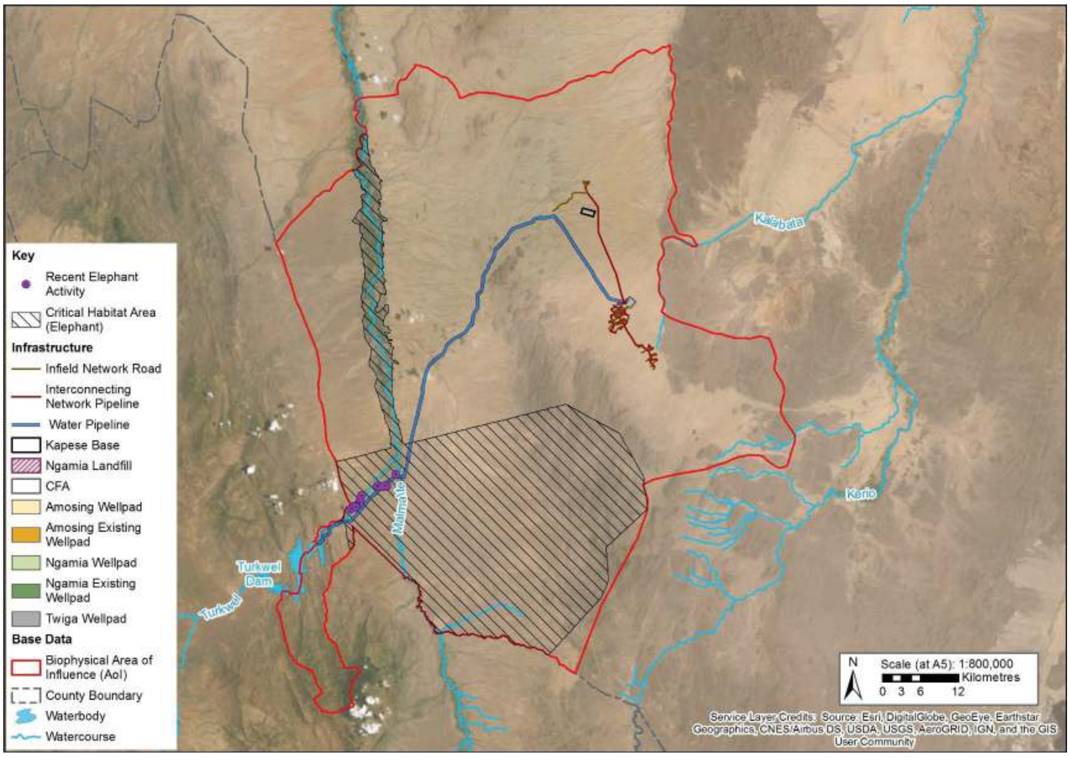

Figure 4: Location of African elephant critical habitat within the AoI

Table 6: Critical habitat threshold assessment - herpetofauna

Common Name	Species	Extent of Occurrence (EOO)	Criterion 2: Threshold	Does population meet Criteria 2 Threshold
Turkana Toad	*Sclerophrys turkanae*	Based on literature sources calculated at 15,892 km^2	Areas that regularly hold ≥ 10% of the global population size AND ≥ 10 reproductive units of a species.	Yes. Only recorded from a single location within the critical habitat area of analysis. Based on the limited information on this species the precautionary principle is applied, and this species is assigned critical habitat status.

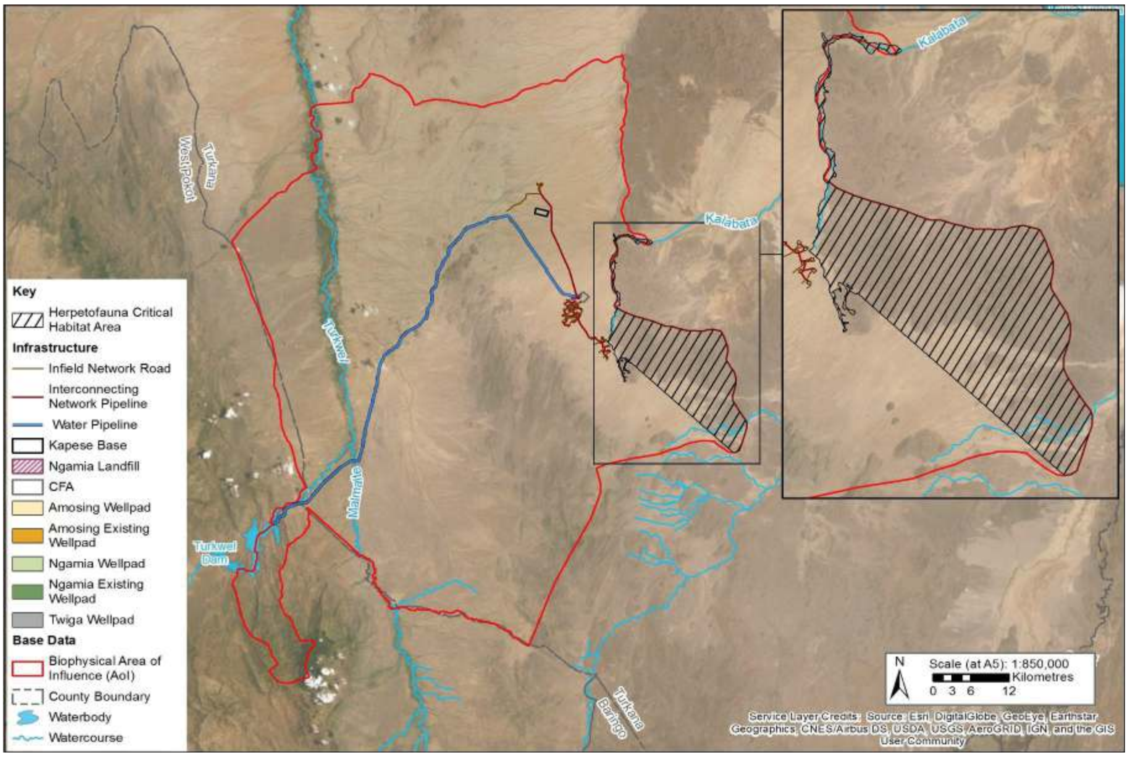

Figure 5: Location of Turkana toad CH within the AoI

Table 7: Critical Habitat threshold assessment - invertebrates

Common Name	Species	Extent of Occurrence (EOO)	Criterion 2: Threshold	Does population meet Criteria 2 Threshold
Ground beetle	*Omophron* sp.	Uncertain, species only known from a single location, EOO assumed to be < 50,000 km^2	Areas that regularly hold ≥ 10% of the global population size AND ≥ 10 reproductive units of a species.	Yes. Only known from a single location in the Kalabata River near to Loperot. The absence of additional specimens despite focussed sampling suggests that this species is either present in low abundances or that its lifecycle or ecology makes it unlikely to be captured by conventional sampling methods such as light traps. Given the limited information available on this species a precautionary approach is followed and this species is assigned critical habitat status.

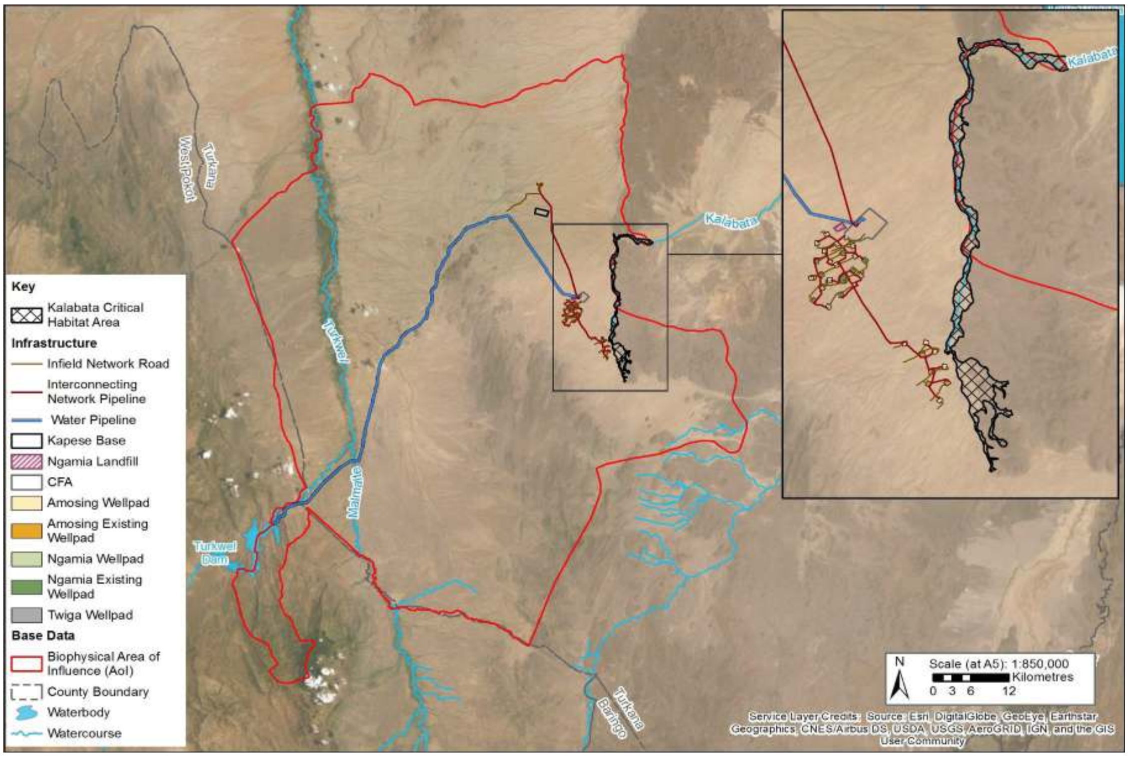

Figure 6: Location of invertebrate CH within the AoI

Table 8: Critical Habitat threshold assessment - fish

Species	Extent of occurrence (EOO)	Criterion 2: Threshold	Does population meet Criteria 2 Threshold
Haplochromis turkanae	415 km linear distance (Turkwel Gorge to northernmost point of Lake Turkana)	500 km linear geographic span (i.e., the distance between occupied locations furthest apart) (IFC GN, 2019) .	**Yes,** *H. turkanae* was previously only known from Lake Turkana. Despite the range extension the geographic span still falls below the threshold and therefore the species qualifies for critical habitat status based on Criterion 2.
Haplochromis macconneli	416 km linear distance (Turkwel Gorge to northernmost point of Lake Turkana)	500 km linear geographic span (i.e., the distance between occupied locations furthest apart) (IFC GN, 2019) .	**Yes,** *H. macconneli* was previously only known from Lake Turkana. Despite the range extension the geographic span still falls below the threshold and therefore the species qualifies for critical habitat status based on Criterion 2.

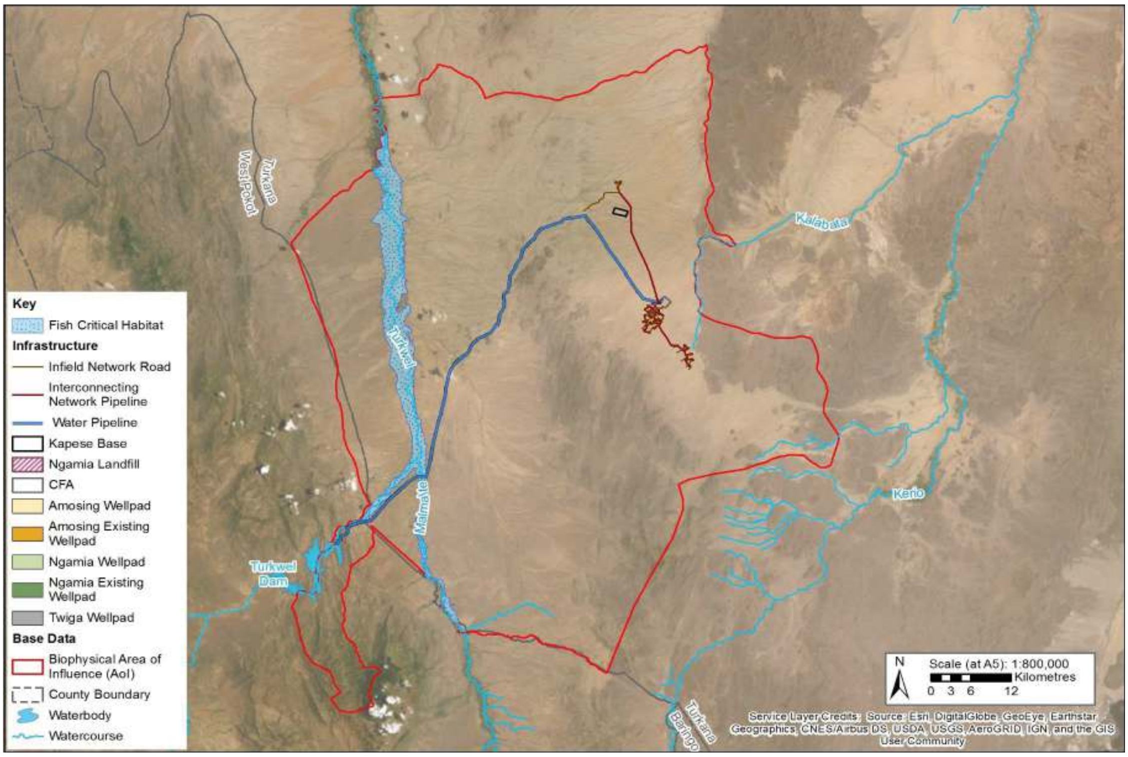

Figure 7: Location of fish CH within the AoI

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GOLDER

TECHNICAL MEMORANDUM

DATE 1st May 2020 1433957_644

TO Paul Mowatt , Tullow

CC Andrew Morsley, Mervyn Mason

FROM Peter Kimberg **EMAIL** pkimberg@golder.com

APPROACH TO ASSESSMENT OF NATURAL AND MODIFIED HABITAT

1.0 INTRODUCTION

The purpose of this appendix is to provide the approach used for the determination of natural and modified habitats (as required by the International Finance Corporation (IFC) Performance Standard 6 (IFC, 2012a)), and the outcomes of that assessment. This document is based on the *South Lokichar – Approach to Identification of Natural and Modified Habitats during Site-Specific Assessments (SSA) – Holding Statement* submitted by Golder Associates to Tullow Kenya B.V in 2017 (Golder Report No. 1433956.567 D.0, 2017).

2.0 BACKGROUND

This section presents a summary of the definitions of natural and modified habitats, as presented by the IFC in the 2012 Performance Standards (IFC 2012a) and associated Guidance Notes (IFC 2019). Those definitions, in combination with the knowledge of the baseline condition of vegetation communities present within the Area of Interest (AoI) were used as the context for the development of the approach to natural and habitat identification in the sections that follow. This approach was then used to identify the extent of natural and modified habitats in the AoI.

2.1 Natural Habitats

The IFC defines natural habitat as areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or areas where human activity has not essentially modified an area's primary ecological functions and species composition (IFC 2019, GN38).

The IFC stipulates that the proposed project will not significantly convert or degrade natural habitats, unless the following conditions can be met:

- No other viable alternatives within the region exist for development of the project on modified habitat;
- Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and
- Any conversion or degradation is mitigated according to the mitigation hierarchy (IFC 2019, GN38).

In areas of natural habitat, mitigation measures need to be designed to achieve no net loss of biodiversity, where feasible (IFC 2019, GN38).

The IFC further stipulates that the determination of natural habitat will be made using credible scientific analysis of best available information (IFC 2019, GN39).

Natural habitats should not be interpreted as untouched or pristine habitats (IFC 2012b, GN39). The question is the degree of impact. If, in the judgement of a competent professional, the habitat still largely contains the principal characteristics and functions of a native ecosystem(s), it should be considered a natural habitat regardless of some degree of degradation (IFC 2019, GN39).

2.2 Modified Habitats

The IFC defines modified habitat as areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition (IFC 2019, GN34).

According to the IFC, the determination of modified habitat can be based on the level of human-induced disturbance (for example, presence of invasive species, level of pollution, extent of habitat fragmentation, viability of existing naturally occurring species assemblages, resemblance of existing ecosystem functionality and structure to historical conditions, degree of other types of habitat degradation) and the biodiversity values of the site (for example, threatened species, ecosystems, and ecological processes necessary for maintaining nearby critical habitats) (IFC 2019, GN27).

3.0 IDENTIFICATION OF NATURAL AND MODIFIED HABITATS

The primary drivers of change in vegetation communities in the region are overgrazing by livestock (primarily goats, shoats, donkeys and camels), and timber harvest for firewood and/or charcoal production. The intensity of these effects tends to be magnified with the proximity to areas of permanent settlement, such as Lokichar and Nakukulas, and with proximity to water supply points, and roads (Golder Report No. 1433956.567 D.0, 2017).

In order to assess the distribution of anthropogenic elements within the AoI locations, the following features were plotted and mapped:

- Settlements (this includes both larger settlements such as Lokichar and Nakukulas and smaller rural settlements referred to as manyattas). Locations of settlements were plotted based on GIS information provided by Tullow, field observations and visual scanning of recent satellite imagery;
- Livestock corrals (*anok* in Turkana, these structures are made from *Acacia reficiens* branches that are harvested to make walls to keep livestock in at night). Livestock corrals are often situated near settlements and in many cases are large enough that they are identifiable on aerial imagery, and were plotted based on field observations and photos. It is acknowledged that many smaller corrals may have been missed in the process;
- Roads and tracks (both national roads and smaller vehicle tracks) were plotted based on information provided by Tullow and visual assessment of satellite imagery;
- TKBV supplied community water points were plotted based on spatial information provided to Golder by Tullow.

A map showing the locations of these anthropogenic features within the AoI is provided in Figure 1. The locations of the various anthropogenic impacts showed a high degree of spatial correlation with roads and tracks linking settlements and livestock corrals clustered around settlements (Figure 1). TKBV supplied community water points are similarly situated near to settlements, corrals and roads (Figure 1).

The impacts of these elements would not be limited to the locations plotted in Figure 1, but would radiate outwards along a gradient from these points. Habitats near roads, settlements and watering points can be expected to show the highest degree of utilisation and modification. In order to delineate the areas of highest utilisation, modification 5 km buffers were plotted around each of the anthropogenic elements (Figure 2). These boundaries are by no means definitive and it can be accepted that habitat modification extends outwards from areas of highest human density along a gradient and that the remotest areas would show the lowest degree of modification. Nevertheless, a large component of the local population comprises nomadic pastoralists that cover large distances to reach suitable grazing areas for their livestock.

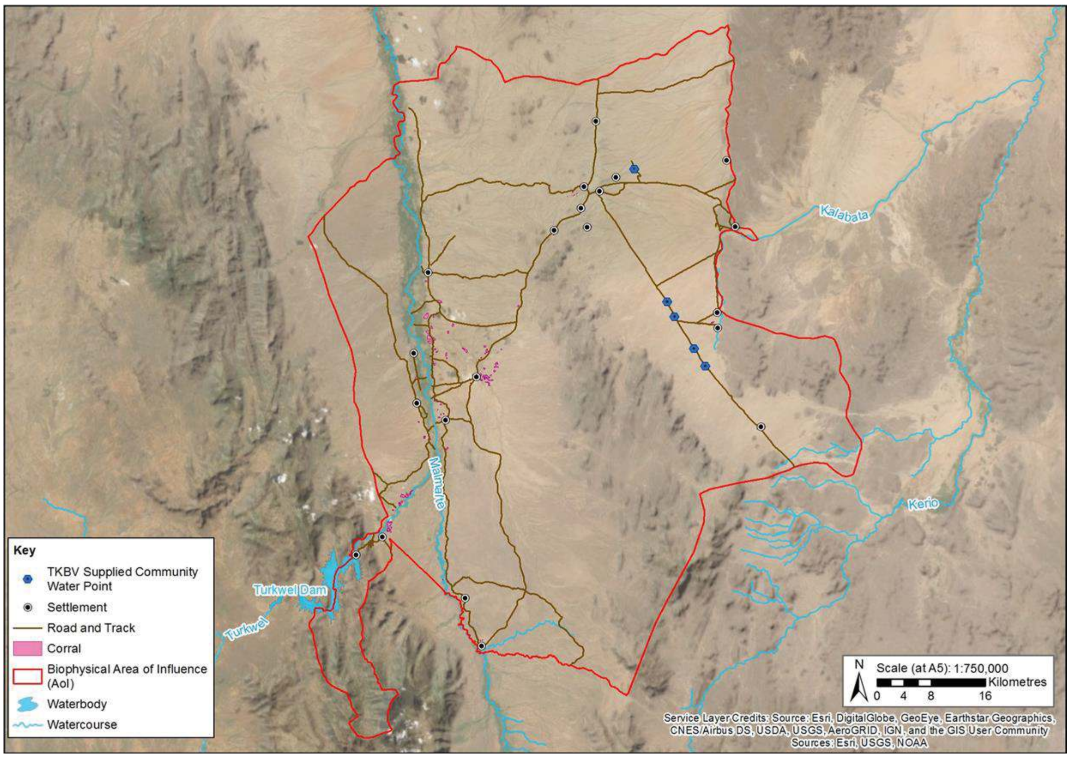

Figure 1: Location of anthropogenic elements within the AoI

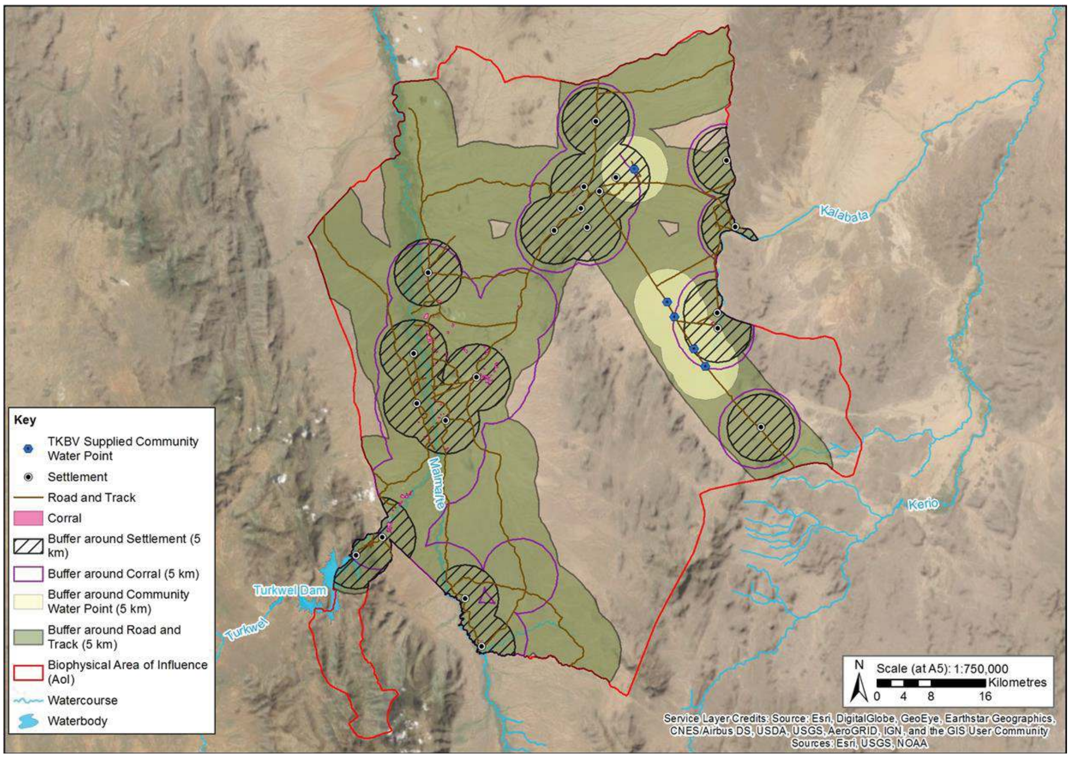

Figure 2: Anthropogenic elements with 5 km buffers

3.1 Quantifying Degree of Modification

The approach for quantifying habitat modification was based on the methodology proposed in the 2017 Golder Report (Golder Report No. 1433956.567 D.0, 2017) which in turn was based on the methodology proposed by based on that proposed by Herlocker (1989). Degree of habitat modification was plotted based on the overlap of the buffers shown in Figure 2. A map showing the degree of habitat modification within the AoI is provided in Figure 3.

Areas located more than 5 km away from any of the known sources of anthropogenic impacts (settlements, roads, livestock corrals and TKBV supplied community water points) were assigned a very low degree of modification (Figure 3). These areas are mostly situated on the periphery of the AoI far away from settlements, roads and tracks. A large portion of South Turkana National Reserve (NR) in the south central portion of the AoI, and the mountainous area that separates Amosing and Ngamia from the Malmalte and Turkwel rivers is classified as having a very low degree of modification (Figure 3). Based on the IFC definition, these habitats would have the highest likelihood of being classified as natural. However, it should be noted that a large proportion of the population of Turkana county are nomadic pastoralists that move extensively with their livestock, and even these areas were confirmed to be far from pristine as shown in the Project Biodiversity Baseline report (Baseline Report - Golder Report No. 1433956.620.B.0, 2019). Vestiges of the original faunal community remain in these areas (Baseline Report - Golder Report No. 1433956.620.B.0, 2019), and the habitats provide core critical habitat for bird and mammal species of conservation concern as shown in Appendix A (Critical Habitat Assessment).

Areas that only fall within the extent of a single buffer area (within 5 km of a single source of anthropogenic impact) were assigned a degree of modification of low (Figure 3). These are primarily peripheral areas, mostly located > 5 km away from settlements, livestock corrals and TKBV community water points, but within 5 km from roads or tracks (Figure 3).

Habitats that overlap with 2 buffer areas were assigned a degree of modification of moderate (Figure 3). Again, these are mostly peripheral areas > 5 km away from settlements, but within proximity of livestock corrals, roads and tracks (Figure 3).

Areas within the 5 km buffer of settlements were mostly characterised as highly modified (Figure 3). These habitats are extensively utilised and modified, with vegetation intensively grazed and harvested for firewood. Little of the indigenous faunal community remains within these areas (Figure 3) (Golder Report No.). It should, however, be remembered that both natural and modified habitats may contain high biodiversity values, thereby qualifying as critical habitat (IFC 2012b, GN28). In fact, the habitat along the Kalabata River was identified as critical habitat for the Turkana toad, undescribed Omophron beetle, and vulture species with much of this habitat categorised as highly modified.

Habitats within the extent of all the buffer areas were assigned a very high degree of modification (Figure 3). These are the habitats in the AoI with the highest human and livestock densities near to settlements, roads, livestock corrals and TKBV supplied community water points. In addition to the inhabitants of the settlements and their livestock, these areas also attract large numbers of nomadic pastoralists. These habitats are situated in the vicinity of the large settlements of Lokichar and Nakukulas (Figure 3).

3.2 Natural and Modified Habitats within the Project Footprint

In order to assess and characterise the habitats most likely to be impacted upon by the project, a 500 m buffer was drawn around all the proposed project infrastructure and this was superimposed on the habitat modification map (Figure 4).

None of the habitats within the project footprint were categorised as having a very low degree of modification (Table 1, Figure 4). Areas showing a low degree of modification comprise 12.3% of the project footprint (Table 1, Figure 4). Moderately modified habitats comprise 32.5% of the project footprint (Table 1, Figure 4). Highly modified habitats comprise 41% of the project footprint and very highly modified habitats a further 14.2% (Table 1, Figure 4).

Based on this assessment as well as baseline data none of the habitats within the project footprint can be classified as natural. The habitat at the proposed Ngamia and Amosing wellpads ranged from moderately to very highly modified (Figure 4).

The habitat surrounding Kapese ranged from low to very highly modified (Figure 4). The habitat crossed by the proposed make-up water pipeline is primarily categorised as moderately to highly modified (Figure 4).

Table 1: Degree of modification of surface area of project footprint buffer (presented as % of total surface area)

	Very Low	Low	Moderate	High	Very high
Degree of modification (% of surface area of project footprint buffer)	0.0	12.3	32.5	41.0	14.2

4.0 CONCLUSIONS

The presence of natural habitat requires mitigation measures designed to achieve no net loss of biodiversity. Based on this assessment as well as baseline data, none of the habitats within the project footprint were classified as natural.

Based on discussion and consultation with Mr. John Kimeu, a botanist at the National Museum of Kenya (NMK) in Nairobi, who was contracted to conduct the baseline vegetation surveys for the project, the most intact vegetation community within the project footprint is the *Faidherbia* - *Celtis* riparian forest along the Malmalte River. This overlaps with critical habitats identified in the Critical Habitat Assessment (Annex I) and will be crossed by the proposed make-up water pipeline. Tullow has committed to the use of horizontal directional drilling (HDD) under the Malmalte River to avoid any impacts on this community.

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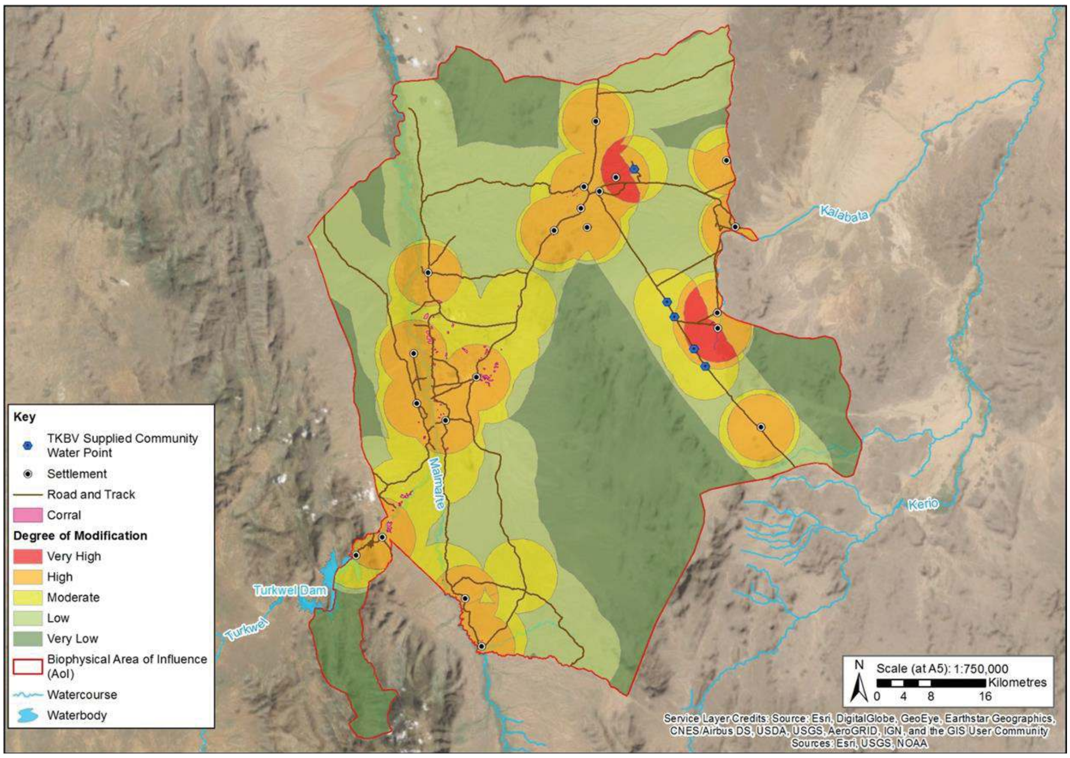

Figure 3: Degree of habitat modification based on overlaps of buffers around known sources of anthropogenic impact

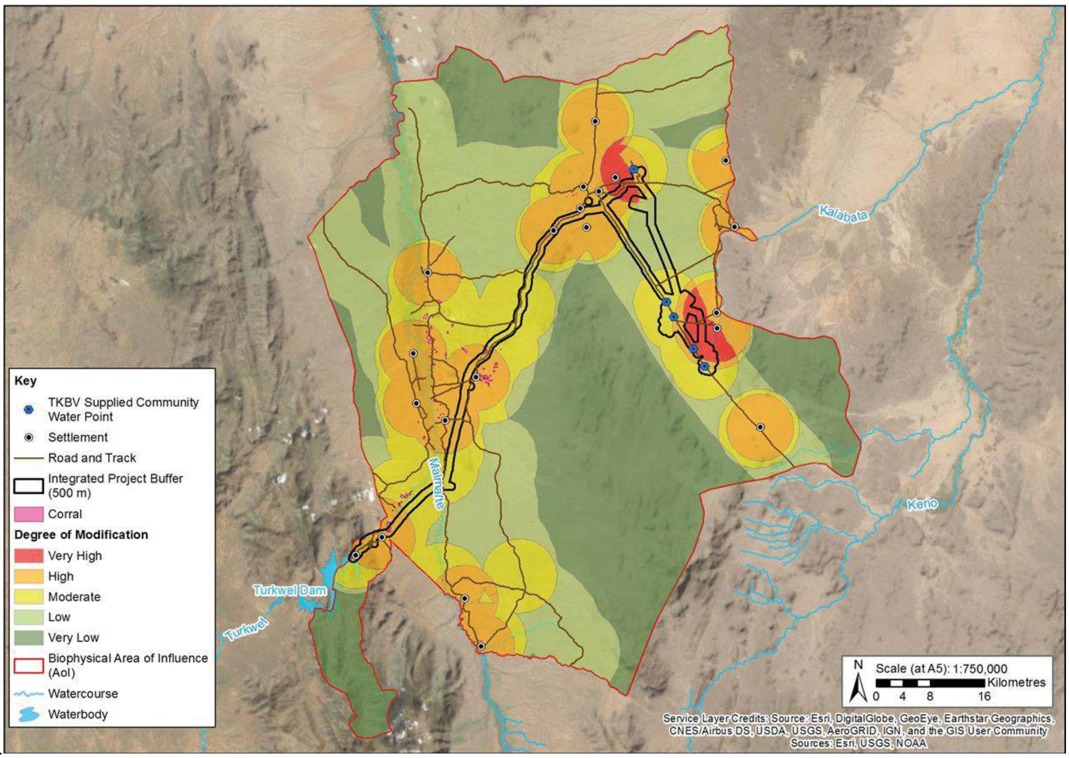

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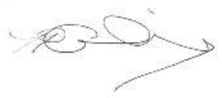
Figure 4: Degree of modification of habitats within the direct project footprint



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Cultural Heritage

D5

1.0 CULTURAL HERITAGE – EXPANDED DEFINITIONS OF RECEPTOR IMPORTANCE

Receptor Importance	Example Cultural Heritage Receptors
Very high	■ Living cultural sites of international importance with significant cultural or touristic value. Sites that cannot be moved because they are natural features or part of the physical landscape or that are non-replicable. Sites that are critical[1] and/or rare at the national or international level. ■ Intangible cultural heritage with the greatest social[2] and/or historic[3] and/or scientific[4] and/or environmental[5] value. Intangible cultural heritage that is recognised and designated at international level. ■ Archaeological and historic sites of international importance, with significant cultural or touristic value or the highest potential for further, significant discoveries to be made. Archaeological and historic sites with rare and/or previously unstudied or understudied features with a high potential for crucial further research. Archaeological and historic sites which are afforded protection and where no intrusion is permitted.
High	■ Living cultural sites of national or regional importance with significant cultural value. Non-replicable cultural sites that are not critical and/or rare, or cultural sites that are potentially replicable and that could be moved in highly exceptional circumstances (in consultation with site guardians and the affected communities). ■ Intangible cultural heritage with significant social and/or historic and/or scientific and/or environmental value. Intangible cultural heritage that is recognised and designated at national level. Intangible cultural heritage endemic to a certain place or group of people (and therefore 'rare'), and which is widely representative of that specific place or group. ■ Archaeological and historic sites of national or regional importance, with high potential for further discoveries to be made. Archaeological and historic sites with understudied features and/or high potential for further research.
Medium	■ Living cultural sites of local importance with significant cultural value. Sites that are common and potentially replicable and that can be moved in exceptional circumstances (in consultation with site guardians and the effected communities). Sites that are unused, but are known to the community and associated with settlement history/oral history ■ Intangible cultural heritage with some social and/or historic and/or scientific and/or environmental value. Intangible cultural heritage that is common and widely representative of the population as a whole. ■ Archaeological and historic sites of local importance, with some potential for further discoveries to be made. Archaeological and historic sites with features which have been comprehensively studied and/or are poorly preserved, with limited potential for further research.

[1] 'Critical cultural heritage consists of one or both of the following types of cultural heritage: (i) the internationally recognized heritage of communities who use, or have used within living memory, the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designations' (IFC, 2012a).

[2] Value to society in the present.

[3] Value to our understanding of the human past.

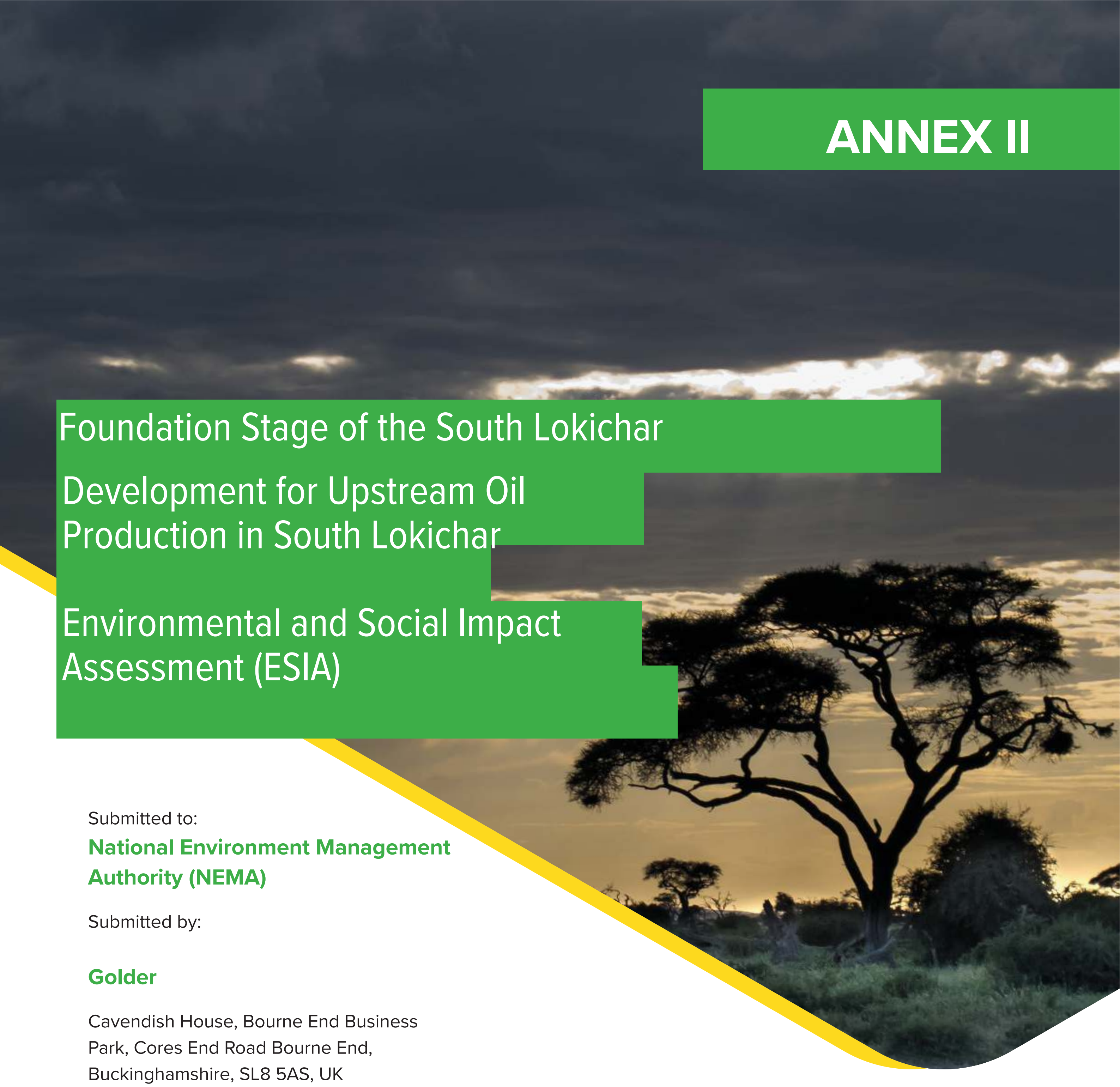
[4] Value to our understanding of people and their environment.

[5] Value to our understanding of the environment.

Receptor Importance	Example Cultural Heritage Receptors
Low	■ Living cultural sites of limited local importance and cultural value. Cultural sites that are defunct and/or have little or no historic value. Cultural sites that are common and/or are replicable and that can be moved or destroyed (in consultation with site guardians and the affected communities). ■ Intangible cultural heritage with limited social and/or historic and/or scientific and/or environmental value. Intangible cultural heritage that is common and widespread, but only representative of a limited proportion of the population. Intangible cultural heritage that is associated with common and/or replicable cultural heritage assets and so has the greatest potential to be replicated (through community engagement). ■ Archaeological and historic sites of limited local importance, with low or no potential for further discoveries to be made. Archaeological and historic sites with features which have been comprehensively studied and/or are poorly preserved/destroyed, with no potential for further research.

2.0 CULTURAL HERITAGE – EXPANDED DEFINITIONS OF IMPACT MAGNITUDE

Magnitude of Impact	Description Criteria	
	Adverse	**Beneficial**
High	■ 'Living' cultural heritage receptors, or component parts thereof, are altered, removed or damaged such that their value and/or functionality/setting/accessibility are entirely changed or lost. Receptor use is prevented, or significantly limited; ■ Intangible cultural heritage receptors are entirely changed, and traditional beliefs, practices or behaviours cannot continue and are lost, or are severely inhibited; and ■ Archaeological receptors or their settings are altered and key elements are changed such that the resource value is entirely altered or lost.	■ 'Living' cultural heritage receptors, or component parts thereof, are altered or maintained such that their value/ functionality/setting/accessibility is improved. ■ Intangible cultural heritage receptors are safeguarded for the future, with the sustainability of traditional beliefs, practices and behaviours supported. ■ Archaeological information is disseminated and contributes towards an improved understanding of the archaeological record in the area.
Medium	■ 'Living' cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are changed, and modification of receptor use is required; ■ Intangible cultural heritage receptors are changed, and traditional beliefs, practices or behaviours are modified; and ■ Archaeological receptors or their settings are altered and key elements are changed such that the resource value is modified and/or information is lost.	
Low	■ 'Living' cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are slightly changed, but no modification of receptor use is required; ■ Intangible cultural heritage receptors are slightly changed, but traditional beliefs, practices or behaviours are not modified; and ■ Archaeological receptors or their settings are slightly altered, but their integrity is maintained or archaeological receptors are altered but no information is lost (through archaeological excavation and recording).	
Negligible	No predicted change from baseline for tangible or intangible cultural heritage receptors.	



ANNEX II

Foundation Stage of the South Lokichar Development for Upstream Oil Production in South Lokichar

Environmental and Social Impact Assessment (ESIA)

Submitted to:

National Environment Management Authority (NEMA)

Submitted by:

Golder

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June 2020

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ANNEX II

Signature Page

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Andrew Morsley

Project Director

Golder Associates (UK) Ltd

15 June 2020

ANNEX II

A Stakeholder Engagement Plan

B Stakeholder Engagement Consultation Material (Pending)

C Stakeholder Engagement Consultation Report (Pending)

ANNEX II

Stakeholder Engagement Plan

A

GOLDER

REPORT

Foundation Stage Development

ESIA Stakeholder Engagement Plan

Submitted to:

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1433956.616/A.2

September 2019

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Glossary of terms

- **Environmental and Social Baseline:** A component of an ESIA process undertaken to develop an understanding of the existing environmental and socio-economic conditions in the areas that may be affected by a Project. Baseline studies provide a basis for analysis of potential positive and negative impacts of a Project in the ESIA and, where possible, provides information for monitoring and measuring impact throughout implementation of the ESMP (see below).
- **Environmental and Social Impact Assessment (ESIA):** Formal assessment required when a project may create significant adverse impacts that are diverse and irreversible. An ESIA is often called an Environmental Assessment (EA) or Environmental Impact Assessment (EIA) in Kenyan legislation. Even if the word "social" is not included, readers should understand that the acronyms EA, EIA and ESIA are used interchangeably. The term and acronym adopted by this Project is "ESIA".
- **Environmental, Social and Management Plan (ESMP):** Component of the ESIA that provides an action plan or series of plans for implementation of mitigation measures required to avoid or minimise adverse impacts and to optimise beneficial effects of a project. An ESMP also includes information on management, monitoring and reporting related to environmental and social performance.
- **Early Oil Pilot Scheme (EOPS):** An intermediate step to the full commercialisation of discovered resources in South Lokichar. EOPS involves the production of limited quantities of crude oil from existing well pads and existing wells (no additional land required).

  The EOPS Project is divided into two stages. Phase I includes the trucking of stored crude oil produced during the Extended Well Testing (EWT) carried out during the exploration and appraisal phase. Phase II includes the production of limited quantities of crude oil from existing wells at Amosing and Ngamia fields and transportation of the oil using existing road infrastructure to Mombasa.

  Phase I was permitted under the existing EWT EIA licenses and Phase II has a separate ESIA, which has been approved by NEMA and is available on the TKBV website and at all TKBV Community Resource Centres.
- **Scoping:** Scoping is the process of determining the content and extent of the matters that will be studied during the baseline and ESIA. The scoping process will vary depending on the proximity of surrounding communities, legal requirements, the capacity of authorities, and the specifics of the Project. The Scoping Report (or Project Report Study as defined by the National Environmental Management Authority (NEMA)) is submitted to the regulatory authority for review and approval along with the Terms of Reference (ToR) for the ESIA.
- **Socio-economic Investment:** Resources provided prior, to, and beyond, committed expenditure defined in the ESMP. Social investment is above and beyond international requirements and is part of TKBV's goal to build positive and beneficial relationships with governments, communities and industry wherever it does business.
- **Stakeholder(s):** Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively (IFC, 2007).
- **Stakeholder Engagement Plan (SEP):** The SEP, sometimes called a Public Consultation and Disclosure Plan (PCDP), is a key component required for verifying compliance with international standards on public disclosure.
- **Foundation Stage Development (FSD):** A further step to the full commercialisation of discovered resources in South Lokichar. FSD consists on the exploitation of three existing oil fields (Amosing, Ngamia and Twiga) within Blocks 10BB and 13T in Turkana County. Oil will be exported via the Lokichar to Lamu Crude Oil Pipeline (LLCOP), which will be permitted under a separate ESIA.
- **Full Field Development (FFD):** The original name for the full commercialisation of discovered resources in South Lokichar. The name FSD replaces FFD.

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Acronyms

AOC	Africa Oil Kenya
BID	Background Information Document
bopd	barrels of oil per day
CDP	Community Development Plan
CFA	Central Facilities Area
CPF	Central Processing Facility
CRC	Community Resource Centre
EIA	Environmental Impact Assessment
EMCA	Environment Management and Coordination Act of 1999
EOPS	Early Oil Pilot Scheme
ESIA	Environment and Social Impact Assessment
ESMP	Environment and Social Management Plan
FFD	Full Field Development
FSD	Foundation Stage Development
FSEO	Field Stakeholder Engagement Officers
FSSE	Field Supervisor Stakeholder Engagement
GPA	Government and Public Affairs
IFC	International Finance Corporation
KWS	Kenya Wildlife Service
LLCOP	Lokichar to Lamu Crude Oil Pipeline project
MCA	Members of the County Assembly
MMbbl	million barrels of oil
NEMA	National Environment Management Authority
NGO	Non-government Organisation
NLC	National Land Commission
NTS	Non-Technical Summary
PAP	project affected people
SEP	Stakeholder Engagement Plan
ToR	Terms of Reference

TKBV	Tullow Kenya B.V
VSOs	Village Socialisation Officers

1.0 INTRODUCTION

This document has been prepared by Golder Associates UK (Ltd) (Golder) for Tullow Kenya B.V. (TKBV). This Environmental and Social Impact Assessment (ESIA) Stakeholder Engagement Plan (SEP) is a planning and management document for the Foundation Stage Development (FSD) ESIA. The ESIA SEP presents the main activities, and programme to be delivered as part of the ongoing engagement process with key project stakeholders for the FSD ESIA. As the FSD develops, the SEP will be revised and updated to reflect any planned stakeholder engagement activities related to significant changes or alterations to the Project (e.g. in Project design parameters).

It is important to highlight that this SEP is in line with previous engagements described in the SEP for Full Field Development (FFD) 14514160360.501, dated November 2014, and the Project is described in the FFD Project Report: Golder document: 14514160360.516, dated December 2015.

FSD is a separate project from other related developments by the Project proponent TKBV, such as South Lokichar Early Oil Pilot Scheme (EOPS) and Lokichar to Lamu Crude Oil Pipeline project (LLCOP), which have a separate SEP and ESIA.

1.1 Objectives

The FSD ESIA SEP presents and explains the main activities and programme to be developed by TKBV to continue the engagement process with key stakeholders during the preparation of the FSD ESIA and throughout the lifespan of the FSD.

As part of the ESIA process, stakeholder engagement will accurately capture issues, comments and questions from stakeholders in a meaningful manner. This information will be included as appropriate in the ESIA. Therefore, it is essential that all key stakeholders are involved to the FSD engagement process.

2.0 REGULATIONS AND INTERNATIONAL STANDARDS

The ESIA and SEP must comply with the following Kenyan legislative, regulatory and policy requirement, IFC performance standards and Tullow company policies.

2.1 Kenyan National Regulations

The Kenyan regulatory framework contains a number of stakeholder engagement requirements. The principle relevant regulations and requirements are as follows:

- The Constitution of Kenya (2010):
  - Article 1(2) provides that all sovereign power belongs to the people of Kenya. It further states that people may exercise their sovereignty directly or through their elected representatives. Public participation is direct exercise of sovereignty;
  - Article 10(2) indicates that public participation is among the national values and principles of governance;
  - Article 33 guarantees the freedom of expression including the freedom to seek, receive or impart information or ideas;
  - Article 35 provides for the right to access information. It guarantees every citizen the right to access information held by the state;
  - Article 42 that every person has a right to a clean and healthy environment. Subsection 1 adds that this includes the protection of the environment for the benefit of present and future generations through legislative and other measures;

  - Article 43 follows declaring the economic and social rights of every Kenyan and details them in subsections: (a) the right to the highest attainable standard of health, (b) which includes the right to health care services, (c) including reproductive health care and (d) the right to clean and safe water in adequate quantities;
  - Article 174(c), gives powers of self-governance to the people. The people can derive direct benefit from meaningful public participation as this contributes to better informed decision-makers armed with additional facts, values and perspectives obtained through public input;
  - Article 174(d) recognizes the rights of communities to manage their own affairs and to further their development. Article 232(1) (d) provides for the involvement of the people in the process of policy making and part (f) provides for transparency and provision to the public of timely and accurate information. Access to information for Kenyan citizens is guaranteed by Article 35 of the Constitution; and
  - Article 37 and 104 include a provision on grievance mechanisms, including a right to assemble, demonstrate, to picket and to present petitions or seek redress within the judicial system; and
- Environment Management and Coordination Act 1999 & 2003.

Environmental Management & Coordination Act (1999): establishes the principle of public participation in the development of policies, plans and processes for the management of the environment, including within the EIA process.

Environmental (Impact Assessment & Audit) Regulations (2003) (as Amended): Reg. (17) contains public participation requirements during the ESIA study regarding seeking the views of the people or communities which are likely to be affected by the Project. This includes requirements related to public announcements and notices, public meetings and recording of oral and written comments.

- The Draft Environmental Management and Coordination (Strategic Assessment, Integrated Impact Assessment and Audit) Regulations, 2018.

The draft regulations provide for the need to register environmental assessment experts and the requirement for an environmental assessment expert licence. The regulation spells out requirements for a project report as well as the submission comment and authorisation process. The regulations spell out the requirements for the integrated environmental impact assessment, environmental audit and monitoring, and strategic environmental assessment processes in some detail.

The need for stakeholder engagement is indicated in a number of aspects. Of specific relevance is a requirement to invite comments by the public, development of a SEP as well as reporting on the implementation thereof.

2.2 International Standards

TKBV has committed to meet the requirements of the IFC Performance Standards on Environmental and Social Sustainability (2012). The IFC Performance Standards set out a framework for managing and improving project performance from planning and assessment, through construction and operations to closure and after-care.

The IFC Performance Standards state that stakeholder engagement is an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to Affected Communities.

Specific requirements of the IFC PS1 includes:

- Stakeholder Analysis and Engagement Planning:

- Identify affected stakeholders and other stakeholders that may be interested in the project and consider how external communications might facilitate a dialogue with all stakeholders; and
- Development of a SEP, including measures to allow for the effective participation of stakeholders identified as disadvantaged or vulnerable;

- Disclosure of Information:
  - Provision of relevant project information on (i) the purpose, nature and scale of the Project; (ii) duration of the proposed activities; (iii) any risks to and potential impacts on such stakeholders and the relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism;
- Consultation:
  - Undertake a process of consultation that provides affected stakeholders with opportunities to express their views on project risks, impacts and mitigation measures;
  - Include a two-way process which (i) begins early in the process of identification of environmental and social impacts and continues on an on-going basis as impacts arise; (ii) is based on prior disclosure and dissemination of relevant, transparent, objective, meaningful and easily accessible information that is in a culturally appropriate local language; (iii) focuses inclusive engagement on those directly affected as opposed to those not directly affected; (iv) is free of external manipulation, interference, coercion, or intimidation; (v) enables meaningful participation where applicable; and (vi) is documented; and
  - Tailor consultation to the language preferences of the affected communities, their decision-making process and the needs of disadvantaged or vulnerable groups;
- Informed Consultation and Participation:
  - Conduct an Informed Consultation and Participation (ICP) process that will result in affected stakeholders' informed participation;
  - Managed a consultation process that (i) captures both men's and women's views, if necessary, through separate forums or engagements, and (ii) reflect men's and women's different concerns and priorities about impacts, mitigation mechanisms, and benefits, where appropriate; and
  - Document the process, in particular the measures taken to avoid or minimize risks to and adverse impacts on the affected communities, and will inform those affected about how their concerns have been considered;
- Free, Prior, and Informed Consent:
  - For projects with adverse impacts to Indigenous Peoples (IP), the Project is required to engage them in a process of ICP and in certain circumstances the Project is required to obtain the Free, Prior, and Informed Consent (FPIC) of IP.
- External Communications:
  - Implementation of a procedure for external communications that includes methods to (i) receive and register external communications from the public; (ii) screen and assess the issues raised and determine how to address them; (iii) provide, track and document responses; and (iv) adjust the environmental and social management program;
- Grievance Mechanism for Affected Stakeholders:
  - Establish a grievance mechanism to receive and facilitate resolution of affected stakeholders' concerns and grievances about the environmental and social performance; and

  - Inform the Affected Stakeholders about the mechanism in the course of the stakeholder engagement process;
- On-going Reporting to Affected Stakeholders:
  - Provision of a schedule for periodic reports to the affected stakeholders that describe the progress with implementation of the Project action plans on issues that involved ongoing impacts on affected stakeholders and on issues that the consultation process or grievance mechanism have identified as a concern to those communities; and
  - Provision of reports not less than annually (IFC, 2012).

2.3 TKBV Policies

The FSD stakeholder engagement will be governed by TKBV's internal policies and standards and the TKBV Stakeholder Engagement Guide, listed below:

- Identify and assess all stakeholders directly or indirectly affected by planned activities based on the Project's potential risks and adverse impacts;
- Develop and implement a Stakeholder Engagement Plan that is scaled to project risks, potential impacts and the stage of the Project, that describes how stakeholders will be provided with access to timely, relevant, understandable and accessible (i.e. culturally appropriate and in the local language) information, and that describes how project impacted people will be provided an opportunity to discuss and have input into project design, scope, impacts and mitigation measures prior to the start of project activities;
- Identify priorities of impacted peoples regarding economic and social development aspirations and take steps to increase understanding of traditional resource use, economic activity, local decision-making practices, location of cultural heritage sites in the areas of operation;
- Establish a commitment register to document any and all commitments made on behalf of TKBV and track, report and record progress towards completion of all commitments in the register;
- Establish a Grievance Mechanism compatible with the level of risks and impacts associated with the Project's activities to facilitate resolution of any grievances arising in relation to its activities prior to conducting operations:
  - Ensure that the Grievance Mechanism process is straightforward and easy for all segments of impacted stakeholders to use at no cost;
  - Design the Grievance Mechanism in a manner that minimises the potential for retribution against a grievant and does not impede access to other remedies;
  - Consider local language, gender roles, traditional decision-making processes and communications preferences;
  - Document the various requirements of the Grievance Mechanism and ensure that all applicable staff and contractors are familiar with the process and can adequately explain it to external stakeholders;
  - Ensure that all applicable staff and contractors are fully informed about the Grievance Mechanism through its stakeholder consultation activities and communications materials;
  - Establish maximum timeframes for formally acknowledging a grievance/complaint and ensure resolutions are achieved as promptly as possible;
  - Establish a formal Grievance Register to record, investigate, and track resolution of all grievances and complaints; and
  - Monitor the use and effectiveness of the Grievance Mechanism and its outcomes with a view towards continuous improvement.

3.0 OVERVIEW OF PREVIOUS ENGAGEMENT

TKBV has been active in Kenya since 2010. During this period, the extent of stakeholder engagement activities at a national, county and local level has increased substantially. This increase has been driven by several factors including:

- An increase in exploration and appraisal activities (e.g. seismic and drilling operations);
- The geographic footprint of the operations expanded significantly between 2013 and 2015 as new basins/areas were targeted within the extensive licence areas (although activities are now concentrated in the South Lokichar Basin);
- The on-going management of new contractors with different operating models and experience;
- Changes in government roles and responsibilities as a result of newly devolved County Government powers; and
- Increasing requests for information from stakeholders.

During the course of previous engagement and consultation activities, stakeholders have raised vastly different issues, which have been captured in stakeholder issues and response spreadsheets and addressed by TKBV and Golder.

Various engagement methods have been utilised with prioritisation to oral and visual engagement, given the prominence of such methods in Turkana's traditional society. Engagement methods have included:

- Engagement through the existing Community Resource Centres (Nakukulas, Lokichar, Lokori and Lodwar in Turkana County);
- Individual, focus group or *baraza* (traditional community meeting) community engagement;
- Information, education and communication material, including written materials and video;
- Preparation and distribution of a monthly community newsletter, *Eana Atopupokin*, Turkana for "Let's Talk and Agree";
- Participation in radio engagements;
- Use of theatre groups to explain specific topics such as the TKBV's Grievance Mechanism; and
- Targeted site visits for community representatives and leaders, in order, to explain ongoing TKBV activities.

TKBV has four Community Resource Centres (CRC) in Lodwar, Lokichar, Nakukulas and Lokori. The CRC allow the opportunity for walk-in visitors to receive project information, to ask questions, and to log issues/grievances. The CRC are manned by Community Communications Coordinators. TKBV also has a team of Field Stakeholder Engagement Officers (FSEO) who support day-to-day operations engaging with local stakeholders. TKBV also has dedicated Grievance Officers responsible for managing the TKBV Grievance Mechanism (see further information in Section 8.0).

3.1 Full Field Development (FFD) Scoping Consultation

At scoping stage, FFD project information was communicated to stakeholders, rather than what is now called FSD. FFD was described as development of up to 5 fields, rather than the 3 identified for FSD. The rest of the project described at scoping remains the same for FFD as for FSD.

ESIA scoping consultations for FFD were initiated by a Golder and TKBV team in November 2015 and included a series of meetings to disclose the Project concept and explain the ESIA process. Consultations were held with government, international organisations, international, national and regional NGOs and regional media.

The objectives for each meeting were:

- Provide information on the Project and details of the ESIA process to key stakeholders;
- Align the ESIA approach with national regulations and international lender requirements;
- Document issues, questions and concerns that need to be considered and addressed during the later stages of the ESIA and reflected in the ToR; and
- Solicit feedback from key national and regional stakeholders on our approach to consultation with a wider group of stakeholders, especially potentially project affected people (PAPs).

During the meetings listed above, a total of 188 issues, questions and concerns were documented. They are presented below (% of total issues in parenthesis):

- ESIA General Inquiries – 18%
- Engagement – 16%
- Environment – 16%
  - Water – 9%
  - Biology – 3%
    - Pollution/Waste – 3%
- Land Access & Acquisition – 15%
- Community Aspects – 11%
  - Benefits – 4%
  - Health, Safety & Security – 3%
- General Project Updates / Inquiries – 8%
- National Content – 5%
- Security – 3%
- Northern Rangelands Trust – 3%.

3.2 Engagement for EOPS Phase II

ESIA scoping consultations were held in May and June 2016. These meetings consisted of a series of sessions to disclose the approach to the EOPS Phase II ESIA. The EOPS ESIA consultations started in June 2018 with the majority of the meetings in late September 2018. In each meeting, the consultation team sought to:

- Provide information on the EOPS Project and review the EOPS ESIA process to key stakeholders;
- Explain how the ESIA approach addressed both national regulations and international lender requirements;
- Document issues, questions and concerns; and
- Solicit feedback from key national and regional stakeholders for future consultation.

During the meetings, a total of 327 issues, questions and concerns were documented. The following represents the most frequently raised issues (% of total issues in parenthesis):

- Community Aspects (health, safety and security, benefits, cultural heritage and social maladies) - 21%;
- Environment (including water, air quality, biology, pollution, traffic, visual and soil) – 20%;

- Engagement – 18%;
- Project Updates/Inquiries – 14%;
- ESIA General Inquiries – 7%;
- National Content – 6%;
- Land Access & Acquisition – 6%; and
- Security – 4%.

4.0 STAKEHOLDER IDENTIFICATION

Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively.

Formal stakeholder identification exercises were conducted for the following areas:

- Significant urban centres relevant to the Project; and
- Affected communities and interested parties.

Stakeholders have been identified throughout the lifetime of the Project by various functions within TKBV (including Social Performance, Communications, Government and Public Affairs, National Content, Asset Protection) with the purpose to involve groups of people directly and indirectly influenced by the Project (please, refer to Appendix A Background Information Document for additional Project information).

A consolidated stakeholder register has been developed. Stakeholders are categorised based on their area of geographical interest and alignment or otherwise with TKBV operational footprint. A total of approximately 300 stakeholders (either individuals or groups) have been identified and recorded in the register.

The stakeholder register considers those stakeholders who may have vulnerable status. Vulnerable groups may be defined as people that by virtue of gender, ethnicity, age, disability, economic disadvantage or social status may experience different or unique effects from the Project than others. The following measures will be implemented to enhance the ability of vulnerable stakeholder groups to participate meaningfully in the ESIA process:

- During the continued process of stakeholder identification, TKBV will identify disadvantaged or vulnerable persons or groups; and
- Staff will identify consultation approaches and activities that will support effective engagement of vulnerable persons.

The consolidated stakeholder register will be updated on an on-going basis as new stakeholders are identified and TKBV activities change.

4.1 Stakeholder Groups

Project stakeholders include individuals, groups, communities, businesses, local government authorities, non-governmental organisations, faith-based organisations and other institutions. Table 1 provides a summary description of the main stakeholder groups linked to project activity.

Table 1: Summary description of key Project Stakeholders

Category	Stakeholder Group
Community Stakeholders	Traditional leadership, including: ■ Council of Elders (Turkana only); ■ Traditional governance leaders, such as seers and elders in permanent settlements (adakar) and mobile/pastoral administrative units (arumrum); and ■ Chief's Elders. Project-affected settlements, including: ■ Women; ■ Vulnerable persons; ■ Youth; and ■ Disabled persons.
National Government Elected Positions	Members of Parliament for all Constituencies in the FSD area of Influence Senators Women representative
National Government Appointed Positions	National Administration – County Commissioner, Deputy County Commissioners, Assistant County Commissioners, Chiefs and Assistant chiefs National Police services – County Commander, Sub-county Commanders, Officers Commanding Station Ministry of Petroleum and Mining – Petroleum Development Community Engagement officers at Sub-County Level
County Government Elected Positions	Members of the County Assembly (MCAs)
County Government Appointed Positions	Sub-county Administrators Ward Administrators National Land Commission – County Land Management Board
County Executive	County Governor County Deputy Governor County Secretary County Executive Committee ("Ministries" in Turkana County / "Departments" in West Pokot County): ■ Health Services and Sanitation; ■ Finance and Planning; ■ Tourism, Culture and Natural Resources / Tourism, Culture, Youth, Sports, Gender and Social; ■ Water, Irrigation and Agriculture / Water, Environment and Natural Resources;

Category	Stakeholder Group
	■ Public Service and Disaster Management / Public Service, ICT and Devolved Units; ■ Agriculture, Pastoral Economy and Fisheries / Pastoral Economy, Agriculture and Irrigation; ■ Education, Social Services and Culture / Education and Technical Training; ■ Land, Survey, Housing, Physical Planning and Urban Area Management / Lands, Housing, Physical Planning and Urban Development; ■ Roads, Transport and Public Works / Roads, Publics Works, Transport and Infrastructure; and ■ Trade, Gender and Youth Affairs (Turkana only).
Business Community	Current and potential suppliers for FSD Turkana Chamber of Commerce Business Consortium Business Women Group
Water Institutions	Water User Associations and Water Service Providers
Media Organisations	Radio Stations: Sayare Radio, Akicha, Jambo, Maata
Faith-based Organisations	Diocese of Lodwar Turkana Pastor's Association
NGOs, Community-based Organisations and Donors	SIKOM Peace for Development Friends of Lake Turkana CordAid Turkana Basin Institute REACH World Vision Oxfam Kenya Extractive Industries Development Program Kenya Red Cross Human Rights Watch Danish Demining Group Northern Rangelands Trust Let Us Talk Turkana Empowerment Advocacy Group Turkana Pastoralists Development Organisation (TUPADO) St. Peter Community Network (SAPCONE) Turkana Civil Society Platform (coalition of 12 local CBOs) Turkana Natural Resource Hub Agency for Pastoralist Advocacy & Development (APAD) Alemun Pastoralist Empowerment Initiative (APEI) Turkana Women Advocacy Development Organization (TWADO) Turkana Development Organization Forum (TUDOF) National Environment Management Agency (NEMA) Water Resources Management Authority (WRMA)

Category	Stakeholder Group
	Turkana County Drivers Association (TUCODA) Health Organisations British Council United Nations Development Programme West Pokot Youth Bunge County Forum

4.1.1 Administrative Divisions and Governance

Turkana and West Pokot Counties are two of 47 Counties in Kenya. Each Sub-county is further divided into Divisions, Locations and Sub-locations. Within the County, Sub-counties are also divided into electoral Wards, each being represented by a Member of County Assembly (MCA) in the County Assembly. These administrative units represent two strands of governance. Divisions, Locations and Sub-locations are part of a National Government administrative structure. This overlaps with the Sub-county structure, however a Ward is part of the newly instituted devolution process. Sub-county Administrators and Ward Administrators are part of the County Government administration structure. The Constitution of Kenya (2010) set up these two levels of government, making a shared mandate between the national government and counties.

4.1.2 Traditional Governance and Vulnerable & Marginalised Communities

TKBV seeks to achieve the principles of Informed Consultation and Participation by developing robust, open and transparent channels of communication with all Project-affected marginalised groups. Achieving communication with Vulnerable & Marginalised Communities requires developing direct lines of engagement with different categories of stakeholders that each represent different interests among that group of people. These multiple lines of engagement must provide a reasonable and equal opportunity to participate, receive information in advance and to receive information in a culturally appropriate format that allows them to understand how the project and proposed mitigation and benefit enhancement will affect their lives. With this in mind, engagement must be freely open to multiple entities. These entities are divided into categories described in the table above. The priorities among these categories are those stakeholders that are from regional administrative units affected by the Project or that represent the Project-affected people, with a priority to engage and pursue agreement from Traditional and pastoralist groups, but also considering:

i) County Government Elected and Appointed officials who represent traditional and pastoralist groups; and

ii) National Government Elected and Appointed officials who represent traditional and pastoralist groups.

For these formal government structures, it has been relatively simple to identify specific stakeholders that represent Project-affected people, including vulnerable groups. However, additional work has been conducted to identify and prioritise traditional leadership. Specifically, this work has involved the identification of traditional pastoralist units (*Adakar*, *Arumrum*[1] *or Mongots*[2]) within a given administrative unit. While it is clear that County Government and National Government officials are key representatives of pastoralists, there are other traditional structures that exist and need to receive an opportunity to receive information and give feedback.

In addition to identifying County and National Government officials, Golder has initiated the identification of all traditional pastoralist units within a given County or National administrative unit. Experience has clearly shown

[1] These are terms for clusters of homesteads. Adakar are sometimes referred to as “cattle camps” even if the herd does not contain cattle. This term is used interchangeable with the term kraal, a term more commonly used in South Africa. Arumrum is a relatively new form of social organisation that started in the mid-1990s. It is a large encampment of multiple heard owners that seek to build barriers to fend off attacks from outsiders. Such clusters can be up to 100 households.

[2] This refers to a traditional pastoralist grouping of homesteads in West Pokot.

that while County and National officials have direct lines of contact with traditional leaders, some traditional leaders may have felt excluded. This is partially linked to the mobile nature of the traditional groups and their challenges in convening in centrally located settlements.

5.0 STAKEHOLDER ENGAGEMENT PROGRAMME

5.1 Integration with ESIA

The results of stakeholder engagement will be integrated into the specialist baseline studies (as required) and impact analysis in the ESIA. Stakeholder issues must be considered in the ESIA and in the project planning and design.

Stakeholder engagement during the FSD ESIA should include the following phases:

- Phase 1: Golder and TKBV lead Scoping consultation (completed);
- Phase 2: Disclosure of the project during baseline studies, including the draft Background Information Document (BID), which is presented in Appendix A; and
- Phase 3: During impact assessment and mitigation planning, Golder will lead consultation on the results of the ESIA studies.

At the current time (July 2019), engagement is in Phase 2. Golder has shared an overview of the Project during its baseline studies, where data holders coincide with stakeholders, and will continue these efforts in conjunction with TKBV. The final phase is scheduled for 2019. The remaining FSD ESIA engagements will continue to build on engagement methods, materials and stakeholder identification. This work will be complemented by TKBV efforts to duplicate disclosure at the settlement level through public meetings. The frequency and level of detail required for these public meetings will be determined at the completion of Phase 2 of the engagement process.

5.2 Proposed Engagements Methods

The methods of engagement will seek to provide consistent messages about the FSD through the presentation or distribution of presentations, maps and documents. These methods will include, but will not be limited to:

- **Key informant interviews and Focus Group Discussions:** Stakeholder engagement is closely linked with environmental and social baseline studies. As specialists conduct primary data and information collection, they will also make sure key informants, Project-Affected People (PAP) and other interested groups receive standardised project information and have the chance to raise issues, concerns and quetsions;
- **Workshops/Seminars** – Workshops and seminars will be convened for stakeholders in various stakeholder groups. Such grouping will seek to provide sufficient time for people to raise issues and may be organised around specific themes;
- **Posters** – Information shall be presented via posters in select public places and communal areas. Pictorial content shall be used to facilitate communication to all interested parties. Such posters must present the project and related information visually, using methods such as 3D visualisations, flyovers, photography-based maps, overlays and so forth;
- **Settlement Meetings** – These meetings will be considered for ESIA disclosure to share information and receive comments or issues on the project-aspects discussed. These meetings may occur when and if necessary, to gain public opinion and maintain open avenues of communication; and

- **Media advertisements** – Media advertisement shall be considered to involve local stakeholders and raise awareness about various engagement events.

TKBV and Golder will also consider including other methods of distributing project information as appropriate, such as theatre groups and SMS messaging platforms.

5.3 Materials

TKBV and Golder team will use the most appropriate material for consultation meetings considering all needs from stakeholders (e.g. using visual illustrations and verbal explanations for illiterate stakeholders). These materials will not be limited to English language but Swahili, Turkana and any other local language as appropiate to maximise communication and understanding of the project-engagement.

The following consultation materials will be available during the engagement process at local, county and national level:

- A Background Information Document (BID): This document gives and overview of project features, scope of work and project area, and will provide contact information to continue capturing issues and responses from stakeholders;
- A Non-Technical Summary (NTS);
- Poster: A group of posters shall be produced and be available during engagements to provide a visual aid to some of the key messages in ESIA documents;
- Registration and comment sheets: this element should be available at all times for stakeholders to raise and send comments/issues to project proponent. Issues and responses are captured in a database and will be summarised within the draft ESIA;
- Power point presentations: Various visual presentations will be produced and will varying depending on the stakeholder group; and
- Project Oil Kenya website – a dedicated website designed to provide up-to-date information and contact details.

5.4 Process Record-Keeping

TKBV and Golder have and will keep records of stakeholder engagement activities, comments received and responses to these throughout the lifecycle of the FSD. The following aspects shall be considered as part of the record-*keeping* process during consultation:

- All stakeholder interactions shall be recorded. Contact details of individuals and instutions engaged shall be recorded and included into the Project stakedholder database;
- Minutes-of-meetings will be prepared as part of the records;
- An Issues and Response Report will be produced in order to capture of issues raised at meetings. This report shall be available to attendees for verification at regular intervals;
- Digital photographs and video recordings on approval to participants attending engagements meetings; and
- Recording the times and content of media advertisements, radio broadcasts and interactive talk shows, and the issues raised during these consultation processes.

5.5 Schedule

5.5.1 Phase 2

As stated above, the engagement programme is currently in Phase 2, which is designed to disclose project details. This phase has also included making the distinction between EOPS Phase II ESIA and the renewed focus on FSD.

The stakeholder engagement programme will continue the identification of traditional leadership within Government and County administrative units in Turkana South, Turkana East and Pokot West Sub-counties. The completion of traditional leadership identification will be used in conjunction with National and County administrative units. Efforts will be made to give all leadership in Turkana and West Pokot an opportunity to receive information. However, there will be more concentrated work in those Sub-counties that are closer to the Project (i.e. where the Project anticipates any infrastructure to be developed, which potentially could affect traditional livelihoods).

Building on the past engagement, the remaining engagement in Phase 2 will primarily target County level leadership, with a specific effort to inform residents most likely to observe impacts related to the Project.

For both Phase 2 and Phase 3, engagement will concentrate on the Sub-counties where Project infrastructure is based. A map of Sub-county administrative units is shown in Figure 1. Leadership from all administrative units will be provided with an opportunity to attend engagement meetings. This is particularly important given the migratory practices of pastoralists who can travel great distances in their use of natural resources. However, it is not practical to hold local meetings in all local administrative units. Stakeholders farther from the host Sub-counties will be able to attend disclosure meetings, but these will be provided in strategic locations, such as County and Sub-county centres.

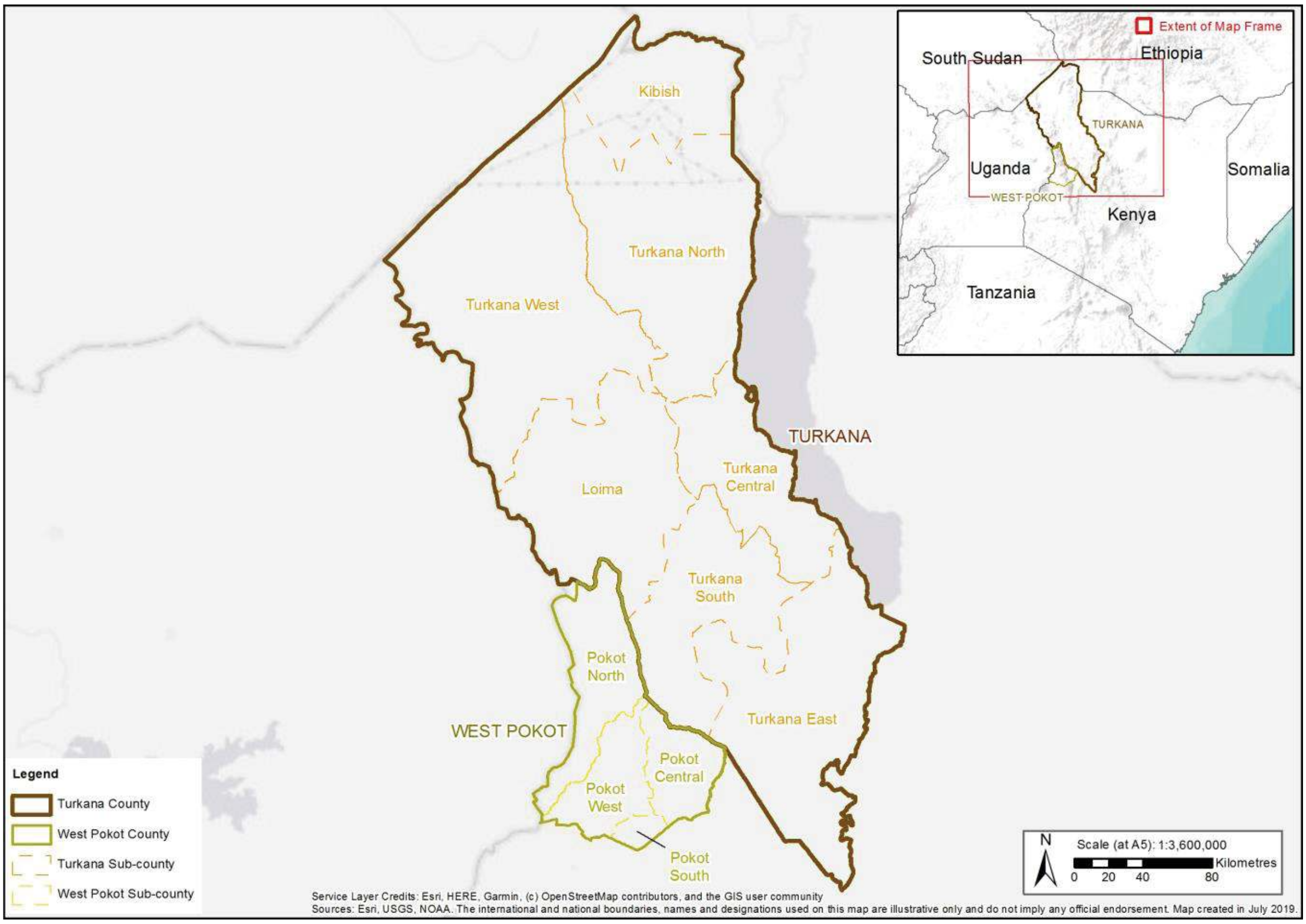

Figure 1: Turkana and West Pokot County and Sub-county administrative units.

The planned timeframe for engagement activities cover the following aspects.

Q3 2019

- Publication of SEP and tactical plan (to be produced by Golder).
- Update engagement tools: stakeholder register and issues and concerns matrix.
- Courtesy visits/calls and face-to-face meetings with National and County representatives to introduce engagement activities.
- Continue updating stakeholder register and issues and concerns matrix.
- Joint team (TKBV and Golder) to continue to extend geographic scope of mapping exercise with traditional leadership units within Turkana South, Turkana East and Pokot West sub counties.
- Fieldwork planning for project disclosure (letters of invitation, tactical plan, logistical arrangements).
- Update materials (if necessary) and engagement tools.

5.5.2 Phase 3

With the completion of the ESIA, including impact analysis and proposed mitigation commitments, the engagement programme is planned to enter the final phase in Q4 2019. Consultations will provide ESIA project information to stakeholders from the following levels:

Nairobi:

- National government officials and agencies; and
- National NGOs, multi-national organisations.

Lodwar / Kapenguria:

- National government officials;
- County government officials (Governor, County Executive Committee, Members of the County Assembly) County Ministries and technical specialists;
- Council of Elders (Turkana only); and
- Regional NGOs, multi-national organisations.

Turkana South & East Sub-counties / Pokot West Sub-county:

- National government officials;
- County government officials;
- Council of Elders (Turkana only);
- Sub-County Administrators;
- Ward Administrators;
- Village Administrators (positions being filled as part of devolution process under the new Constitution);
- Traditional leadership (Seers and Elders) in Locations, Sub-Locations, and Wards where infrastructure will be located;
- Local/International NGO/CSOs; and
- Community meetings.

Engagement events during this phase are based on the draft ESIA report, which includes baseline studies, impact analysis, mitigation or management strategies. Results of this consultation phase will be compiled, summarised and presented as part of the revised ESIA document and Engagement Report. As relevant, changes to the ESIA document resulting from engagement meetings will be indicated in the final report.

Following stakeholder engagement, Golder will update the Environmental and Social Management Plan (ESMP), which is an umbrella document that will include sub-plans for specific topics important for FSD. All stakeholders will be provided with an opportunity to review and comment on the findings of the ESIA, including the associated mitigation commitments that aim to reduce all negative impacts and enhance benefits to the extent possible.

6.0 APPROACH TO ENGAGEMENT

All disclosure and engagement activities will be organised to create various opportunities for people to receive information and give feedback. Within the process, there will be clear reporting on the number of meetings held. Revised ESIA and ESMP documents will highlight where the process causes substantial changes as a result of feedback and negotiation on the mitigation strategies. Benefit enhancement initiatives will be contained within a Community Development Plan (CDP).

The approach seeks to give all interested parties in each strand of governance an equal opportunity to consider the impacts, mitigation and benefit enhancement as a whole.

6.1 Outputs of Engagement Process

Prior to the finalisation of the ESIA, all environmental and social management actions will be disclosed. The output of communication with vulnerable and marginalised groups will be recorded in an Engagement Report. This will summarise all issues, comments and questions, as well as TKBV responses in relation to the project description, project impacts and project avoidance, minimization, mitigation and compensation, which will form a key part of the FSD ESIA. Plus, TKBV's initiatives to increase positive impacts will be captured through its regularly updated CDP.

Detailed documentation of all concerns, agreements and disagreements will be clearly summarised in an *Engagement Report*, to be included in the final version of the ESIA documentation.

7.0 ROLES AND RESPONSIBILITIES

The Golder stakeholder engagement team and TKBV team representatives will be principally responsible for implementing and delivering the stakeholder engagement process throughout the mentioned three phases. Representatives from both teams shall be present during these rounds of engagements, and be responsible to disclose project information, capture issues and comments and address project-related questions.

7.1 TKBV

TKBV management of the above-ground operating environment is delivered through several functions including Social Performance (Stakeholder Engagement, Land Access and Resettlement, Social Impacts, Social Investment), Government and Public Affairs (GPA), Communications, Human Resources – Manpower and Industrial Relations, Local Content and Asset Protection. These functions have defined objectives and annual work programs and budgets. The functions are resourced at both the national and Turkana levels. The Turkana-based team holds primary responsibility for the delivery of the FSD ESIA SEP.

In Turkana, TKBV engagement functions are distributed between several teams:

- The Stakeholder Engagement team comprises Field Supervisor Stakeholder Engagement (FSSE) and Field Stakeholder Engagement Officers (FSEOs);
- Village Socialisation Officers (VSOs) are also hired from settlements across the Project Area of Influence. These community members are asked to help FSEOs in distribution of information and reporting back when issues or questions arise among the population;
- Grievances are managed by a dedicated Grievance Officer, responsible for implementation of the Grievance Management Procedure;
- The Government and Public Affairs team comprises a GPA Coordinator and GPA Advisor;
- The Communications function comprises a field-based Communications Coordinator and Communication Officers located in the three TKBV Community Resource Centres (TCRC) in Lodwar/Turkana Central, Lokichar/Turkana South and Lokori/Turkana East respectively; and
- The Local Content function comprises a Socio-economic Investment & Capacity Building Advisor.

7.2 ESIA Stakeholder Engagement Team

The ESIA is managed by Golder Associates and work closely with TKBV managers to explain impact analysis, mitigation measures and management plans. Golder or sub-consultants working under Golder, have conducted the majority of ESIA engagements to date as it relates to information disclosure during baseline studies.

The main roles and responsibilities include:

- ESIA Project Manager: Andrew Morsley, responsible for delivering ESIA, direct liaison with TKBV Management team and Golder SE team;
- Stakeholder Engagement and Social Lead: Paul Lawrence, responsible for leading the SEP and tactical plans along the ESIA process, responsible to liaise directly with TKBV to plan and deliver SEP according to Kenyan National regulation and international standards;
- Stakeholder Engagement and Social Researcher: Priya Ramsaroop, responsible to support and work in close coordination with the Stakeholder Engagement and Social Lead in activities related to stakeholder engagement, mapping traditional leadership units, social field data gathering and analysis, and coordination with Regional Stakeholder Engagement sub-consultants; and
- Regional Stakeholder Engagement sub-consultants: Responsible for implementing SEP in close coordination with the Stakeholder Engagement and Social Lead. Fluent in Swahili and other local languages, and responsible for the coordination and support of the stakeholder engagement at the local level, through logistical support, invitation and meeting arrangements, meetings facilitation, minutes and issue capturing, translation or arrangement of translators as may be required and general process support.

7.3 Stakeholder Engagement Contact Details

Key contact information:

- Development Team TKBV Kenya BV
  - P.O. Box 63298-00619 Nairobi, Kenya
  - +254 20 428 6000
  - infokenya@TKBV oil.com
- Communications Team/Community Resource Offices
  - Lodwar: +254 701 482948
  - Lokichar: +254 701 483763
  - Lokori: +254 701 483740
  - Nakukulas: +254 798 481845
  - Kenya.fieldcommunications@TKBV oil.com
- Grievance Officer
  - Kenya.Grievance1@TKBV oil.com
  - +254 708 95 95 95

8.0 GRIEVANCE MECHANISM

During the exploration phase, TKBV operated an informal project-based grievance management system. While not guided by a defined procedure, this system allowed for the capture and resolution of grievances registered by impacted people within the area of operations.

In 2014 a formal Grievance Management Procedure was developed and a dedicated Grievance Officer was recruited. In 2015 a field-level Grievance Management Committee (internal committee chaired by the Field Operations Manager) was established to ensure appropriate levels of project management and clarity on functional roles and responsibilities for investigation and resolution of grievances where necessary, and also as second tier level for review and resolution of registered grievances which require a review or have failed to be resolved at first order review.

The Grievance Management Procedure aims to ensure that individuals, families, groups, communities and other stakeholders within the project affected area are able to raise concerns, complaints or grievances; and that TKBV is able to effectively acknowledge, record, review and formally respond to grievances before they escalate into serious disputes.

8.1 Multi-tier system for review and resolution of registered grievances

TKBV use a multi-tier system in which a grievance that is not resolved in a first order review is considered again in a second order review. Data collated through this procedure is analysed on a monthly basis and assists in the identification of emerging and current social trends and risks for TKBV, lessons learnt and TKBV's impacts on the communities and how to improve outcomes and accountability.

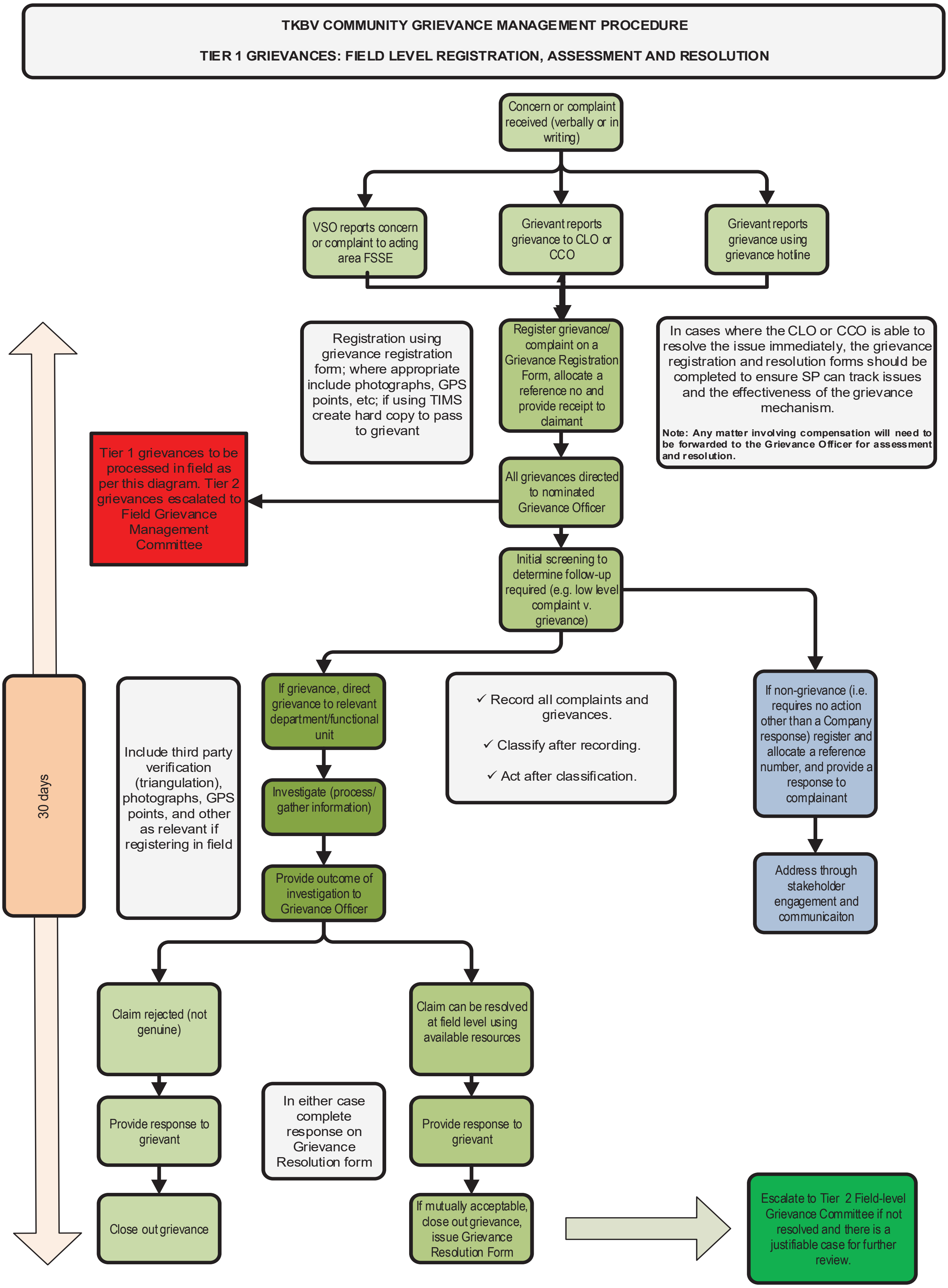

Figure 2: TKBV Community Grievance Management Procedure

The Grievance Mechanism seeks to:

- Provide an equitable and context-specific process which respects the confidentiality of all parties, protects all parties from retaliation and builds trust as an integral component of broader community relations activities;
- Provide a predictable, accessible, transparent, and legitimate process to all parties, resulting in outcomes that are seen as fair, rights compatible effective, and lasting; and
- Enable more systematic identification of emerging issues and trends, facilitating corrective action and pro-active engagement.

The procedure governs how TKBV will receive grievances pertaining to project activities. It will capture grievances arising from actual project impacts, as well as issues that are simply perceived to be related to TKBV, irrespective of whether they derive directly from TKBV or contractor activities.

Grievances shall be investigated and resolved through a defined series of steps as outlined in this procedure. This process allows for three stages of resolution. Specifically: Tier 1 (Entry level) procedures define the means through which community-level grievances may be (i) received, acknowledged and registered by the Project; and (ii) how field-level investigation and resolution of grievances will occur. Tier 2 procedures allows for unresolved grievances to be escalated for further review at the field level. Tier 3 grievance management, which allows for the grievant to proceed to court in the event that the grievance cannot be resolved to the satisfaction of the grievant and the Project, will remain outside the scope of this procedure.

8.2 Definitions

In addition to the definitions provided directly below the contents page of this document, additional definitions are provided in management of grievances.

- **Concerns/Issues:** Questions, requests for information, or general perceptions not necessarily related to a specific impact or incident caused by project activity. If not addressed, concerns and issues can become grievances. Concerns/issues will be recorded as part of the grievance mechanism and resolution procedure but will not be processed as a grievance.
- **Grievance/complaint:** This procedure will utilise the terms ‘grievance’ and ‘complaint’ interchangeably. Typically grievances are related to a specific and identifiable impact caused by a project activity, which is raised by an affected individual, family, group or community of stakeholders with the intent of bringing the impact to the attention of TKBV or contractor seeking that the impact be mitigated (e.g. dust, noise or vibration). More specific grievances raised by an individual, family, group or community of stakeholders who claim to be affected by real or perceived impacts of a company’s operations will require specific, targeted corrective actions, which may include compensation. These complaints will be handled by the TKBV Grievance Officer.
- **Grievance Mechanism Tiers:**
  - Entry Level (First Tier) refers to a process through which a grievance is received, acknowledged and registered and subsequently may be investigated and resolved directly between the grievant and the Project through a process of direct or mediated dialogue either by the Grievance Officer (in collaboration with the relevant department) or by site management; and
  - Second Tier refers to the process that needs to be followed when an Entry Level (Tier 1) grievance cannot be resolved directly between the grievant and the Project (i.e. at the Tier 1 level) and is thus escalated to Tier 2, involving adjudication by a TKBV Field Operations Grievance Committee, which may include appropriate external representation as required. The need to involve appropriate third party representation will be determined in line with the nature of the grievance, and in collaboration with field operational managers and the community to ensure transparency and adequate

independence. Should the Tier 2 dispute resolution process fail to satisfy the grievant and close the grievance, the complainant can access judicial channels to try and gain resolution.[3]

9.0 MONITORING, EVALUATION AND REPORTING

Recording, monitoring, evaluating, and reporting upon TKBV Kenya's FSD ESIA Stakeholder Engagement program are critical for ensuring that stakeholder engagement activities do not simply occur in isolation, but that they support business objectives and occur in an on-going coordinated manner across and between functions with responsibility for stakeholder engagement.

The objectives of TKBV's recording, monitoring, evaluation and reporting efforts are to:

- Record stakeholder engagement efforts and identify potential impacts and risks;
- Assess risks and impacts and their consequences on project-affected peoples;
- Consult on new impacts and risks that are identified during the planning and assessment process;
- Provide input into proposed mitigation measures, as well as the opportunities for sharing of community benefits;
- Ensure compliance with Project commitments that have been made;
- Verify the effectiveness of the resolution of community grievances relating to TKBV operations; and
- Manage and track the degree to which TKBV has been able to gain social acceptance.

The monitoring, evaluation and reporting of stakeholder engagement will build upon the issue identification done during the scoping consultation. Stakeholder issues and questions collected during other phases will be summarised to highlight the most common topics among consulted groups.

The results of baseline studies will be presented in the draft ESIA. All issues will be shared among the ESIA specialists to ensure that stakeholder questions are considered in the development of impact analysis and mitigation. The goal of this internal process is to ensure that questions about impact management are sufficiently understood and addressed.

A summary of the draft ESIA and associated management plans will be used to solicit another round of comments during the disclosure of the draft ESIA results. Stakeholder issues collected during previous phases will be important in generating non-technical summary documents. These simplified versions of the full ESIA will seek to answer all key issues and questions in language that is understandable for all stakeholders.

Finally, a summary of all stakeholder issues will be included in the final ESIA report. This final report will highlight any critical questions or areas of disagreement identified during the disclosure and discussions around impact analysis and mitigation.

[3] The process of going through the formal judicial channels of the host country (or other applicable judicial or non-judicial systems outside of the host country) will be referred to as the 'Third Tier' of community grievance resolution; however, for the purpose of this document it is considered to be outside the scope of the non-judicial community grievance mechanism. It is the responsibility of TKBV staff members and the Grievance Officer to alert grievants to this potential avenue of redress should they not be satisfied by the Tier 2 resolution process.

Signature Page

Golder Associates (UK) Ltd

Kevin Arbizu
ESIA Practitioner

Andrew Morsley
Associate/ESIA Project Manager

KA/AM/es

Date: 10 September 2019

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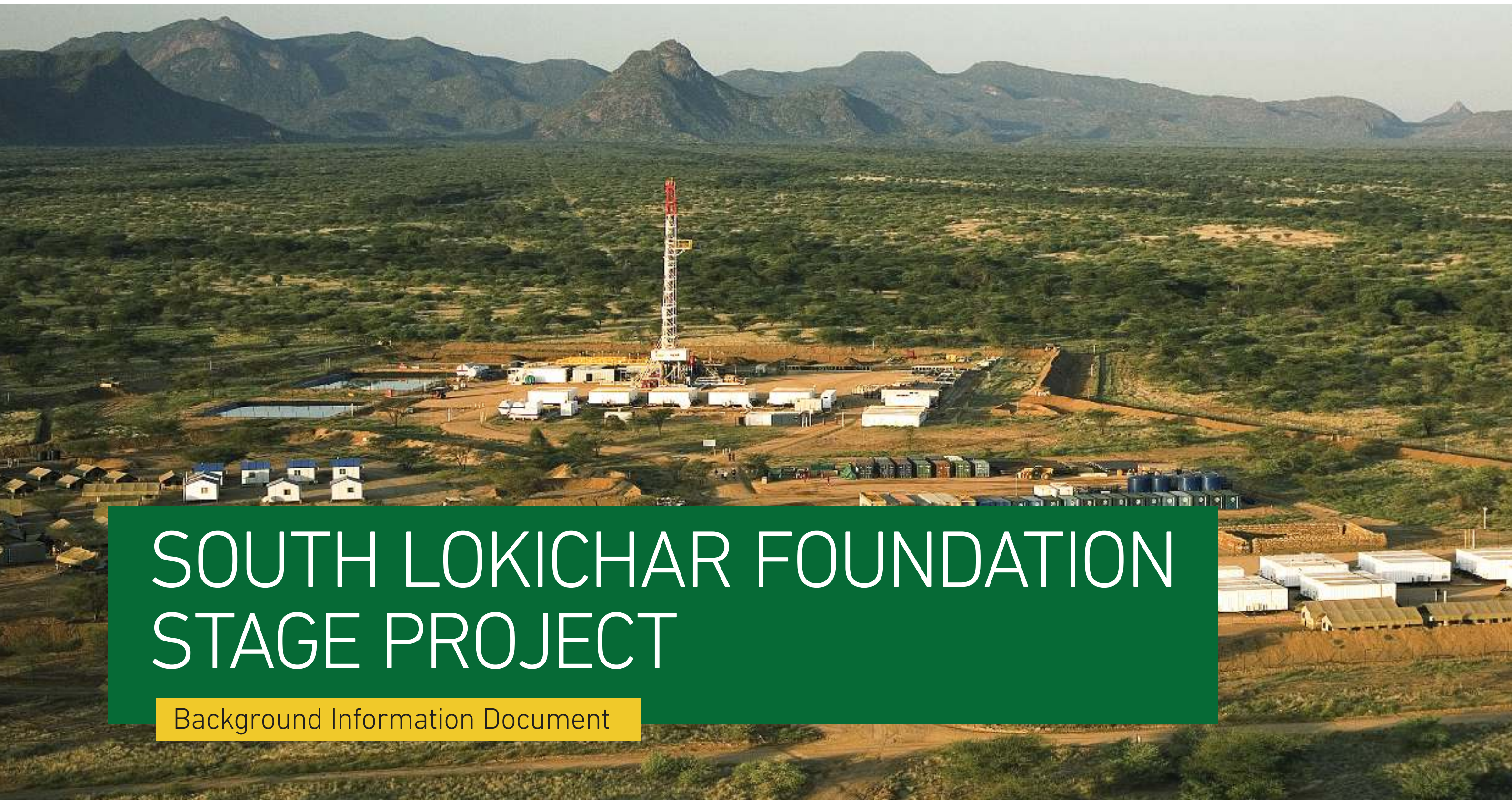
APPENDIX A

Background Information Document



SOUTH LOKICHAR FOUNDATION STAGE PROJECT

Background Information Document

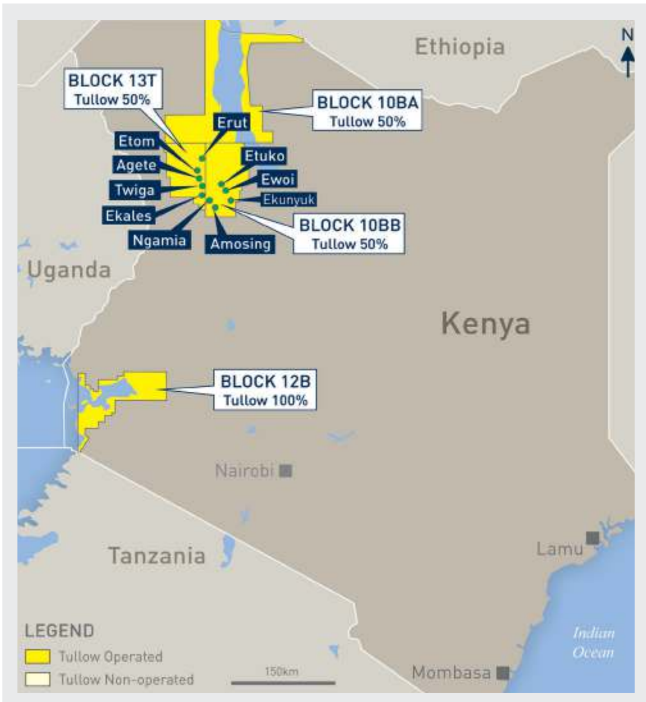
EXPLORATION & APPRAISAL SUCCESS

In 2012, the Ngamia-1 exploration well in the South Lokichar Basin in Turkana, northern Kenya, successfully encountered over 200 metres of net oil pay. As a result, a significant drilling programme began with further exploration success in the South Lokichar Basin at the Amosing, Twiga, Etuko, Ekales, Agete, Ewoi, Ekunyuk, Etom, Erut and Emekuya oil accumulations.

A total of 40 exploration and appraisal wells have now been drilled in the basin and the Joint Venture Partnership (Tullow Oil, Africa Oil, Total and the Government of Kenya) has conducted extended well tests, water injection tests, well interference tests and water-flood trials, all of which have proved invaluable for planning the development and commercialisation of the oil fields.

DEVELOPMENT PLANNING

Following a full assessment of all the exploration and appraisal data, it is estimated that the South Lokichar Basin contains at least 560 million barrels of oil (mmbo) that can be recovered, but with the potential to produce more. Project Oil Kenya's Joint Venture Partners have proposed to the Government of Kenya that the Amosing, Twiga and Ngamia fields should be developed as the Foundation Stage of the South Lokichar development. This approach brings significant benefits as it enables an early Final Investment Decision (FID) taking full advantage of the current low-cost environment for both the field and infrastructure development and provides the best opportunity to deliver First Oil in a timeline that meets the Government of Kenya expectations. The installed infrastructure from this initial phase can then be utilised for the optimisation of the remaining South Lokichar oil fields, allowing the incremental development of these fields to be completed at a lower cost post-First Oil. The incremental development of the remaining recoverable oil and the upside potential is expected to increase plateau production to 100,000 barrels of oil per day (bopd) or greater.

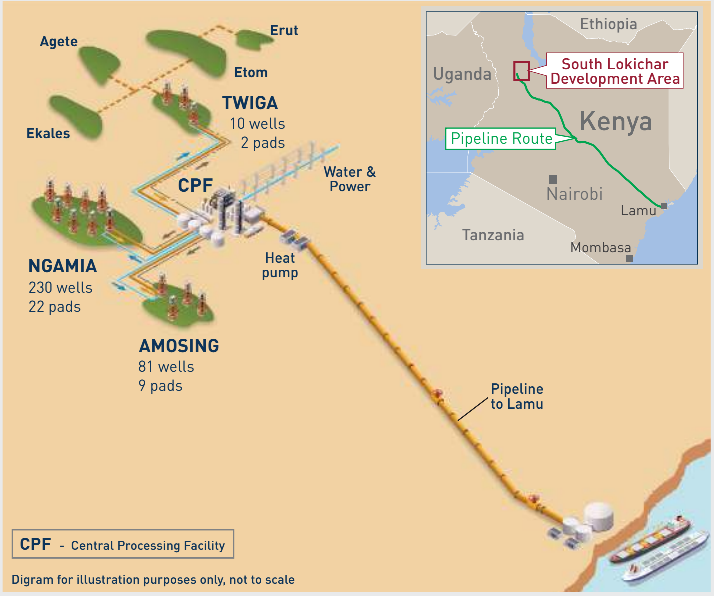


FOUNDATION STAGE PROJECT

The Foundation Stage Project is currently planned to develop an initial 230 wells through 22 well pads at Ngamia, 81 wells through 9 well pads at Amosing, and 10 wells through 2 pads at Twiga. This stage will target production of approximately 226 mmbo, and a plateau rate of 60,000 to 80,000 bopd. Once the crude oil has been processed and stabilised it will be transported via a buried export pipeline to Lamu, for onward sale to the international market.

The Front-End Engineering and Design (FEED) work, and Environmental and Social Impact Assessments (ESIA) for the Foundation Stage Project are ongoing. FID is targeted in 2H 2020 and First Oil production approximately 36 months after FID. Total gross capex associated with the Foundation Stage upstream infrastructure and oil export pipeline is expected to be around $3 billion.

The key components of the South Lokichar Foundation Stage Project include the construction of the following infrastructure:



- New well pads in different fields within the South Lokichar Basin and well drilling activities;
- Buried interconnecting flowlines to transport oil;
- A water pipeline from Turkwel dam;
- Construction of a Central Processing Facility (CPF);
- Construction and use of new access roads; and
- Support facilities and infrastructure, including construction camps, laydown areas and waste management infrastructure.

LAND

In the Land Access Framework Agreement (LARF), it is stated that access to land for the Project will range from temporary occupation, permanent occupation and rights of way. Land will be required within three main fields Twiga, Amosing and Ngamia. The total area of the perimeter of the three fields is approximately 6500 hectares. However, permanent access will only be required for discrete pieces of land for infrastructure such as well pads, CPF and flow lines. Currently the Joint Venture Partners are finalising the exact location and size of the footprint through the Front-End Engineering Design (FEED) process.

In February 2019, The National Land Commission gazzetted the intention to acquire land within the perimeter of the fields and once the final footprint of the surface infrastructure is defined, the information on the land size and geographic location of the land required will be communicated to Turkana County Government, and the affected communities.

The current schedule targets securing access to land by the end of 2019.

Initial engagement among key national stakeholders started in August 2018 and will continue throughout the entire process.

Land acquisition for petroleum activities is a process through which land is acquired on behalf of the Ministry of Mining and Petroleum for Project Oil Kenya by the National Land Commission (NLC) in partnership with Turkana County Government (TCG). The land shall at all time belong to the Government of Kenya.

A Resettlement Action Plan (RAP) specifies the procedures that will be followed in land acquisition and the actions that will be taken to mitigate the effects, compensate for losses and provide development benefits to persons and communities affected by the project. As part of the RAP, displaced people will be assisted by the project in their efforts to improve their livelihoods and standard of living or at least to restore them to pre-displacement levels, providing sufficient investment resources to give the persons displaced by the project the opportunity to share in the project benefits.

The specific details of the livelihood programmes will be made available once the baseline information from each project specific RAP has been collected and the programmes have been designed to address the resettlement plans.

WATER

Water is required for construction and oil production operations. Exact volumes of water required is still being evaluated.

A multi-criteria decision analysis technique was applied to compare seven options identified as potential water sources. The following criteria were used to identify the optimum solution: technical feasibility; regulatory approvals; stakeholder acceptability; social and environmental impact; security (asset protection); and cost. Using this technique, other options were eliminated leaving four options; Turkwel Dam, Lake Turkana, local groundwater and distant groundwater and further technical studies on hydrogeology and hydrology were conducted. Turkwel Dam is considered the most appropriate water source for the project.

The design of the water pipeline will include the provision of water supply for communities living along the pipeline route, through off-takes at various points in the pipeline. Those water points will be managed by the respective County governments, who will take responsibility for the water service provision.

A Water Delivery taskforce (Turkwel Dam Integrated Development Project), was set up In July 2018 with clear Terms of Reference (ToR), led by National Government (PS level) but with representation from Turkana and West Pokot (Governor level), the taskforce is to spearhead stakeholder engagements.

SHARED PROSPERITY AND LOCAL CONTENT

Sustainability is one of Tullow's 2030 Vision core pillars and one of the ways that it is achieved is through Shared Prosperity which is delivered through three focus areas namely: Local Content & supplier capacity; Developing local skills; and Socio-economic investments. Project Oil Kenya is committed to enabling Kenyans to benefit through jobs, and the supply of goods and services. It will achieve this by working closely with both national and county governments, as well as development partners, the local businesses including those at the county level and learning institutions.

The Foundation Stage Development will follow these Local Content Principles:

- Create a lasting legacy for Project Oil Kenya. It includes employment creation, skills development, local contracting and knowledge transfer.
- Initiatives will be planned over the Project Life Cycle and will be geared towards developing sustainable benefits.
- Successful project delivery requires a balance between cost, schedule, quality and Local Content.
- Delivery of Local Content is a shared responsibility by everyone in the business.
- Contractors and sub-contractors will share Project Oil Kenya's Local Content principles and will play a key role in delivering the Project's Local Content plan.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

The ESIA is a process and management technique that allows consideration of the likely environmental and social impacts of a development prior to it proceeding. This provides an opportunity to ensure that the design is optimised in an integrated manner, minimising negative environmental and social impacts and maximising positive impacts.

The ESIA is being conducted by Golder Associates (UK) Limited and Kenyan, NEMA registered, partners. Although the ESIA is commissioned by Tullow the ESIA contractors are independent with a remit to provide unbiased data and assessments. The ESIA process is being implemented with the goal of maximising Kenyan knowledge and expertise.

In accordance with Kenyan regulation and international standards, all risks and impacts (positive and negative) identified will be analysed with a consideration of recent environmental and social baseline data. Key topics of the baseline include:

- Socio-economics;
- Land tenure and use;
- Community health and safety;
- Cultural heritage;
- Biodiversity;
- Ecosystem services;
- Soil;
- Geology and seismicity;
- Water;
- Air quality and climate;
- Noise and vibration; and
- Landscape and visual.

PROJECT OIL KENYA

The ESIA for the Foundation Stage Project differs from earlier impact assessments conducted by Tullow. Previously ESIA permitting has been for short-term impacts (e.g. seismic lines, exploration drilling or the Early Oil Pilot Scheme). The ESIA being conducted now is for the much longer production phase and requires much more comprehensive data gathering and analysis.

As a first priority, the ESIA must consider applicable Kenyan legislation. In addition to this, the Project will meet the International Finance Corporation (IFC) Environmental & Social Sustainability Performance Standards. These international standards are a framework for the future management of all environmental and social performance.

There are three main stages in the ESIA process

1 Scoping Phase (completed March 2016)

2 Baseline Studies (through 2016-2019) and;

3 Impact analysis and mitigation (Currently ongoing)

Stage 3 includes the development of Environmental and Social Management Plans (ESMP), which includes all commitments to address Project impacts.

The National Environmental Management Authority (NEMA) has accepted the Terms of Reference for the ESIA, which outlines the work plan for the next phases of the project. Once finalised the ESIA will be submitted to NEMA for approval. No construction activities for the Foundation Stage Project will start until approval is received.

STAKEHOLDER ENGAGEMENT

The objective of stakeholder engagement is to establish and maintain constructive relationships with external stakeholders over the life of Tullow's operations. The Joint Venture Partners commit to identifying and assessing all stakeholders affected by planned activities, based on the Project's potential risks and adverse impacts. Stakeholders will be provided with access to timely, relevant, understandable and accessible information, and how project impacted people will be provided with an opportunity to discuss and have input into project design, scope, impacts and mitigation measures prior to the start of project activities.

The stakeholder engagement process for the ESIA will be outlined in a publicly available ESIA Stakeholder Engagement Plan (SEP). The overall objective of the SEP is to explain how the Project will engage with stakeholders throughout the course of the Project. As part of the ESIA, stakeholder engagement will capture issues, comments and questions accurately and in a meaningful manner.

GRIEVANCE MECHANISM

The Tullow Grievance Mechanism aims to ensure that individuals, families, groups, communities and other stakeholders within the project affected area are able to raise concerns, complaints or grievances; and that the company is able to effectively acknowledge, record, review and formally respond to grievances before they escalate into serious disputes. It also aims at strengthening mutual constructive long-term relationships with the communities and stakeholders. The Grievance Mechanism is free to use and is promoted widely in the Project area.

CONTACT INFORMATION

For more information on the Project or ESIA, residents in the Project area may visit Tullow Community Resource Officers in Turkana or use the contact numbers/emails below:

Lodwar Tullow Community Resource Centre
Nawoitorong Road
Opposite County Government Headquarters
Tel: +254 715 594829

Lokichar Tullow Community Resource Centre
Lokichar Kitale Road
Next to Toyota Kenya Lokichar
Tel: +254 715 594 212

Nakukulas Tullow Community Resource Centre
Ngamia Nakukulas Road
After Ngamia Secondary School
Tel: +254 798 418 445

Lokori Tullow Community Resource Centre
Lokori Kapendo Road
Before Lokori Mixed Primary School
Tel: + 254 727 129 425
Email: Kenya.fieldcommunications@tullowoil.com

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Nairobi, Kenya
Tel: +254 (0) 20 428 6000
Email: infokenya@tullowoil.com

PROJECT PARTNERS: TULLOW Oil, AfricaOil Corp, TOTAL

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ANNEX II

B

Stakeholder Engagement Consultation Material

PENDING

ANNEX II

C

Stakeholder Engagement Consultation Report

PENDING

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