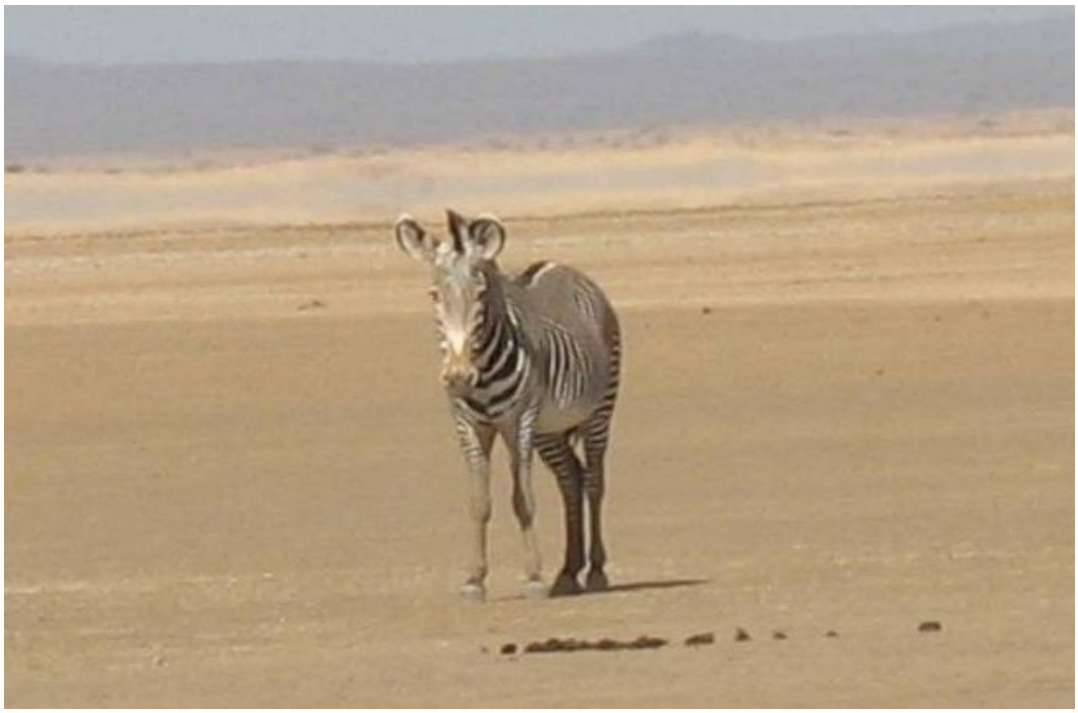
PROJECT REPORT

FOR

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED OIL AND GAS EXPLORATION IN BLOCK 10A, NORTHERN KENYA FOR LUNDIN KENYA B.V.



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Lundin

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EXECUTIVE SUMMARY

The current Environmental Impact Assessment report presents an overview of the issues considered important for fulfilling the requirements of a clean, sustained and healthy environment with respect to seismic survey for potential petroleum deposits within Block 10A, herein referred to as the study area, by Lundin Kenya B.V. ("Lundin" or "the Company") , in accordance with Kenyan legislation and Lundin's corporate HSE requirements as per its Code of Conduct and HSE management system, ("the Greenbook").The study area lies within the former vast Marsabit district of Eastern province in the central part of northern Kenya, to the east of Lake Turkana. It is approximately bound by latitudes 01º 15'N and 04º 27' N and longitudes 36º 03' E and 38º 59' E, and borders Moyale, Turkana, Samburu, Isiolo and Wajir districts to the northeast, west, south and east respectively. The oil and gas prospect (Block 10A) straddles Marsabit south and Marsabit north districts in Kenya.

Lundin Kenya B.V. is a wholly-owned subsidiary of Lundin Petroleum A.B., an independent Swedish oil and gas exploration and production company with a well balanced portfolio of world-class assets in Europe, Africa, Russia and the Far East. The Company is listed at the Nordic Stock Exchange, Sweden, and has existing proven and probable reserves of 184.2 million barrels of oil equivalent (MMboe) as at 1st January 2008. Lundin Kenya B.V. signed a Production Sharing Contract (PSC) with the Kenya Government in October 2007 and obtained an Exclusive Prospecting Right (EPR) for Block 10A. The company was subsequently granted a license for oil and gas exploration within this block to prospect for oil and gas deposits. The current exploration programme will be conducted in the northern Anza graben which straddles Marsabit south and Marsabit north districts in Kenya. The company, having been granted the exploration license for the area, has reviewed previous gravity and magnetic data that detected and determined the large-scale features of the sub-surface geology. The company is also reassessing data from exploration drilling carried out by the previous operators and seismic acquired by previous seismic contractors in the mid 1980's within Block 10A. In this regard, Lundin Kenya B.V's main aim and objective over the next four years will be to explore in detail the assigned area of 14,747.57 sq kms (Block 10A in Northern Kenya) to its full potential with the aim of advancing petroleum production operations within the country. Lundin Kenya B.V. is committed to ensuring that the petroleum exploration works conducted in the assigned area will benefit the immediate communities as well as have a minimal impact on the environment.

Block 10A, as per the petroleum prospecting blocks outlined by the National Oil Corporation of Kenya and herein referred to as the project area or study area is located in the former Marsabit district in Eastern province, Kenya. Marsabit district has subsequently been subdivided into three districts and these include Laisamis (currently Marsabit south), Marsabit (currently Marsabit central) and Chalbi (currently Marsabit north) districts. The oil prospect (Block 10A) straddles both Marsabit south and Marsabit north districts. The two districts are characterised by harsh climatic condition with up to 90% of the landmass being arid while the remaining 10% can be classified as semi-arid. The vegetation is characteristic of arid and semi-arid conditions and is dominantly

comprised of short grass, shrubs and Savanna woodlands of scattered acacia trees. The very arid regions are completely barren. The most prominent physiographic features in the study area are the Chalbi and Koroli deserts which are overlain by relatively thick (8-10 km) fluvial and lacustrine sediments and recent soils. There is however no clear-cut demarcation between Chalbi and Koroli deserts and the two are collectively referred to as the Chalbi desert. Other physiographic features include Kalacha terrace and Bulal lava plain, both overlain by basaltic lavas. The study area is drained by several rivers such as river Balesa which is in turn fed by Ririba, Wata and Bulal rivers. Other rivers/streams draining through the area are Dambito and Sangai. These rivers and streams are dry for most of the year and the river/stream beds are covered by sand deposits and water worn pebbles. The study area is sparsely populated due to the harsh climatic condition and the normadic lifestyle of the inhabitants. The highest population is however concentrated in the major centres such as Kargi, Maikona, Kalacha, Balesa, Dukana and Illeret. The total population in each of these centres is highly variable.

The proposed seismic survey operation for the purpose of oil and gas exploration within Block 10A will be limited to part of Marsabit south (formerly Laisamis) and Marsabit north (formerly Chalbi) districts within the Mesozoic basin of the Anza graben. The seismic survey will involve the acquisition of at least 750 line kilometres of 2D seismic data along pre-existing and new seismic transects/lines. The seismic survey will be conducted using a Vibroseis energy source which will likely include 4-5 vibrators, 1 recording truck, up to 3 D8 bulldozers, 6-8 cable geophone/personnel carriers, 1 mechanical service vehicle, 1 fuel truck, 6 light duty vehicles, and one helicopter. The energy source will be Vibroseis, only, if it proves impossible to access difficult sections of terrain will the use of explosives be contemplated. This would be as a last resort. Neither any damage to the terrain nor environmental degradation is envisaged. This was the major concern expressed by the inhabitants during the current EIA study, who were reassured to find out that no adverse impacts are envisaged as a result of the seismic survey operation.

The electronics within the seismic acquisition recorder and associated cables are powered by very low voltage DC and this presents no threat to wildlife or people. All the seismic survey data is centrally recorded, collated and stored on magnetic media in the central recording system, located in the recording vehicle. The whole seismic survey is strictly managed with prescribed safety procedures to ensure that no incidents or accidents occur that would affect the local population, livestock or wildlife.

The main aim of the proposed project is to prospect for commercially viable oil and gas reserves in Block 10A. The success of this project will lead to exploratory drilling of oil wells in the project area and if this is proven to be commercially viable, it will definitely have a significant positive impact in Kenya’s energy sector. Further, it will boost the national economy and commercial production of oil, and shall lead to an improvement of the socio-economic well being of the Northern frontier districts and the country in general.

The proposed project is justified by a number of factors, among which the global demand for oil and the escalating oil prices reaching an all time high in July 2008. During the initial study and exploratory drilling by the previous operators, potential oil and gas resources were noted to occur in Chalbi-3 and Sirius-1 wells. This indicates that there could be possible mature hydrocarbon deposits within the area that could produce commercially viable oil and gas. This state of affairs calls for investment in seismic exploration activities and support facilities like infrastructure and social amenities. The proposed project will therefore go along way in ensuring that the potential of this part of Kenya is fully realized.

The project will lead to economic empowerment not only to the project proponent but also of a host of other people who will both directly and indirectly benefit from jobs and business opportunities within the project area. The only way to realize Vision 2030 that has been aptly propounded by the government of the Republic of Kenya is to make deliberate investments like the one proposed. The project envisages having a significant positive effect on the lives of many people in terms of revenue generation to the central government through permits and taxes as well as growth in the GDP. More importantly, the design of the project is well thought out and use of state of the art technology in seismic exploration survey will be used and abidance to international standards in health and safety in work place as well as environmental conservation will be adopted in order to minimize environmental degradation. Appropriate Suggested Mitigation measures are detailed in this project report.

On the basis of the foregoing and considering the positive social-economic benefit of the proposed project, the proponent sought the services of Earthview Geoconsultants Limited to carry out an environmental impact assessment (EIA) of the proposed project. The EIA was subsequently undertaken between August 18-23, 2008 (scoping) and September 16-25, 2008 (EIA). The framework and methodology adopted during the present EIA included but not limited to:

(i) Scaling and Scoping,
(ii) Review of Regulatory Framework and Institutions,
(iii) Comprehensive Environmental Assessment, Impact Identification as well as Suggested Mitigation measures, and finally
(iv) Recommendations of appropriate Environmental Management Plan.

The environmental parameters assessed during the present EIA include: Physiography, geology and geological setting, soils and soil characteristics, climatology and air quality, surface and ground water potential and quality, flora and fauna, land resources, visual aesthetics, noise and vibrations, solid wastes and effluents, socio-economics and health and safety issues.

The policy and legislative framework upon which the EIA survey for the proposed project was based on includes: Energy Policy (Sessional Paper No.4 of 2004), Environment and Development Policy, National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999), Mining Policy, Health

Policy, and the Economic Recovery for Wealth and Employment Creation Strategy. The institution charged with overseeing the implementation of the Environmental Management Coordination Act (EMCA) 1999 is the National Environment Management Authority. Acts that do have a bearing on the rules and regulations that touch on oil and gas exploration include: Energy Act, 2006, Mining Act, Cap 309, Explosives Act, Cap. 115 Revised 1989, Public Health Act, Cap 242, Water Act 2002, Factories Act, Cap 515, Local Government Act, Cap 265, and Penal Code, Cap 63.

This environmental impact assessment report has identified various potential impacts, both positive and negative, of the proposed project and Suggested Mitigation measures have been recommended. On the basis of the environmental impact assessment, appropriate environmental mitigation measures and Environmental Management Plan have been drawn up for all aspects of the survey and are suggested to be put in place. The modes for implementation of recommendations arising from this assessment are outlined in detail within this document and reference should be made to them in their respective sections. Some of the key recommendations include:

- The seismic lines, where possible, should be made in such a way as to avoid natural drainage lines and lugga and road crossings. Existing access ways should be considered for usage as much as possible.
- The company should regularly service all its trucks, service vehicles and machinery powered using fossil fuels so as to reduce exhaust emissions.
- The seismic crew should separate grey and black water which should be fed to evaporation pits. These should then be treated and filled at the end of the survey and camp occupation.
- During the planning of seismic lines, established vegetation, sensitive soils and hilly terrain, should be avoided if possible. If inevitable considerations should be made to follow established access roads and river crossings.
- Consultation with local leaders and elders should be done prior to cutting of any trees or clearing of vegetation and in selection of final transect lines that may interfere with the identified community and natural heritage sites.
- The Proponent should liaise with the communities and community leaders in coming up with appropriate CSR programmes that will be beneficial to them.
- The company should use local leaders to sensitize the neighbouring community about the project and its possible noise and vibration impacts. The communities should be informed in advance when a seismic survey operation is to be executed along a given seismic transect/location.
- Any hazardous and toxic waste materials should be disposed off in accordance to national and internationally accepted standards.
- Employees from outside the two prominent communities in the area should be acquainted with the cultural lifestyle of the local people prior to work commencement. It was suggested that camp site be located within a reasonable distance from a town and large settlements.
- Lundin should consider sourcing unskilled labour from the project area

- During seismic operations the company should consider minimal fencing off of the area of operation in order to allow free movement of livestock and the pastoralists
- The company should sustain public education and sensitization programmes before and during project operation.
- The company should construct the operational base at a reasonable distance away from settlements.
- The Vibroseis *shot points* should be located as far as possible from Kalacha terrace where basalts are loosely deposited so as to minimise the risk of landslides in the form of rock fall, rock slides and slumping. The company proposes to use low vibrator drive levels
- Worker health and safety should be assured through the development and implementation of standard workplace practices and the company HSE/OHS policies.
- The company should implement a risk assessment and security plans in consultation with the local authorities and provincial administration.
- The company should also encourage related companies particularly communication companies to venture into the area as it has a high business potential.

The project shall employ state of the art technology that is economically viable, environmental friendly and socially acceptable. However, the Company should adhere to the proposed Suggested Mitigation measures in this report as is reasonable to ensure that it protects the local communities' cultures and heritages and the environment's integrity.

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CHAPTER 1:

INTRODUCTION

1.1 Introduction

The environmental impact statement presented in this report provides an overview of issues considered important for fulfilling the requirements of a clean, sustained and healthy environment with respect to seismic survey for potential petroleum deposits in the Larger Marsabit area oil prospecting Block 10A, Kenya by Lundin Kenya B.V. (Figure 1.1).

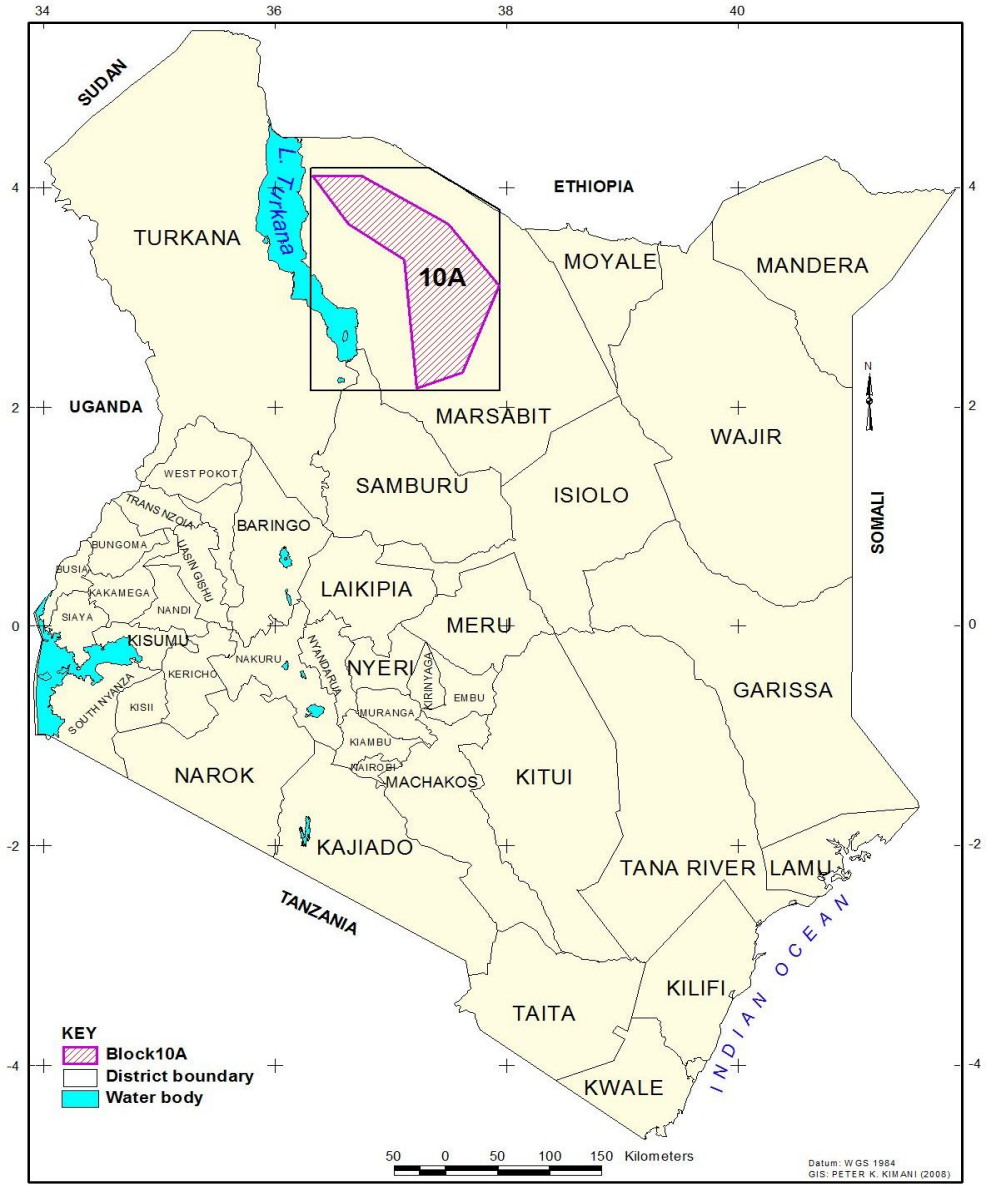

Figure 1.1: Location of the study area

The critical role that energy plays as an input to socio-economic development and environmental protection is now universally acknowledged, as it is an important vehicle for income and employment generation and for satisfying basic human needs (Global Village Energy Partnership (GVEP) Kenya, 2006)). The international community is today confronted with the daunting task of reducing poverty and achieving sustained economic growth and development for the benefit of all. The provision of adequate, quality and affordable energy services can play a decisive role in poverty reduction (GVEP Kenya, 2006).

Lundin Kenya B.V is proposing to carry out seismic surveys in parts of Chalbi district (currently Marsabit North), Marsabit district (currently Marsabit Central) and Laisamis district (currently Marsabit south) districts in order to assess its potential for oil deposits and to locate traps where such deposits may occur.

1.2 Developer Identification

This Environmental Impact Assessment (EIA) is carried out for Lundin Kenya B.V (Pin No. P051212981B), with respect to the proposed seismic survey for potential oil deposits in Block 10A.

1.2.1 Addresses

Offices In Kenya:	**Contact:**
Ground Floor, Acacia House, Westlands Office park, Waiyaki Way	Mr. Martin Mbogo General Manager Lundin Kenya B.V. P.O. Box 63298-00619 Nairobi Kenya

1.2.2 Activities of LUNDIN Kenya B.V.: An Overview

Lundin Kenya BV (LKBV) is a wholly-owned subsidiary of Lundin Petroleum AB. Lundin Petroleum is a Swedish independent oil and gas exploration and production company with a well balanced portfolio of world-class assets in Europe, Africa, Russia and the Far East. The Company is listed at the Nordic Exchange, Sweden (ticker "LUPE"). Lundin Petroleum has existing proven and probable reserves of 184.2 million barrels of oil equivalent (MMboe) as at 1st January 2008.

Lundin Petroleum seeks growth through involvement in all cycles of the upstream oil and gas business. The heart of an oil and gas company is in reserves-the oil and gas which is discovered and which can be economically and commercially extracted. This reserve base provide production

As an international oil and gas exploration and production company operating globally, our aim is to explore for and produce oil and gas in the most economically efficient socially responsible and environmentally acceptable way, for the benefit of shareholders, employees and co-ventures

Lundin Petroleum applies the same standards to all activities worldwide to satisfy both the commercial, ethical and local requirements. Lundin Petroleum strives to continuously improve the performance and to act in accordance with good oilfield practice and high standards of corporate citizenship.

1.3 Brief Site Description

Block 10A, as per the petroleum prospecting blocks outlined by the National Oil Corporation of Kenya (NOCK, 1987) and herein referred to as the project area or study area is located in the former Marsabit district in Eastern province, Kenya (Figure 1.2). Marsabit district has subsequently been subdivided into three districts and these include Chalbi (currently Marsabit North), Marsabit (currently Marsabit Central) and Laisamis (currently Marsabit South) districts. The oil prospect (Block 10A) straddles both Marsabit South and Marsabit North districts. The two districts are characterised by harsh climatic condition with up to 90% of the landmass being arid while the remaining 10% can be classified as semi-arid. The most prominent physiographic features in the study area are the Chalbi and Koroli deserts (Charley, 1987; Key, 1987; Key and Watkins, 1988). Which are overlain by relatively thick fluvial and lacustrine sediments and recent soils (Bosworth and Morley, 1994; Dindi, 1994). There is, however, no clear-cut demarcation between Chalbi and Koroli deserts and the two are collectively referred to as the Chalbi desert (Figure 1.2). The study area is drained by several rivers such as river Balesa which is in turn fed by Ririba, Wata and Bulal rivers. Other rivers/streams draining through the area are Dambito and Sangai (Charley, 1987; Key, 1987; Key and Watkins, 1988). These rivers and streams are dry for most of the year and the river/stream beds are covered by sand deposits and water worn pebbles. Such rivers and streams are locally referred to as luggas. The study area is sparsely populated due to the harsh climatic condition and the normadic lifestyle of the inhabitants. The highest population is concentrated in the major centres such as Kargi, Maikona, Kalacha, Balesa, Dukana and Illeret (Figure 1.2). The total population in each of these centres is however highly variable. According to the 1999 census, Maikona and Illeret had a total population of 6593 and 11355 respectively, whereas Kargi, Kalacha, Balesa and Dukana had a total population ranging from 4060 to 6592. The lowest population is found in Huri hills area and this varies from 1326 to 2570 (Figure 1.3). The proposed seismic survey for oil and gas exploration within Block 10A will be limited to part of Laisamis (currently Marsabit South) and Chalbi (currently Marsabit North) districts within the Mesozoic basin of the Anza graben (Figure 1.2).

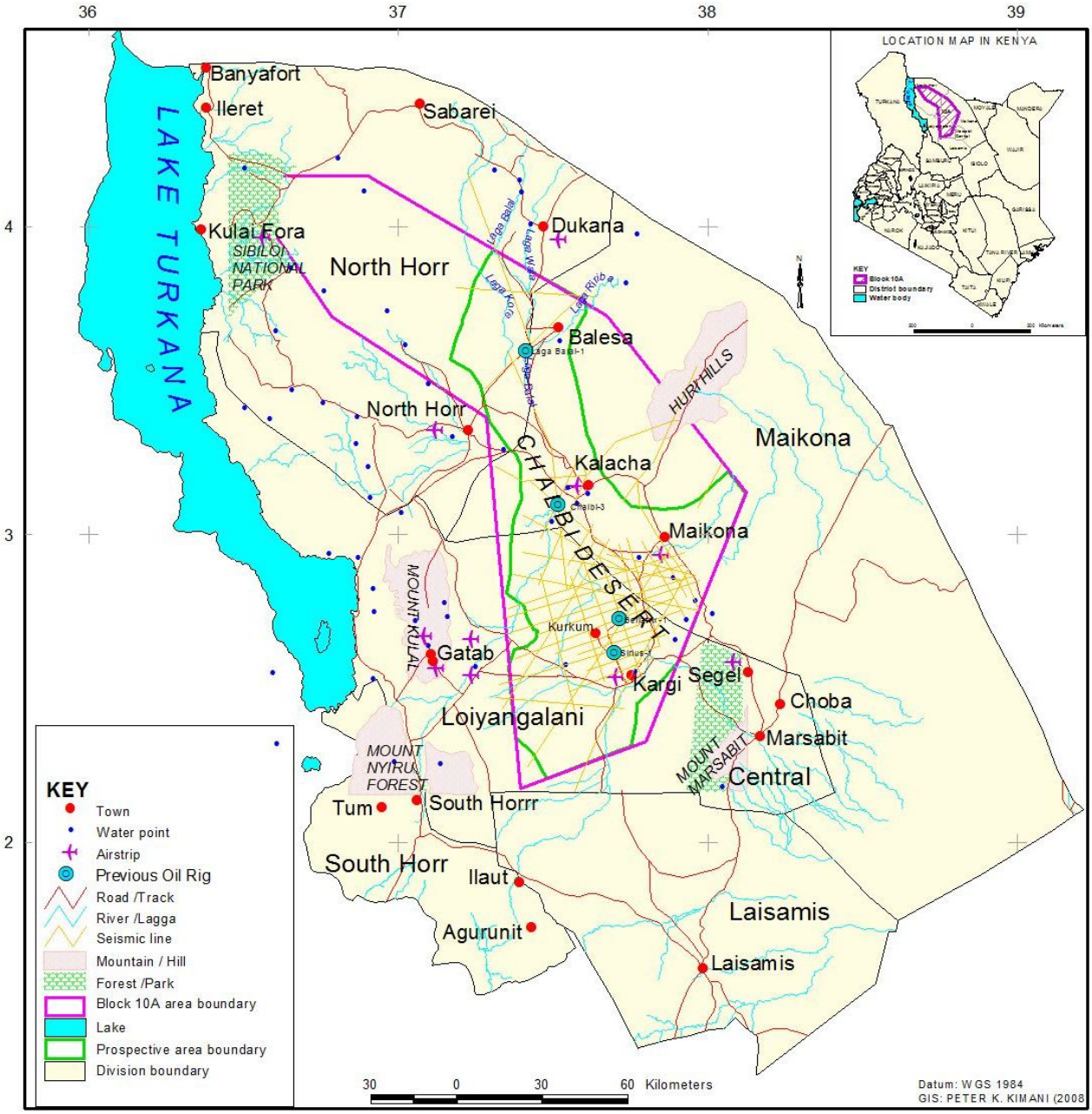

Figure 1.2: District location of the study area

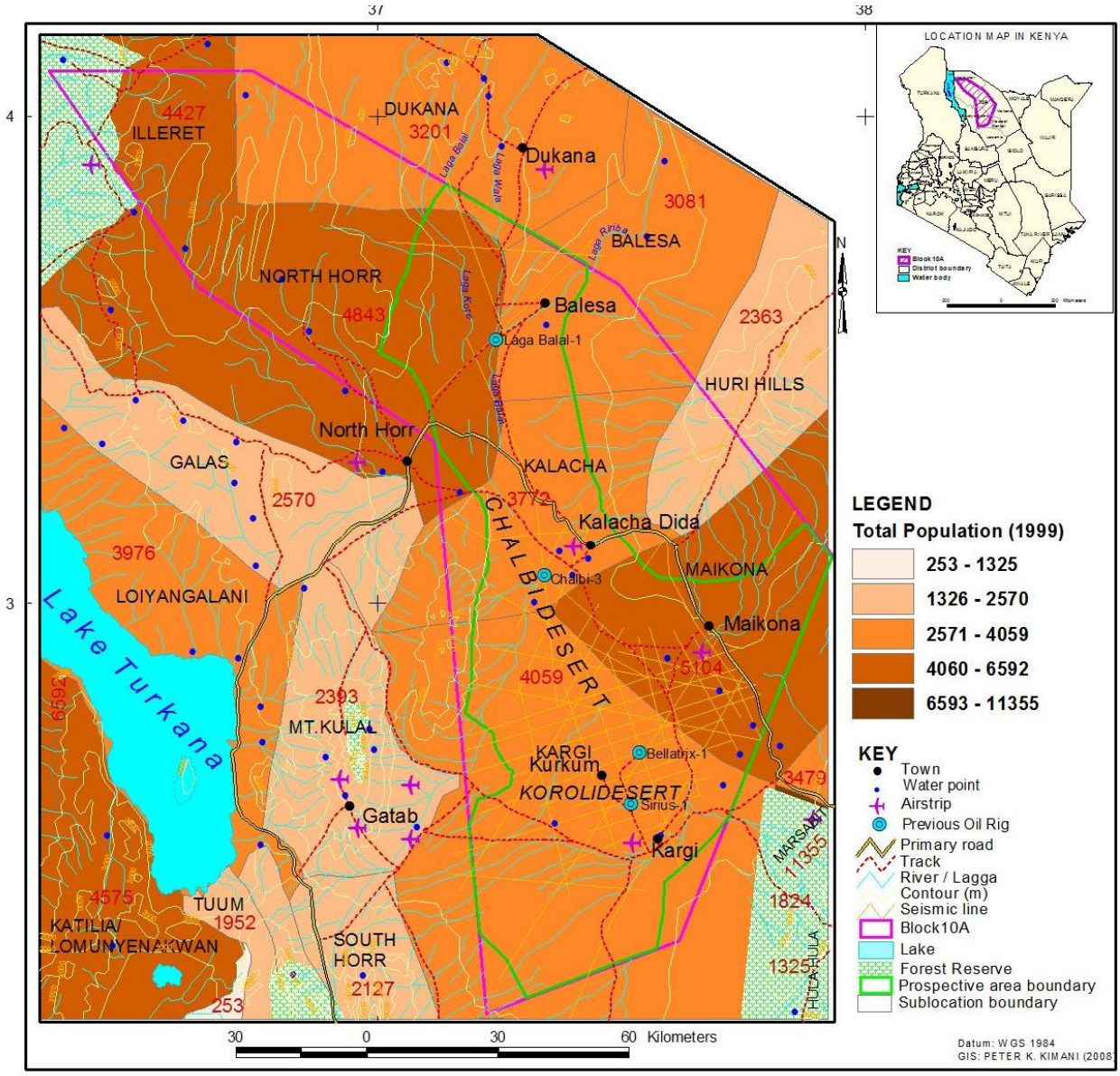

Figure 1.3: Population distribution

1.4 Project Background, Development Rationale and Objectives

1.4.1 Project Background

Lundin Kenya BV ("LKBV") has recently secured a Petroleum Production Sharing Agreement (PSC) from the Government of Kenya for Block 10A. LKBV plans to invest in seismic studies to allow its' geologists and geophysicists identify drillable exploration prospects on Block 10A. An exploration prospect is a structure which has the potential to contain hydrocarbons but which has to be drilled to confirm success. If this exploration drilling is successful in identifying hydrocarbons the discovered resources are added to the country's contingent resource portfolio.

Lundin's main aim and objective over the next four years will be to explore in detail the assigned area of 14,747.57 km^2 (Block 10A in Northern Kenya) to its full potential with the aim of advancing petroleum producing operations within the country. Lundin is committed to ensuring that the petroleum exploration works conducted in the assigned area will benefit the immediate communities as well as have a minimal impact on the environment.

The seismic acquisition project is targeted at acquiring and interpreting 750 line kilometres of 2D seismic data at an estimated cost of about US$ 7 million

1.4.2 Project Rationale

Environmental degradation due to poorly implemented and executed development projects has been a rampant problem in Kenya. Due to this inherent problem, the Kenyan government through a Parliamentary Act harmonised the country's environmental laws under the Environmental Management and Coordination Act (EMCA) 1999, for the purposes of coordinating environmental management through National Environment Management Authority (NEMA). EMCA 1999 makes EIA mandatory for all the projects specified in the Second Schedule of the Act.

The purpose of this project is to prospect for commercially viable oil and gas deposits in Block 10A. The success of this activity will lead to drilling of oil wells and subsequent commercial production of the same. This, if successful, will have a significant positive impact in Kenya's energy sector; will boost the Gross Domestic Product (GDP) and per capita income, and commercial production of the oil and gas, which shall lead to an improvement of the socio-economic well being of the Northern frontier districts and the country in general.

During the initial study and exploratory drilling in the mid and late 80's by the previous operators, potential oil and gas resources were noted to occur in Chalbi-3 and Sirius-1 wells. There is however no information available about the status of oil and gas resources in Lugga Balal well-1 also drilled by the previous operator and Bellatrix-1 well.

1.4.3 Project Justification

The critical role that energy plays as an input to socio-economic development and environmental protection is now universally acknowledged, as it is an important vehicle for income and employment generation and for satisfying basic human needs (GVEP Kenya, 2006). The international community is today confronted with the daunting task of reducing poverty and achieving sustained economic growth and development for the benefit of all. The provision of adequate, quality and affordable energy services can play a decisive role in poverty reduction (GVEP Kenya, 2006).

Kenya has in the past relied on hydroelectric power as the main source of power supply in addition to a limited supply of geothermal power which has not been fully harnessed due to financial constraints. In the past ten years or so, the country has been affected by prolonged periods of drought and this has significantly affected the hydroelectric

power supply which has been erratic and consequently leading to prolonged periods of power rationing impacting the industry and the country negatively. The insufficient hydroelectric power supply has been due to insufficient rainfall as well as deforestation and subsequent erosion in water catchment areas. This has often led to siltation in the hydroelectric reservoirs reducing the volume of water available for storage for hydroelectric power generation.

To improve on the security of energy supply, industries have had to invest in stand-by generators which run on expensively imported diesel, thus pushing the cost of production even higher. The industry sector has thus been faced with costly energy supply which has in part resulted in high production costs. Thus the availability of fossil fuels locally would significantly reduce the energy cost as well as production cost of industries. Following the discovery of hydrocarbons in the Muglad and Melut basins of the South Sudan rifts, several oil companies have intensified exploration efforts in the related Mesozoic and Early Tertiary rift basins of Kenya. Thus the current project, which involves seismic survey for oil and gas, aims at exploring for oil and gas in Block 10A as an alternative source of energy which will help in reducing the cost of energy and over reliance on hydroelectric power and importation of crude oil. If the hydrocarbon prospect in this block is successful, the country stands to benefit from oil and gas exportation to other countries thus increasing the per capita income and the GDP from foreign exchange. In view of the foregoing, Lundin Kenya B.V. has thus been granted exclusive prospecting rights (EPR) and exploration licence in Block 10A to explore oil and gas resources to boost the country's energy supply.

The proposed project would also have a number of positive spin-offs. First, the project will help in opening up the Northern and North-eastern frontier districts of Kenya. This will then lead to the maximum utilization and exploitation of natural resources that abound in this region. The Northern and North-eastern frontier districts are endowed with a lot of potential, especially mineral, tourism, livestock resources and are culturally rich. The government intends to put up deliberate investment programmes that are meant to address the problems of the northern region of Kenya. This is in an effort to bring the region up to the level of the more developed areas of the country. There is also national and international interest in the region as the frontier for development activities in southern Sudan. The region has a high investment potential, with mining, tourism, fishing, agriculture, and animal husbandry being major economic activities that have not been fully exploited. Thus the proposed project is an initial effort to tap into the resource potential of the region and will help in opening up trading opportunities with the neighbouring countries.

Secondly, the project is in an Arid and Semi Arid Land (ASAL) region with minimal socio-economic development activities and inadequate job opportunities. Initially the exploration activities will create job opportunities albeit mostly for non-skilled personnel. The wages to the casual employees will trickle down to the family members and thus to the communities as the lifestyle in the area is still communal. This will help in easing the impacts of endemic poverty in the area. The success of the exploration project will further spur complementary economic and social development in the area. For instance

investors in the transport and communication sector will be encouraged to venture into the area. Regular (mobile and fixed line) telecommunication services in the area are rather poor and only North Horr town has this service. For most of the area, one has to rely on satellite phones and radio communication systems. In addition, transport system is extremely unreliable since there are no public service vehicles in the area and the roads are impassable especially in the rainy seasons.

1.4.4 Objectives

The objectives of the proposed oil and gas exploration project in Block 10A include, but are not limited to the following:

a) To acquire quality data that will be useful in identifying drillable prospects in Block 10A

b) To meet the PSC contractual obligations

In carrying out the above, Lundin shall seek:

c) To identify, evaluate and propose suggested mitigation measures for potential environmental impacts of the proposed project on the various bio-physical and socio-economic structures of the area.

d) To assess and analyse the environmental costs and benefits associated with the proposed project.

e) To outline environmental management plans and monitoring mechanisms during the project execution phase.

1.4.5 Development Partners

No development/investment partners identified at the moment. It is expected however that third party contractors will be engaged

1.4.6 Project Description

Lundin Kenya B.V. (the Company) will engage the services on an internationally-recognised Contractor to perform seismic data acquisition.

Geophysical aims

The purpose of the seismic survey is to detail more precisely the sub-surface structures identified during earlier vibroseis surveys. The primary reference is a NNW-SSE (NW-SE) trending rift system with multiple, tilted fault blocks. The sediment thickness in the

deepest parts of these fault blocks can reach 6,000m with a TWT of approximately 3.0-3.5 seconds.

Figure 1.4 below gives an indication of the structures and data quality which have been achieved in the past. The purpose of the current survey is to improve on this standard.

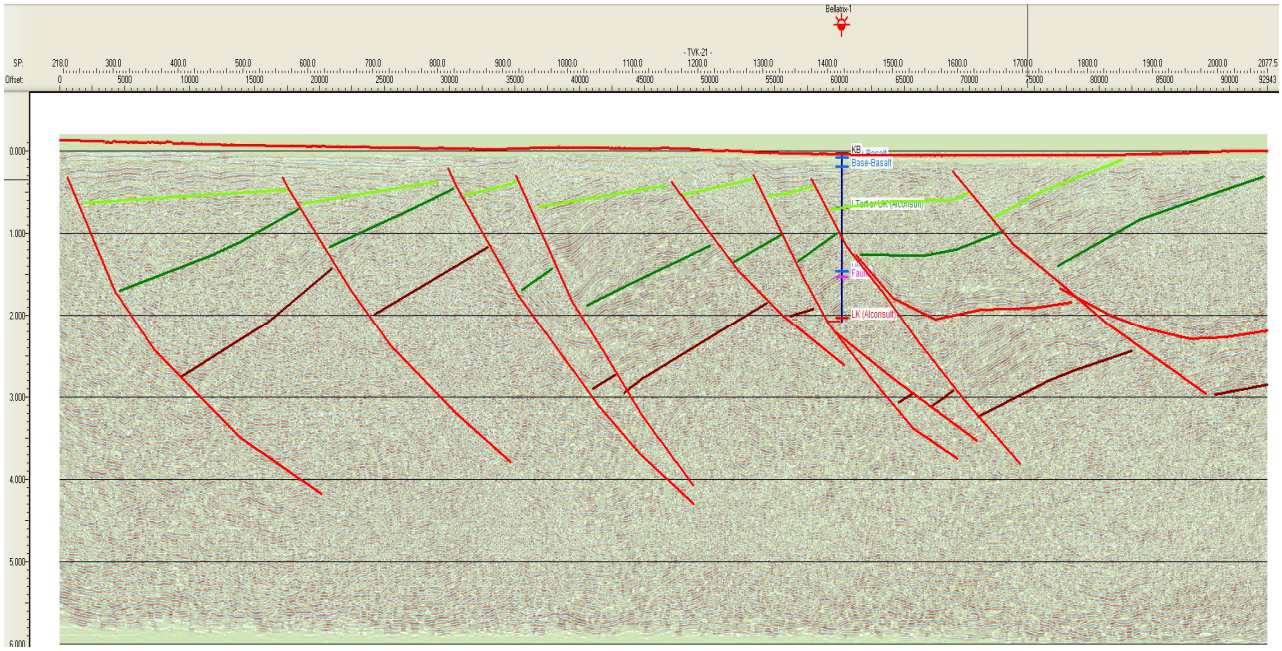

Figure 1.4: Typical Migrated Seismic Section from the 1986 survey

Description of services

The Contractor shall perform the following tasks:

- Acquire a minimum 750km of vibroseis data using the equipment and personnel detailed in later sections.
- Acquire any additional vibroseis data as requested by Company under the terms of the Contract

1.5 Terms of Reference (TOR)

The following Terms of Reference (TOR) apply to the project

- To hold appropriate meetings with the project proponent to establish the procedures, define requirements, responsibilities and a time frame for the proposed project.

- Produce an Environmental impact assessment report that contain among other issues potential negative and positive impacts and recommendation of appropriate mitigation measures to minimize or prevent adverse impacts of the proposed project.

- Carry out a systematic environmental assessment at the proposed project site and the surrounding area following the NEMA regulations and best international practice for an activity of this nature.

- Provide a description of the proposed activities throughout the entire implementation process of the proposed project with special focus on potential impacts to the surrounding environment and the socio-economic fabric of the local communities

- Develop Environmental Management and Monitoring Plan and cost estimates for the proposed project.

CHAPTER 2:

PROJECT DESCRIPTION AND METHODS

2.1 Project Description

Lundin Kenya B.V. is involved in petroleum exploration. The company signed a Production Sharing Contract (PSC) with the Kenya government in October 2007 and obtained an Exclusive Prospecting Right (EPR) for Block 10A. The company was subsequently granted a license for oil and gas exploration within this block to prospect for oil and gas deposits. The current exploration programme will be conducted in the Northern Anza graben which straddles Marsabit south and Marsabit south districts in Kenya. The company, having been granted the exploration licence for the area, has reviewed previous gravity and magnetic data that detected and determined the large-scale features of the sub-surface geology. The company is also reassessing data from exploration drilling done by the previous operators in the mid 1980's within Block 10A.

The proposed seismic survey operation for the purpose of oil and gas exploration within Block 10A will involve the collection of at least 750 line kilometres of 2D seismic data. The seismic survey will be conducted using a Vibroseis energy source which will likely include 6 vibrators, 1 recording truck, up to 3 D8 bulldozers, 6-8 cable geophone/personnel carriers, 1 mechanical service vehicle, 1 fuel truck, 6 light duty vehicles, and one helicopter. The energy source for the survey is Vibroseis. Selected areas of the program, in more rugged areas, may require the use of an explosive source. This however will be avoided if at all possible. In addition, during the current EIA study, the inhabitants were assured that no adverse negative impacts are envisaged as a result of the seismic survey operation. It should be noted that while there are pre-determined seismic line transects based on analysis of existing data as well as available information, the actual locations of the seismic transects may be varied prior to and/or during the seismic data acquisition exercise.

The seismic data acquisition plan is as follows:

- Survey teams will first map out the seismic transects on the ground surface using coordinates of planned seismic lines, taking care to avoid existing infrastructure, manyattas and minimizing any damage to cultivated land, natural water points and pastureland.
- As the seismic survey process requires a good acoustic coupling of energy source and the ground, preferably where there is solid rock outcropping at the surface, the survey transect lines will be cut with the use of bulldozers for the purpose of removing loose boulders, top soil or surface outcrops where feasible with attention to minimizing any damage to the environment.
- Two sets of seismic lines will be acquired: (1) a regional sparse grid with an average distance between individual lines of 20 km, and (2) an "infill" set of lines with individual spacing of 2 to 4 km.
- All seismic lines will have individual widths of 5-8 m. Line clearance, both in terms of width and depth of cut will be kept to an absolute minimum.

A total of approximately 150 staff will be working in the field during the seismic survey operations at any one time. Before commencement of the seismic survey for oil and gas exploration, initial works will entail the setting up of at least one main camp site and a minimum of three remote and temporary “fly” camps within the operational area. These camp sites are yet to be identified and will be established in consultation with the local communities, elders and area leaders.

2.2 Collection of Baseline Data

2.2.1 Overview of Methods

The general framework of the methods of baseline data collection used was as follows:

1. Scaling and scoping (determination of geographical and other boundaries; preliminary assessment) undertaken between 18th and 23rd August 2008.
2. Review of existing regulatory framework and Institutional arrangement.
3. Detailed assessment
4. Impact identification and development of suggested mitigation measures
5. Development of an Environmental Management Plan including costs estimates and responsibility assignment

The field study (detailed assessment, impact identification and development of mitigation measures) was carried out from 16th September to 25th September 2008. GPS co-ordinates were taken and recorded for all the sampling points in the field as shown in Figure 2.1.

Prior to the field study, a preliminary study involving desk-top study was conducted to review the available reports, design plans and maps in order to compile relevant biophysical and socio-economic information of the study area. The biophysical information was then compiled on environmental aspects such as topography, climate, hydrology, drainage, soils, geology/hydrogeology, vegetation and wildlife. The socio-economic environmental study covered information on issues such as population, literacy, healthcare, land use, land tenure, the social dimensions of well being and income levels, water supply, sanitation levels and security among other pertinent issues. Field visits were conducted in the study area in order to collect site specific information on the biophysical and socio economic environment and to cross check the accuracy of the secondary data compiled during the desk-top study. An extensive field visit was made to all areas within Block 10A oil and gas prospect.

2.2.2 Challenges in the Field

- Change in climatic condition affected the team. The area was hot and very windy.
- Language barrier – the team had to get the services of an interpreter to communicate with the public effectively.
- Relatively rough but motorable terrain particularly between North Horr and Dukana. The road is covered by sand deposits or overlaid by basaltic lavas.

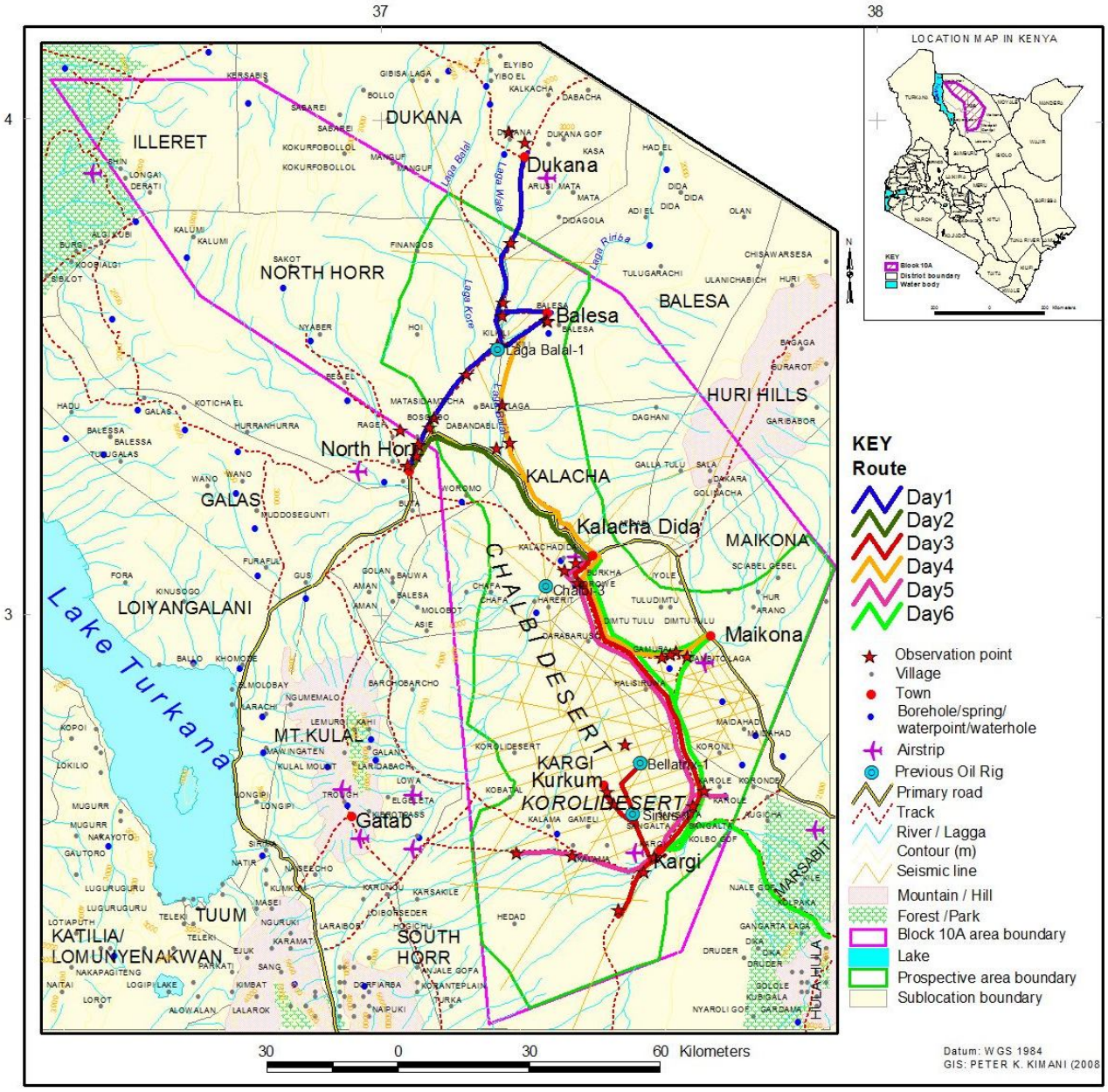

Figure 2.1: Route map for the field survey

2.2.3 Physiography and Geology

A literature review and field verification of the regional physiography and geology of the study area was undertaken and the potential of related hazards such as subsidence, landslides, earthquakes, etc. were assessed in relation to the proposed project activities.

2.2.4 Soils

Primary soil data was obtained using the exploratory soil and agro-climatic zone map and report of Kenya (Sombroek *et al* 1982). Since the scale of the report was 1:1,000,000, it was found necessary to carry out a reconnaissance survey of the area at a scale of 1:50,000 through the use of existing topographical maps, satellite imagery and base maps (supplied by Lundin Kenya B.V. Company) denoting the proposed project site. Field data was collected through visual observation of soil auger points, and mini-pits where necessary to describe the soil mapping units. Soil texture, colour and structure were described to aid in soil classification. Surface physical characteristics were described to determine wind and soil-water erosion hazards, flooding, ponding and water logging potential. Surface stoniness and rockiness was also considered including in areas of agricultural activity. A GPS was used to geo-reference the sampling points. Soil samples were collected for fertility analysis where agricultural activities were noted. At the same time the samples collected would be analyzed for macro mineral elements like Ca and Na in the epipedon that could assist in verifying the observed surface soil morphological characteristics*.* Desktop work included soil map compilation and correlation to assign soil boundaries and harmonize the soil legend.

2.2.5 Winds and Precipitation

Wind and precipitation data was obtained from desktop studies and existing literature from Kenya Meteorological department. In addition, wind data was supplemented by visual observations in the field.

2.2.6 Air

The study area is generally remote, rural and very sparsely populated. Determination of the ambient air quality in this rural setting was assessed qualitatively. Despite the rural setting of this area, it is characterised by strong winds as well as whirlwinds and the air is normally soiled and dusty. This is essentially not in conformity to expected natural background levels for such rural areas.

2.2.7 Water

In order to assess the water potential and quality, a thorough literature review was conducted covering the existing boreholes for physio-chemical analysis. In addition, water samples were collected from boreholes, shallow wells, oasis and springs for physio-chemical analysis. The locations of all sampling points were determined using a Garmin GPS receiver and recorded accordingly.

2.2.8 Terrestrial Environment: Flora and Fauna

Assessment of terrestrial floral and faunal components in the study area was based on field observations and supported by literature review. Considerations included inventories of habitat types and species; vegetation cover and dominance levels;

presence of rare and endangered species; presence of ecological reserves, and any critical ecosystem components. In addition, assessment was done to determine whether the area has experienced any known loss of habitat or biodiversity decline, and whether the proposed operations related to exploration for oil and gas would have any adverse effect on the existing ecosystems, flora, and fauna. The approach employed was through navigation by car aided by GPS coordinates of the study area provided by the proponent. Random stops were made in vegetation transitional zones, areas with unique vegetation settings, animal encounters, settlements and watering points thought to be of interest. Once on the ground a general classification of the area was done using the *Pratt et al* criteria (1966). Key vegetation types were recorded and where possible local names were available they were recorded, in addition both conventional and traditional uses of the tree or shrub was recorded. Species of mammals, birds, reptiles, amphibians, and arthropods present at the time of observation were noted down and identification of particular species confirmed by use of field guide books.

2.2.9 Aquatic Environment

Assessment of the aquatic environment including floral and faunal components in the study area was based on field observations supported by literature review. Considerations included inventories of habitat types and species; vegetation types, and dominance levels; presence of rare and endangered species; presence of ecological reserves, and any critical ecosystem components. In addition, assessment was done to determine whether the area has experienced any known loss of habitat or biodiversity decline, and whether the proposed operations related to exploration for oil and gas would have any adverse effect on the existing ecosystems, flora, and fauna. The approach employed was through navigation by car aided by GPS coordinates of the study area provided by the proponent. Random stops were made whenever an aquatic environment was encountered. Once on the ground a general classification of the area was done, moreover, an inventory of species of mammals, birds, reptiles, amphibians, and arthropods present at the time of observation was noted down and identification of particular species confirmed by use of field guide books.

2.2.10 Land Resources and Natural Heritage Sites

This assessment was based on literature review as well as field observations. The following issues were considered; available renewable or non renewable resources; land degradation and associated risks and contamination; whether land uses at and in the project area could be sustained; whether the operation of the project would have the potential to cause significant land and land use changes; and whether sustainable use of the project sites (base camps and seismic line tracks) can be achieved beyond the project life. Also considered is the sustainable use of the proposed seismic cut lines and the existing road networks after the project decommissioning. In addition to this, an evaluation was done on whether or not there exist archaeological and historical (including cultural) sites in the area that would be affected by the exploration.

2.2.11 Visual Aesthetics

An assessment of visual aesthetics was based on observations in the field. In relation to the seismic survey transect lines, the following issues were considered:- (i) visual and sunlight obstruction in the area; (ii) building structures and conformity to local planning authority; (iii) whether or not the built up environment would be an eyesore and visual obstruction would be an inherent problem to the community; and (iv) whether the proposed camps, access roads and survey transect lines would significantly affect the landscape.

2.2.12 Noise and Vibrations

The noise levels within the study area were measured using a dosimeter during the earlier specified fieldwork period. A considered assessment evaluation of the use of vibroseis equipment related whether or other current, as well as, possible use of limited dynamite charging was undertaken.

2.2.13 Solid Wastes, Waste Oils and Effluents

This assessment was made through observations. Possible impacts from solid wastes and oil wastes generation as a result of the proposed seismic operation were assessed and mitigation measures suggested. Current methods employed in solid wastes and effluent management in the project area was also noted.

Plate 1: Solid waste management challenges at Maikona

2.2.14 Socio-Economics

The methodologies employed include review of available literature, public meetings and consultation with local residents and their leaders. Formal questionnaires and interviews with interested parties and at households level was administered. Public consultation was conducted with the following aims:

- To inform the local people and their leaders about the proposed project and its objectives
- To identify the diverse socio-cultural and economic setups found in the project area
- To gather the concerns and views of the local people on the proposed project
- To establish if the local people foresee any positive or negative impacts associated with the proposed project and if so, how they would like the issues mitigated.

Plate 2: A local resident making his contributions during a public consultation at Maikona on 22nd September 2008

Plate 3: Hon. Chachu (Area MP) making a point during a leaders' consultation session at Kalacha on 20th September 2008

Plate 4: An EIA team member making a point during a public consultation session at Kalacha on 20th September 2008

Plate 5: A public consultation session at Kargi Shopping Centre on 19th September 2008

Plate 6: Residents at a public consultation meeting follow proceedings at Kalacha on 21st September 2008

2.2.15 Health and Public Safety

This assessment was done through literature review of the available health data particularly concerning allegation of increase in oesophagus cancer cases since the decommissioning by the earlier oil exploration companies in the area. Primary data was collected through key informant interviews and observations.

2.3 Data Analysis and Significance Determination

The water samples were taken to the Nairobi based Central Water Testing Laboratories of the Ministry of Water for analysis. Soil samples were taken to the National Agricultural Research Laboratories for soil survey tests.

The criteria for significance determination of the environmental impacts based on the data assessment are as follows:

Score 0 = no known impact	
Score -1 = slight negative impact	Score +1 = slight positive impact
Score -2 = moderate negative impact	Score +2 = moderate positive impact
Score -3 = strong negative impact	Score +3 = strong positive impact

The impacts are further classified as: actual or potential; direct or indirect; short term or long term. Risk levels are classified as low, medium and high.

CHAPTER 3:

BASELINE ENVIRONMENTAL PARAMETERS OF THE STUDY SITE

This chapter provides details of the desktop studies and field survey results which are based on the methods applied in this EIA study as outlined in chapter 2, section 2.2.

3.1 The Study Area

3.1.1 Geographical Aspects and Boundaries

The study area, Block 10A, lies within the former vast Marsabit district of Eastern province in the central part of northern Kenya, to the east of Lake Turkana (Figure 1.1a). It is approximately bound by latitudes 01º 15'N and 04º 27' N and longitudes 36º 03' E and 38º 59' E, and borders Moyale, Turkana, Samburu, Isiolo and Wajir districts in Kenya to the northeast, west, south and east respectively. Marsabit district was recently subdivided into three districts and these include Marsabit South, Marsabit Central and Marsabit North districts, and these covers a total area of approximately 14,747.57 km^2 and are all under one local authority, the Marsabit county council. The oil prospect (Block 10A) straddles both Marsabit South and Marsabit North districts.

3.1.2 Administrative Set-up

The project area lies in the former vast Marsabit district, an administrative unit in Eastern Province that has now been sub-divided into three districts thus: Marsabit Central (Marsabit Town), Marsabit North (Chalbi) and Marsabit South (Laisamis). The district headquarter is Marsabit town with the provincial headqurters located at Embu town. The new districts are already in the formative stages of demarcating their administrative units. Marsabit Central will have its headquarters at Marsabit town, Marsabit North at Maikona while Marsabit South will have its headquarters at Laisamis town. The proposed seismic operations to be undertaken by the proponent will be limited to a large part of Marsabit North and parts of Marsabit South districts.
The larger Marsabit district has three constituencies thus: - Laisamis, Saku and North Horr. The three new districts still have one local authority, the Marsabit County council.

3.1.3 Infrastructure

The road network in the project area is poor with not an inch of bitumen standard road in the former larger Marsabit district. There are murram and earth roads in the project area. These roads are motorable although the earth roads are impassable during rainy season. The main road to the project area is the Nairobi - Isiolo – Moyale highway. The road has bitumen standard up to Isiolo town, however, construction works are currently underway to extend it to Laisamis town. Livestock dealers and small scale business people use this road to transport their wares to and from Nairobi. The project proponent may also use this highway to transport construction and exploration machineries to the area.

Plate 7: State of the road, section of the Dukana – North Horr road

Plate 8:Road condition along Kalacha-North horr

Plate 9: Road condition along Chalbi desert

There are a number of airstrips close to the major towns. Marsabit airport is the airport of choice for larger aircraft as it has a long and tarmaced runway. The airstrip at North Horr (12km west of the town) is in good condition and can handle up to 10 seater planes. Kalacha has an 800m airstrip in town and another larger but disused one about 5km out of town. These airstrips, however, do not have management facilities or offices on site. The table below shows the airstrips found in the project area

Table 3.1: Airstrips in the study area

Town	Coordinate Lat/long (hddd° mm.mmm')	Distance (L x W)	Altitude (m)	Surface	Direction
Kargi	E37° 34.036' N2° 30.234'	650m x 70m	429	Gravel	N - S
Kalacha	E37° 25.602' N3° 08.0680'	800m x 70m	382	Gravel	W- E
	E37° 23.442' N3° 10.3030'	1.07km x 80m	380	Gravel	N - S
	E37°.24.721' N3°.07.223'	750m x 25m	373	Sand	W - E
North Horr	E37° 03.704' N3° 19. 368'	2.03 km x 100m	377	Gravel	N - S
Dukana	E37° 18.050' N3°. 58.751'	1km x 35m	678	Gravel	N - S

N - North S - South E – East W - West

3.1.4 Communication

The project area is poorly served by both land line and mobile telephone technology. Mobile telephony provided by Safaricom is only limited to Marsabit, Laisamis and North Horr towns. Radio and satellite communication can be handy in the project area; however, the cost of operating these types of services may be prohibitive to the local residents.

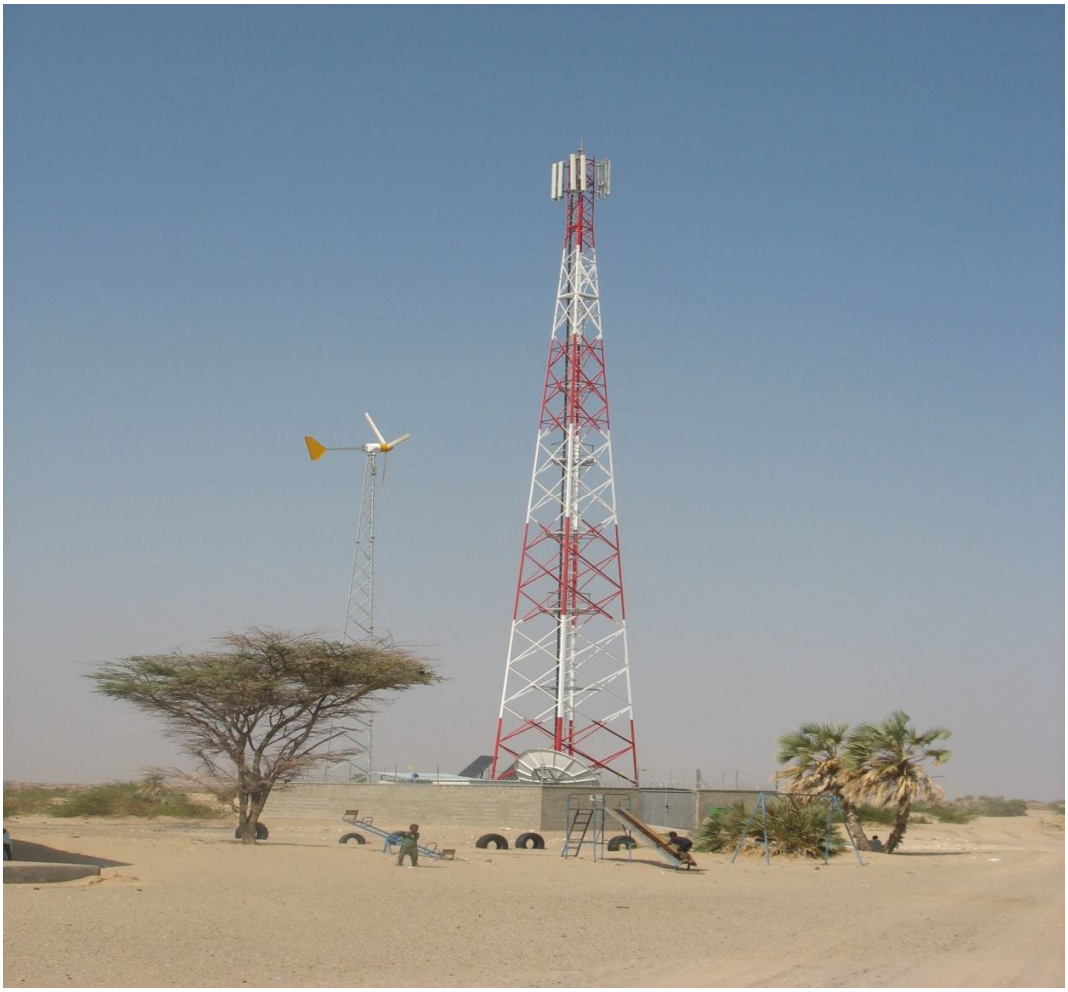

Plate 10: A Safaricom Limited BTS at North Horr.
Note the harnessing of Wind Energy

3.1.5 Governmental, Non-Governmental Organizations, and Aid/Relief Efforts

The project area being in an arid area has several non governmental/ religious based organizations operating within it. These organizations in collaboration with the government assist the community in provision of essential socio-economic and cultural services. Some of the organization that have had a positive impact in the area include:-

1. The Catholic Church

The Catholic Church has had a long relation with the area and supports numerous social amenities in the area besides providing spiritual nourishment to her followers. These services include:

- Supporting health care facilities like dispensaries at North Horr, Kargi and Maikona
- The church supports several primary schools in most of the urban centres

- The church supports childhood nutrition programmes meant for enhancing early childhood education.
- The church trains young people as apprentices in carpentry, mechanics, tailoring and secretarial work among other. This happens for instance at North Horr Catholic Mission.

2. Pastoralists Integrated Support Programme (PISP)

This organization has its headquarters at Marsabit town and supports livestock initiatives in the area. It is involved in livestock health programme, public education on effective livestock management and livestock and livestock products marketing. Its other mandates include:-

- Provision of water resources to the local people for domestic and livestock use
- Basic education support initiatives
- Provision of scholarships to needy secondary school students in the area
- Income generation to support the organization's programmes. The organization currently has two trucks that are used for income generation.
- Micro enterprise support through provision of grants and seed money to women and youth groups
- The organization is also venturing in capacity development through provision of consultancy services. For instance the organization is to implement Lundin's corporate social responsibility projects in the area.
- The organization is also involved in good governance monitoring, peace building initiatives, conflict resolution, and social and public accountability initiatives.

The local people interviewed during our field study acknowledge that the organization has had a positive impact on their livelihoods since rolling out their program's in the late nineties.

3. Solidarities

This organization with the support of DFID has the mandate of supporting sanitation and water supply projects in the area. The organization has constructed pit latrines in area like North Horr, Balesa and Dukana.

4. Community Initiative Facilitation and Assistance (CIFA)

This organization has a geographic coverage of Marsabit and Moyale districts in Kenya and also operates in south Ethiopia. The organization's mandate include:-

- The construction of water facilities like ground and underground storage tanks, rehabilitation of boreholes and construction of shallow wells. The organization is involved in improvement and protection of water catchment areas through capacity building for Water Resources Users Association (WRUA) and Environmental committees.

- The organization facilitates veterinary services for pastoralists and sourcing of markets for livestock and livestock products.
- The organization is involved in initiatives aimed at economic diversification for the local people. This is aimed at cushioning the community from regular drought shocks in the area.
- Peace building initiatives
- The organization is involved in institutional strengthening through capacity building and training.

The local residents acknowledged that this organization has been instrumental in changing livelihoods in the area.

5. African Inland Church (AIC)

The Church has contributed immensely in the provision of health care programmes besides providing spiritual nourishment in the area. Other initiatives the church is involved in are:-

- The Church is harnessing and supplying water resources for domestic and institutional use. For instance the Church has a water borehole assisting the community at Kalacha.
- The church is supporting basic education through sponsoring primary schools at Kalacha and Kargi locations.

The Church has had a positive impact on the residents' livelihoods as witnessed during our field study.

3.2 Physiography and Geology

3.2.1 Physiography

Block 10A can generally be subdivided into six contrasting physiographic provinces (Key, 1987; Key and Watkins, 1988; Charsley, 1987). The mature lowlands occurring in the centre and south are comprised of Korante plain, Hedad, Koroli desert and Chalbi basin, whereas the immature Cenozoic shield volcanoes are found in the north and northeast, southeast and the west. These Cenozoic shield volcanoes include Huri, Marsabit, Kulal and Asie shields respectively (Figure 3.1).

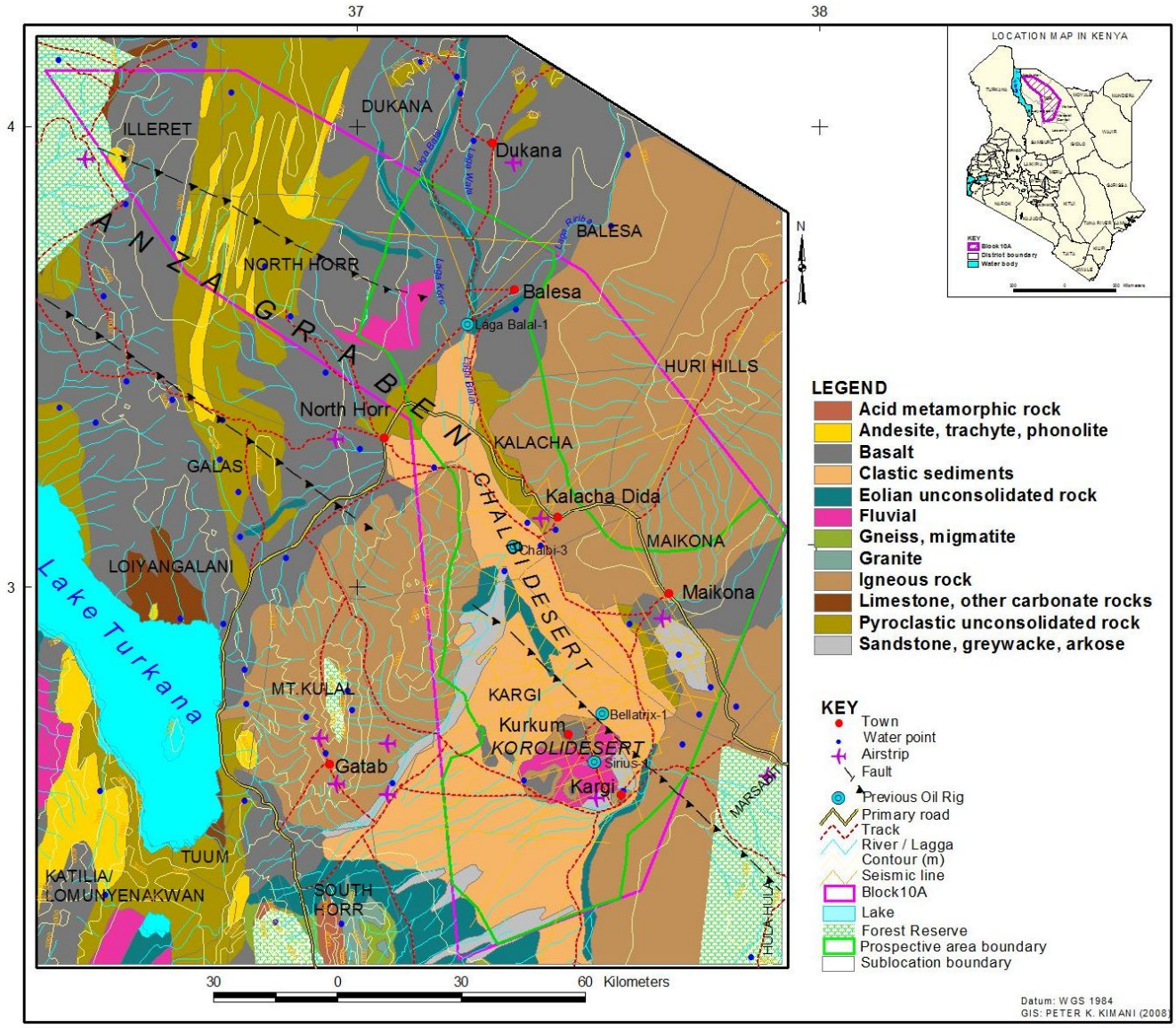

Figure 3.1: Geology of the study area

Further, the Bulal plain between Balesa and Dukana is overlain by basaltic lavas as well as the Dida Galgalla lava plain which occurs in the east and forms a volcanic terrace (the Kalacha terrace) trending in a NNE-SSW direction. The Chalbi desert basin forms a low ground between the volcanic shields and the southward sloping Bulal lava plain (Plates 11 and 12). The physiographic units in Block 10A have variable elevations. The volcanic shields are characterised by elevations exceeding 1350 masl. The elevation of volcanic plains ranges between 400-685 masl. The lowest elevations are found on the plains overlain by Quaternary sediments and recent deposits and these vary between 360-390 m above sea level (masl).

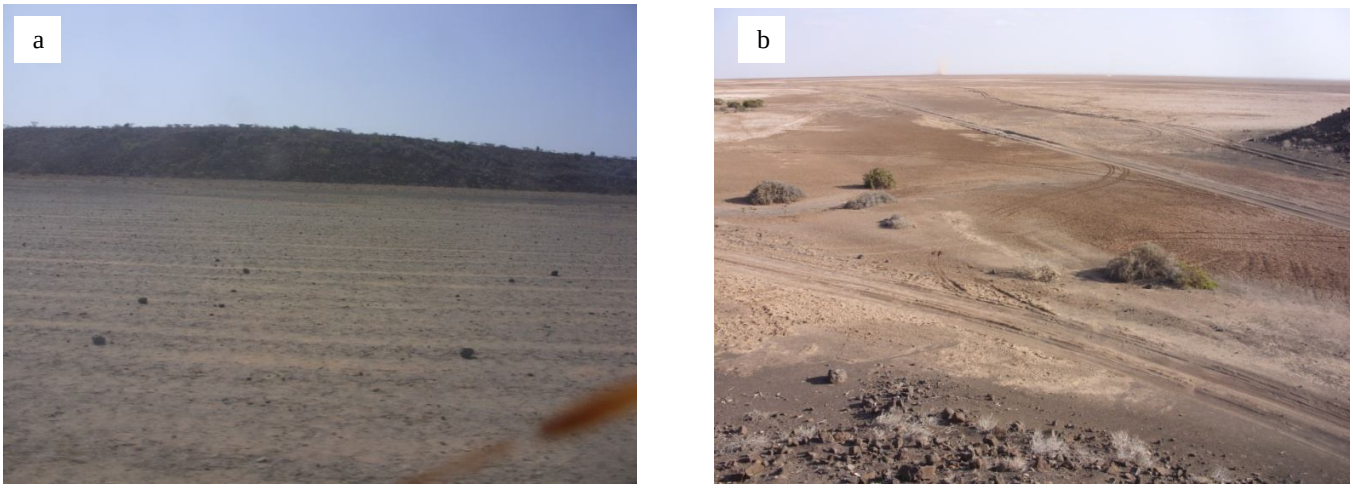

Plate 11a): Kalacha terrace comprised of basalts in the study area and, b) Chalbi desert (Kalacha terrace comprised of basalts

Plate 12: The Bulal plain basalt exposures

3.2.2 Geology and Geological settings

Block 10A is characterised by a cross-cutting Mesozoic basin, the Anza graben. The Anza graben is a component of a continental scale rift system which extends from Sirte basin in Libya, through the Mesozoic basins of Chad and Sudan, to the Lamu embayment in southern Kenya (Bosworth and Morley, 1994). The graben can be divided into two major sectors; the northern and southern Anza grabens. Geophysical and exploratory drilling data demonstrate that the graben extends beneath and trends in a NW-SE direction to the west of the Marsabit Neogene volcanic cone and the immediate north of Garissa, and the basement depth varies between 8-10 km. This sector of the graben is considered to be the southern Anza graben. The northern Anza graben is considered to extend from Lake Turkana to Marsabit (Dindi, 1994). With reference to Mt. Marsabit, the graben can be divided into two physiographic provinces. In the Chalbi desert area to the west and NW of Marsabit, the graben is concealed

beneath Late Tertiary/Recent volcanic rocks and the sub-Miocene Chalbi basin is infilled by various superficial unconsolidated sediments. Outcrops of Miocene sandstone of the late rift-fill are present in this area and the Tertiary lavas may significantly hinder acquisition of good seismic data. Apart from the Tertiary volcanic cover, Block 10A is generally overlain by Quaternary sediments which variably mask the older sedimentary sequence. Where rock exposures occur, the Permo-Triassic, Mesozoic and Precambrian basement rocks comprise the older rock units. The Precambrian rock exposures were, however, noted to occur on hills and Luggas in Korr area (outside Block 10A) where sediment and volcanic cover have been eroded. As stated in the preceding paragraph, several volcanic shields are found in the area and these are the main sources of the widespread cover of basalts within Block 10A. The basalt exposures occur in the whole region except in North Horr area, Chalbi and Koroli deserts where they are overlain by relatively thick sediments and superficial deposits.

Continental sedimentation dominated in most of the Anza basin during the Cretaceous. Bosworth and Morley (1994) have proposed that at least one marine incursion occurred as demonstrated by *Cenomanian* section in the N'dovu-1 well (Bosworth and Morley, 1994). Further, the Sirius-1 well west of Marsabit suggests that rifting was initiated in the northern Anza no later than Early Cretaceous. Only late Cretaceous sediments have been reached by drilling in the central and southern Anza rift and this is attributed to the thickening of the Upper Cretaceous and Tertiary section towards southeast. According Bosworth and Morley (1994), rifting continued in the Anza rift during the Tertiary and a thick sequence (locally in excess of 3000 m) of Paleocene-Miocene fluvial and lacustrine sediments was deposited. Dindi (1994) concurs that the sediment thickness in the northern Anza basin is about 8 km and 10 km as suggested by results of quantitative analysis of gravity and magnetic data respectively. During the early Miocene, a marine transgression deposited carbonates in the Anza rift and this marine sequence is capped by Miocene-Quaternary coarse fluvial deposits. The carbonates were noted during the present study to occur in North Horr and Kalacha areas as indicated in plate 13 below.

a

b

Plate 13: Carbonate rock exposures in (a) North Horr and (b) Kalacha areas.

The risk of potential hazards such as subsidence, landslides, earthquakes, etc. is extremely low or virtually absent. It should however be noted that the risk of earthquake hazard was determined in this study using data from a limited number of seismic stations which are located south of the equator. Hence this statement is not conclusive on the potential of earthquake hazard. Further, there is a potential risk of landslides in form of rock fall, rock slide and slumping especially along Kalacha terrace where basalts are loosely deposited (Plate 11).

3.3 Soils

The soils found in the lacustrine plains (Mapping units PI1, PI2, PI3 and PI4) and sedimentary plains (PS1 PS2 PS3 and PS2 +D1) vary from shallow to very deep, generally with very low to low organic matter content (figure 3.2). The drainage characteristics vary from poorly to moderately well drained in the lacustrine plains and moderately well to somewhat excessively drained in the sedimentary plains. Soil colour in both mapping units varies from pale brown to dark brown. The soils are calcareous, saline and sodic at various thresholds. These soils are susceptible to high wind erosion hazards and local ponding during the wet season. Soils of the sedimentary plains vary from loose powdery like soil with texture that varies from sand to clay loam which is susceptible to wind erosion to surface gravels and pebbles, stones and rocks which may hinder accessibility to certain class of machinery and equipment and agricultural enterprise exploitation. Where saline and sodic conditions exist, the soils exhibit both loose and strongly crusted formation due to sodium and calcium presence respectively. Sand storms are a common occurrence as a result and are responsible for sand dunes formation in adjacent units. Most of the soils classify as lithosols, solonetz, solonchaks, xerosols.

Soils of the footslopes, footridges, lava plateaus and hills (mapping units FV, RV, LV, LsV MV1) vary from imperfectly to well drained, shallow to very deep dusky red to dark brown, gravely, stony, rocky and bouldery at various thresholds, sandy loam to clay texture of various water holding capacity and of low to moderate soil organic matter content (figure 3.2). The soils classify as xerosols, cambisols and regosols. Other soil mapping units' characteristics within Block 10A and its environs have been summarised in table 3.2.

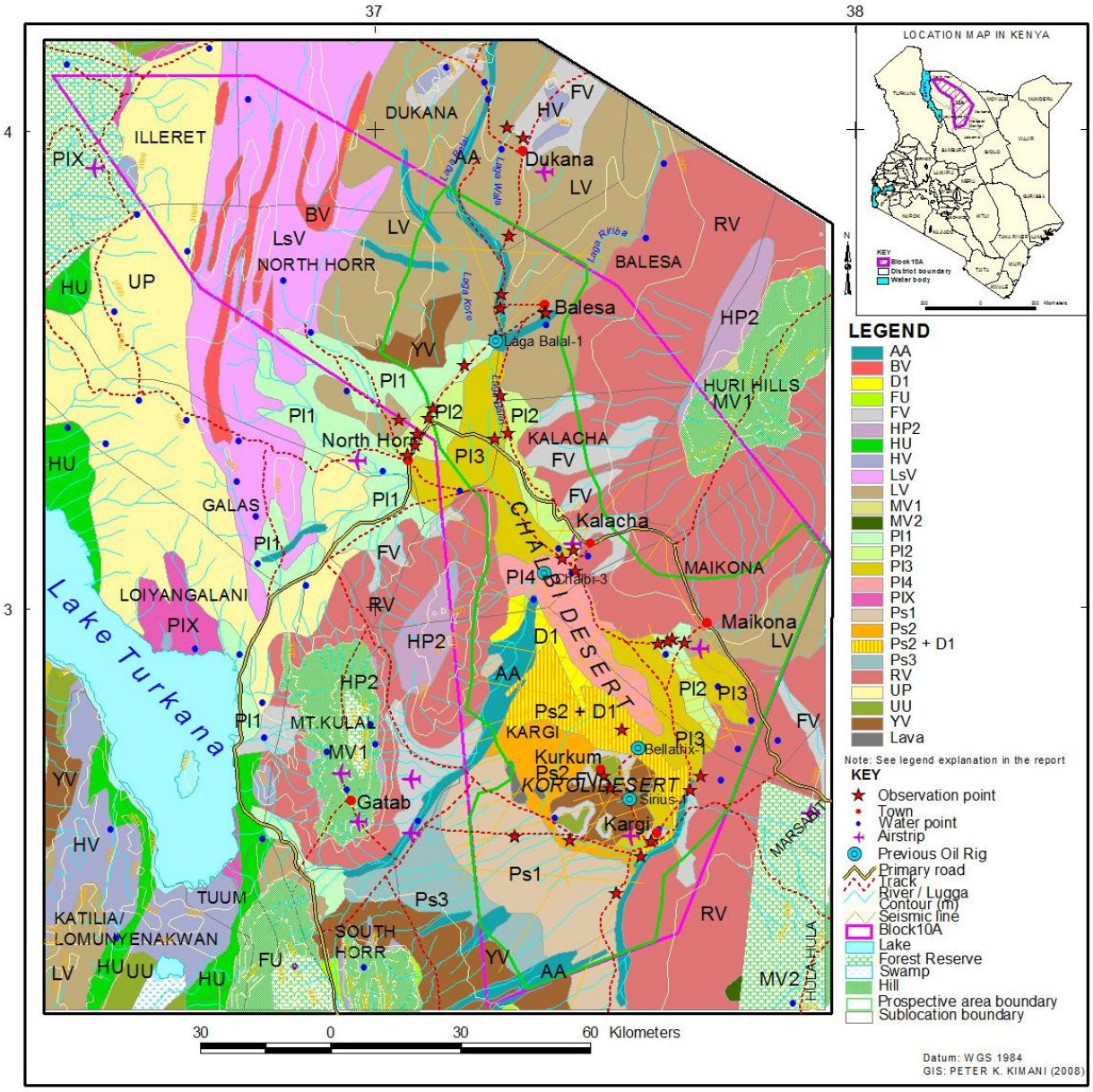

Figure 3.2: Soil map of the study area

Mapping Unit MV1

This unit is Hurri hills, located in the north east border of Block 10A south east of Balesa town. Its geology is undifferentiated volcanic rocks. The landform/topography is of irregular hilly-rolling type (slopes 8-30%). The soils are well drained, very deep to shallow, dusky red to dark reddish brown, locally rocky and stony clay to clay loam. The topsoil conditions are high in organic matter content of high infiltration capacity. Soil water erosion condition classifies as moderate sheetwash and gulley formation. The wind erosion and depositional condition classifies as low.

Mapping Unit LsV

This unit is found in the north west of North Horr town and east of Illeret town within the Block 10A boundary. It extends northwards past Dukana sublocation and southwest of North Horr town to Galas sublocation. Its geology is undifferentiated volcanic rocks. The Landform/topography is stepfaulted plateaus with undulating to rolling topography with inclusions of bottomlands (Mapping Unit BV-Table 3.2 and Figure 3.2). The soils are well drained shallow to moderately deep, dark reddish brown stony and rocky, stoney and bouldery, clay to clay loam. The topsoil conditions are low in organic matter content with moderate infiltration capacity. This unit has a moderate wind and water erosion hazard status.

Mapping Unit LV

This unit is found partly in North Horr township and extends northwards to Dukana sublocation and north westwards to Balesa sublocation. Its Geology is undifferentiated volcanic rocks. The Landform/topography is lava plateaus with very gently undulating topography. The soils are moderately well drained very deep, dark reddish brown locally saline and sodic, calcareous cracking clay. The topsoil conditions are very low in organic matter content with moderate infiltration capacity. In certain areas of this unit especially around Dukana and Balesa towns, surface stones and rocks, predominantly basalts, are abundantly found on the surface. This unit has a moderate to high wind and low water erosion hazard status.

Plate 14: Mapping Unit LV, Dukana area. Note the surface Basalt rocks

Mapping Unit RV

This large unit is found in the eastern and south eastern parts of the study area from Balesa sublocation extending southwards to Kalacha and Maikona sublocations and further southwards towards Marsabit. It is also found west of Chalbi desert past Block 10A boundary. Its geology is olivine basalts and pyroclastics of recent volcanics. The Landform/topography is volcanic footridges with gentle irregular slopes and complex mesorelief. The soils are well to imperfectly well drained, shallow to deep, dark reddish brown, firm, strongly calcareous, clay loam, with stony, rocky and bouldery surface; in many places saline and sodic; with inclusions of recent lava flows. The surface characteristics are low to very low organic matter content with moderate to low infiltration capacity. The erosion condition is moderate to high wind hazard.

Plate 15: Mapping Unit RV, Maikona area. Note the sloppy topography and the mainly basalt rocks on the surface

Mapping Unit FV

This unit forms the footslopes of Mapping unit RV and within the study block it is located in Kalacha sublocation. The same unit is found variously within the general study area (Figure 3.2). Its geology is undifferentiated volcanic rocks mainly basalts. The Landform/topography is footslopes, consisting of undulating slopes of 5%. The soils are well drained, moderate to deep, dark brown to dark greyish brown locally gravely and stony, locally saline, gravely sand to clay loam. The topsoil conditions are low organic matter content and moderate to low infiltration capacity. Soil water erosion condition

classifies as moderate sheetwash and gulley formation. The wind erosion and depositional condition classifies as low.

Mapping Unit YV

This unit is found at the north western tip of the prospecting area north of North Horr town and south west of Balesa town. Its geology is alluvium derived from volcanic rocks mainly basalts with windblown deposits. The Landform/topography is piedmont plains, consisting of almost flat slopes. The soils are well to somewhat excessively drained, moderately deep to deep, yellowish brown, moderately saline and sodic, fine gravely sandy loam to clay loam. The topsoil conditions are low fertile soils of moderate to high infiltration capacity. The erosion condition is low water and moderate wind hazard and none to occasional flooding and ponding in the wet season.

Mapping Unit PS1

This unit is found at the southern tip of the prospecting block, southwest of Kargi town straddling the Kargi-Laisamis road. Its geology is undifferentiated sediments mainly from basement system rocks. The Landform/topography is sedimentary plains, consisting of almost flat, to very gently undulating meso relief. The soils are somewhat excessively to imperfectly drained, very deep to shallow reddish brown to brown, moderately calcareous, slightly saline and strongly sodic, sandy clay loam to clay. The top soils are moderate in organic matter content and of high to moderate infiltration capacity. The erosion condition is high wind erosion and deposition and low to moderate sheet water erosion. Occasional ponding and flooding occurs in wet seasons.

Plate 16: Mapping Unit PS1, Rilma area Near Kargi.
Note the chromic soil colour

Mapping Unit PS2

This unit is found south west of Chalbi desert in Kargi sublocation of Marsabit South district. Its geology is undifferentiated basement system rocks with admixture of sediments from olivine basalts and possibly old lacustrune deposits. Its landforms/topography is middle level sedimentary plains consisting of very gently undulating slopes with small dune ridges with inclusions of lava flows. The soils are imperfectly drained, deep brown to dark brown, moderately calcareous, slightly saline and excessively sodic, sandy clay loam to clay. The topsoil conditions are *moderate* to low organic matter content, of low infiltration capacity. Undulating meso relief due to water, and wind erosion forms interfluves in between *Acacia mellifera* bushes. The unit suffers from slight to moderate sheet and gully erosion and high wind erosion and is susceptible to local ponding in wet seasons.

Plate 17: Mapping Unit PS2, mid of Gatab and Kargi.
Note the gulley forming due to the sodic nature of the soil

Mapping Unit PS3

This unit is found in the southern tip of the prospecting block extending north-westwards between South Horr sublocation and Gatab town. Its geology is undifferentiated basement system rocks. Its landform/topography is middle level sedimentary plains consisting of almost flat to very gently undulating slopes. The soils are somewhat excessively drained, to moderately well drained, very deep, reddish brown locally saline, loamy sand to sandy clay loam. The surface conditions are low organic matter content with variable infiltration capacities. The erosion condition is low to moderate sheet wash and moderate to high wind erosion.

Mapping Unit PS2 +D1

This unit is found south of Chalbi desert and north of Kargi sublocation. It is a complex of soils of units PS2 and D1

Plate 18: Mapping Unit PS2 + D1, near Kargi. Note the contrasting topography of nearly level sedimentary plains in the middle and dunes on the foreground and background

Mapping Unit PI1

This unit is found around North Horr and south of Maikona town and is part of Chalbi desert. Its geology is lake bed deposits (Chalbi) consisting of pyroclastics and olivine basalts sediments. The Landform/topography is lacustrine plains, consisting of almost flat topography. The soils are well drained, very deep, pale brown, saline, fine gravely sandy loam with locally gravel beds. The topsoil conditions are very low organic matter content with moderate infiltration rates. The erosion condition is low to moderate water erosion and high wind erosion.

Plate 19: Mapping Unit PI1, near North Horr. Note the gravel bed in the mid-ground and the surface pyroclastics of various origins (foreground).

Mapping Unit PI2

This unit is found north of North Horr town and around Kalacha town and in part of Chalbi desert south of Maikona. Its geology is lake bed deposits (Chalbi) consisting of limestone sediments. The Landform/topography is lacustrine plains, consisting of almost flat to very gently undulating topography. The soils are moderately well drained shallow to moderately deep, pale brown saline sandy loam with calcrete outcrops. The topsoil conditions are surface pebbles, surface crusts, low organic matter content and moderate infiltration rates. Local dunes (an inference to high wind erosion and deposition) have formed around *Salvadora persica* bushes, South of Maikona. The unit around North Horr and Elgade is excessively calcareous and thus locally barren. The general erosion condition is low water erosion and locally high wind erosion. Around North Horr and Elgade township, the erosion condition is moderate to high gully and high wind hazard.

Plate 21: Mapping Unit PI2, Elgade area. Note the irrigation basins (foreground) and near barren vegetation.

Plate 20: Mapping Unit PI2, Maikona area. Note the Salvadora persica vegetation in the unit.

Mapping Unit PI3

This unit forms the north eastern and south western sections of the Chalbi desert and is also located in the south west of Maikona near the airstrip bordering the LV mapping unit. Its geology is lake bed deposits (Chalbi) consisting of sediments from various sources. The Landform/topography is lacustrine plains, consisting of flat topography. The soils are poorly drained very deep, brown to olive grey friable to firm, moderately calcareous, moderately saline, strongly sodic loam to clay loam, in places gypsiferous, with common low sand dunes. The topsoil conditions are local surface crusts, locally gravely, very low organic matter content of low to moderate infiltration rates. The erosion condition is high wind erosion and deposition hazard.

Plate 22: Mapping Unit PI3, Note the greyish soil colour, surface gravels and the sand dune forming in the background.

Mapping Unit PI4

This unit is the lower Chalbi desert. Its geology is lake bed deposits (lower level -Chalbi) consisting of sediments from various sources. The Landform/topography is lacustrine plains, consisting of flat topography. The soils are very poorly drained deep, greyish brown firm, excessively saline, cracking clay with a crusted and puffed up saline surface. The topsoil conditions are very low organic matter content of low to moderate infiltration rates. Strong and firm surface crusts with salt crystals form on the surface. The erosion condition is high wind erosion and deposition hazard. Ponding is high during the wet season.

Plate 23: Mapping Unit PI4, in the mid of Chalbi. Note the greyish soil colour, crusted and puffed up saline surface

Mapping Unit AA

This unit is found in Balesa sublocation and traverses northwards to Dukana sublocation. It is also situated south east of Chalbi past the south eastern border of Block 10A. The unit is also located south west of Kargi town past the southern border of Block 10A. Its geology is recent riverine alluvium. The Landform/topography is riverine (flood) plains, consisting of almost flat topography. The soils are well to imperfectly drained, very deep, dark reddish brown to pale brown, locally saline, stratified, micaceous, fine sandy loam to loam. The topsoil conditions are moderate organic matter content, of moderate infiltration capacity. The erosion condition is low water and moderate wind erosion hazard. There is the hazard of frequent local flooding and ponding in the wet season.

Plate 24: Mapping Unit AA . Riverine flood plain Near Balesa. Note the erosive effect on the surface with local undulating meso relief and the riverine vegetation on background

Mapping Unit D1

This unit is found in the southeast of Chalbi desert. Its Geology is windblown deposits of undifferentiated sources. The landform/topography is dunes consisting of undulating to rolling relief, with short slopes. The soils are excessively to poorly drained, very deep, locally shallow, dark reddish brown to dark brown loose, saline-sodic, locally calcrete, and loamy sand to sandy loam. The topsoil conditions are very low organic matter content with variable infiltration capacities. The unit has high wind erosion condition.

Other mapping Units

Other mapping units within the general area are: HU HP2, UU, UP, FU, BV and PIX. These units are however located outside the prospecting area and have not been described during the field trip. However, reference to the same can be made in the summarised data in Table 3.2 in tandem with the soil map figure 3.2

Table 3.2 : Soil Properties of other Mapping Units within the environs of the study area

Map unit symbol	Major landforms	Predominant geology and parent material	Topography; predominant slope %	Erosion hazard		Hazard of flooding, Ponding in wet season	Soil Properties							
				Water erosion sheet & gully	Wind erosion & deposition		Drainage class	Soil depth	Colour	Salinity, sodicity	Rockiness, stoniness	Texture	Infiltration capacity of surface soil	Topsoil organic matter content
BV	Bottom - lands	Alluvium & colluvium from volcanic rocks	Very gently sloping < 2%	Low	Low-Moderate	Locally ponding	Moderately well drained	Very deep	Yellowish brown	Locally saline	Calcrete gravel	Sandy clay loam	Moderate	Low
HP2	Hills	Pyroclastic rocks	Gently undulating highlands with small isolated hills	Low, moderate	Moderate	None	Well-somewhat excessively drained	Moderately deep	Brown	Nil	Locally stony & gravelly	Fine gravelly sandy clay loam	High-moderate	High-moderate
HU	Hills	Basement system rocks	Irregular steep slopes. Variable	High	None	None	Well drained	Shallow	Dark brown-dark reddish brown	Nil	Rock outcrop; stony & bouldery	Sandy clay loam-sandy loam	Variable	Moderate
PIX	Lacustrine plains	Lake-bed deposits (Turkana)	-Very gentle slope - Badland topography	Low, High	Low-moderate	None	Somewhat excessively drained, Excessively drained	-Very deep -Shallow	Pale brown	Locally saline	-None -Locally rocky	Sandy loam	High-low	Very low
UP	Uplands	Pyroclastic rocks	Undulating – rolling. Convex slopes of 2-16%	Low	Low	Occasional at lowest level	Well-somewhat excessively drained	Moderately deep-shallow	Brown	Locally saline	Excess. Gravelly at surface	Very gravelly clay loam	Low	Very low
UU	Uplands	Undifferentiated Basement system rocks	Undulating-gentle undulating 2-8%	High sheet	Moderate	None	Well drained	Shallow-moderately deep	Dark reddish brown	Nil	Gravelly	Sandy clay loam-sandy loam	Low-very low	Very low
Lava	Lava flows	Basalts	Almost flat; irregular mesorelief	None	None	None	Well drained	Locally deep	Dark reddish brown	Locally saline	Extremely rocky & bouldery	Pockets of clay loam	Moderate	Very low

3.3.1 Soil fertility sample results for selected agricultural schemes in the study area

Kalacha irrigation scheme

The soils have very high values of calcium, magnesium, electrical conductivity and sodium. The soil pH is too alkaline for crops' growth. Nitrogen, phosphorous and organic matter content are all low (soil sample MK010, Table 3.3). To improve on the soil chemical condition to support crop growth, the alkali soils should be amended by the application of elemental sulphur at the rate of 400 kg/acre. Irrigation and appropriate drainage of the cropland should follow immediately to first, get water into the soil and to drain excess salts. This should be done 4 weeks before planting. To amend the deficient nutrients in the soil, the application of DAP fertilizer at the rate of 150 kg/acre is recommended to augment phosphorous and nitrogen. In addition, 4 tons/acre of well decomposed manure or compost should be added to the soil to increase the organic matter.

Agricultural site at Elgade

The soils have very high values of calcium, electrical conductivity and sodium. The soil pH is too alkaline for crops' growth. Nitrogen, phosphorous and organic matter content are all low (soil sample MK008, Table 3.3). To improve on the soil chemical condition to support crop growth, the alkali soils should be amended by the application of elemental sulphur at the rate of 400 kg/acre. Irrigation and appropriate drainage of the cropland should follow immediately to first, get water into the soil and to drain excess salts. This should be done 4 weeks before planting. To amend the deficient nutrients in the soil, the application of DAP fertilizer at the rate of 150 kg/acre is recommended to augment phosphorous and nitrogen. In addition, 4 tons/acre of well decomposed manure or compost should be added to the soil to increase the organic matter. Since availability of water is a challenge for this site, it may not be feasible for agricultural enterprise.

3.3.2. Soil fertility status of selected mapping units

Mapping unit LV

The soil pH, is too alkaline for crop growth. Nitrogen, Organic carbon and phosphorous are deficient while potassium and calcium are adequate in the soil. Magnesium is high (soil sample MK003, Table 3.3)

Mapping Unit PS1

The soil pH is too alkaline for crop growth. Nitrogen and organic carbon are deficient. Phosphorous, potassium and calcium are adequate in the soil, while magnesium is high (soil sample MKS005, Table 3.3)

Mapping Unit PS2
The soil pH is too alkaline for crop growth. The soil has very high values of calcium, electrical conductivity and sodium. This is a saline and sodic soil. Soil nitrogen, phosphorous and organic carbon are low while potassium and magnesium are adequate (soil sample MKS013, Table 3.3)

Mapping Unit PS2 +D1

The soil pH is extremely alkaline for crop growth. Nitrogen, organic carbon and phosphorous are deficient. Soil calcium, magnesium and sodium are high while potassium is adequate (soil sample MKS012, Table 3.3).This unit is saline and sodic.

The Amoco drilling site at Kurkum (figure 3.2) is found in this mapping unit. A Local soil sample and a white clayey substance used to cool drill bits by Amoco while drilling, was collected adjacent the well. Results indicate the clayey white material is extremely alkaline (pH 9.09). This is the highest pH value of all the sites sampled. The material also contains high levels of calcium, magnesium, electrical conductivity and sodium (soil sample MKS006 Table 3.3). However nitrogen, organic carbon and phosphorous are low, while potassium is adequate. Consequently the material is extremely saline and sodic and cannot support any crop growth. The substance washed over grazing land may inhibit grass growth. This could be the reason the locals say that the substance is a health hazard. Contrary to the clayey substance, the soil near the Amoco site is strongly alkaline and is deficient in nitrogen, phosphorous, potassium and organic carbon. Soil calcium, sodium and magnesium are adequate. The soil can support salt tolerant grasses and plants and with amendment the soil can support crop life.

Mapping Unit PI1

The soil pH is too alkaline for crop growth. Nitrogen, organic carbon and phosphorous are deficient. Soil potassium, sodium and calcium are adequate wile magnesium is high (soil sample NHS 001, Table 3.3). With amendments the soil can support agriculture.

Mapping Unit PI2

The soil pH is too alkaline for crop growth. Nitrogen, organic carbon and phosphorous are deficient. Soil potassium, sodium and calcium are adequate to high while magnesium is high (soil sample NHS 002 and MMS 009 Table ---). With amendments, soil sample NHS 002, (Mapping unit PI2 near North Horr – Figure 3.2), can support agriculture. The same unit South of Maikona is saline and sodic.

Mapping Unit PI3

The soil pH is too alkaline for crop growth. Nitrogen, organic carbon and phosphorous are deficient. Soil potassium, sodium and calcium are adequate to while magnesium is high (soil sample MKS 014, Table 3.3). With amendments the soil can support agriculture.

Mapping Unit PI4

The soil pH is too alkaline for crop growth. Nitrogen, organic carbon and phosphorous are deficient. Soil potassium is adequate while calcium, sodium and magnesium are high (soil sample MKS 011, Table 3.3). The soil is saline and sodic.

Mapping Unit AA

The soil pH is too alkaline for crop growth. Nitrogen, organic carbon and phosphorous are deficient. Soil potassium and calcium are adequate, while magnesium is high (soil sample NHS 002, Table 3.3). With amendments the soil can support agriculture.

Table 3.3 : Soil sample results for selected sites in the study area

	Soil Analysis data							
Field number	NHS 001		NH 002		NH003		NH004	
Lab No/2008	2132		2133		2134		2135	
Soil depth cm	0-20		0-20		0-20		0-20	
Fertility results	value	Class	value	class	value	class	value	Class
Soil pH	8.47	Medium alkaline	8.23	Medium alkaline	8.44	Medium alkaline	8.77	Strong alkaline
Total Nitrogen %	0.02	Low.8	0.03	low	0.01	low	0.02	low
Org. Carbon%	0.25	Low	0.33	low	0.16	low	0.02	Low
Phosphorus ppm	2.5	Low	3.1	low	2.0	low	3.0	Low
Potassium me%	0.63	adequate	0.38	adequate	0.52	adequate	0.78	Adequate
Calcium me%	15.1	adequate	11.2	adequate	10.0	adequate	11.6	Adequate
Magnesium me%	7.32	High	4.44	high	6.75	high	5.33	High
Manganese me%	0.01	Low	0.01	low	0.27	adequate	0.01	Low
Copper ppm	3.1	Low	13.3	adequate	1.8	adequate	0.9	Low
Iron ppm	77.9	adequate	89.9	adequate	97.1	adequate	3.20	Low
Zinc ppm	3.8	Low	17.0	adequate	2.3	low	0.30	Low
Sodium me%	1.85	adequate	1.36	adequate	1.24	adequate	1.32	Adequate
Elec. Cond mS/cm	0.70	adequate	0.60	adequate	0.50	adequate	1.50	High

	Soil Analysis data							
Field number	MKS 005		MKS 006		MKS 007		MKS 008	
Lab No/2008	2136		2137		2138		2139	
Soil depth cm	0-20		0-20		0-20		0-20	
Fertility results	value	Class	value	class	value	class	value	Class
Soil pH	7.60	Medium alkaline	9.09	extreme alkaline	8.73	Strong alkaline	8.55	Strong alkaline
Total Nitrogen %	0.03	Low	0.01	Low	0.01	Low	0.02	Low
Org. Carbon%	0.30	Low	0.15	Low	0.13	Low	0.30	Low
Phosphorus ppm	11.0	Adequate	3.5	Low	2.0	Low	1.5	Low
Potassium me%	1.00	Adequate	0.28	Adequate	0.20	Low	0.32	Adequate
Calcium me%	3.2	Adequate	35.2	High	10.0	adequate	20.8	High
Magnesium me%	4.14	High	3.84	High	2.08	Adequate	5.59	High
Manganese me%	0.44	Adequate	0.34	Adequate	0.04	Low	0.01	Low
Copper ppm	0.9	Low	18.3	Adequate	0.6	Low	0.3	Low
Iron ppm	48.8	Adequate	70.7	Adequate	33.7	adequate	2.00	Low
Zinc ppm	0.1	Low	3.3	Low	0.1	Low	0.4	Low
Sodium me%	0.14	adequate	4.78	High	1.32	adequate	2.72	High
Elec. Cond mS/cm	0.24	adequate	1.30	high	0.24	adequate	0.70	Adequate

	Soil Analysis data							
Field number	MMS 009		MKS 010		MK 011		MK 012	
Lab No/2008	2140		2141		2142		2143	
Soil depth cm	0-20		0-20		0-20		0-20	
Fertility results	value	Class	value	class	value	class	value	Class
Soil pH	8.19	Medium alkaline	8.18	medium alkaline	8.23	Medium alkaline	9.33	extremely alkaline
Total Nitrogen %	0.02	Low	0.17	Low	0.02	Low	0.02	Low
Org. Carbon%	0.11	Low	0.76	Low	0.39	Low	0.28	Low
Phosphorus ppm	3.3	Low	8.2	Low	5.7	Low	3.6	Low
Potassium me%	2.41	High	1.61	high	1.37	Adequate	0.60	Adequate
Calcium me%	46.8	High	36.8	High	197	High	57.8	High
Magnesium me%	5.82	High	9.20	High	5.34	High	5.83	High
Manganese me%	0.01	Low	0.01	Low	0.01	Low	0.27	Adequate
Copper ppm	0.3	Low	0.3	Low	0.8	Low	0.6	Low
Iron ppm	2.5	Low	2.1	Low	9.3	Low	63.5	Adequate
Zinc ppm	0.3	Low	0.4	Low	0.1	Low	0.4	Low
Sodium me%	5.38	High	4.38	High	19.9	High	7.58	High
Elec. Cond mS/cm	6.50	High	4.00	high	105.0	high	2.20	High

	Soil Analysis data							
Field number	MKS 013		MKS 014					
Lab No/2008	2144		2145					
Soil depth cm	0-20		0-20					
Fertility results	value	Class	Value	class				
Soil pH	8.24	Medium alkaline	8.19	medium alkaline				
Total Nitrogen %	0.03	Low	0.03	Low				
Org. Carbon%	0.30	Low	0.21	Low				
Phosphorus ppm	3.1	Low	2.1	Low				
Potassium me%	0.50	Adequate	1.00	Adequate				
Calcium me%	34.4	High	7.8	Adequate				
Magnesium me%	2.31	Adequate	3.34	High				
Manganese me%	0.10	Low	0.10	low				
Copper ppm	0.6	Low	0.2	Low				
Iron ppm	12.5	Adequate	3.2	Low				
Zinc ppm	1.5	Low	0.3	Low				
Sodium me%	4.28	High	0.68	adequate				
Elec. Cond mS/cm	4.00	High	1.80	high				

3.4 Climate

Block 10A is characterized by two types of climatic conditions; the tropical savanna which is typically dry and wet, and the arid and semi arid climatic condition which is generally hot and dry. The areas around Marsabit, Mt. Kulal (slightly outside Block 10A) and Huri hills (partly within the block) generally lie within the tropics and the climate is typically of tropical savanna and is characterized by vegetation of various tree species and grassland. The mean annual rainfall is approximately 600 mm. During the dry season, the temperature ranges between 30 – 37^{o}C while in the wet season, the temperature ranges between 20-25 ^{o}C. The highest temperatures are experienced in the month(s) of August/September and may often exceed 37^{o}C while the lowest

temperatures are experienced in the months of November and December (Sombroek et al., 1982).

The rest of the area within Block 10A falls within the arid and semi arid climatic conditions characterized by harsh climatic condition for most of the year and the vegetation cover is relatively sparse and stunted or completely lacking such as in the Chalbi and Koroli deserts. The mean annual rainfall for the arid and semi arid zones ranges between 300-550 mm, but may significantly be lower ranging between 150-350 mm annually for the very arid zones. The relative humidity is very low. The rainfall distribution is bi-modal for the two types of climatic conditions, but extremely variable and unreliable and famine is a constant threat. The long rainy season is between the months of March to May with a peak in April, while the short rainy season is from the month of October to December with a peak in November (Sombroek et al., 1982).
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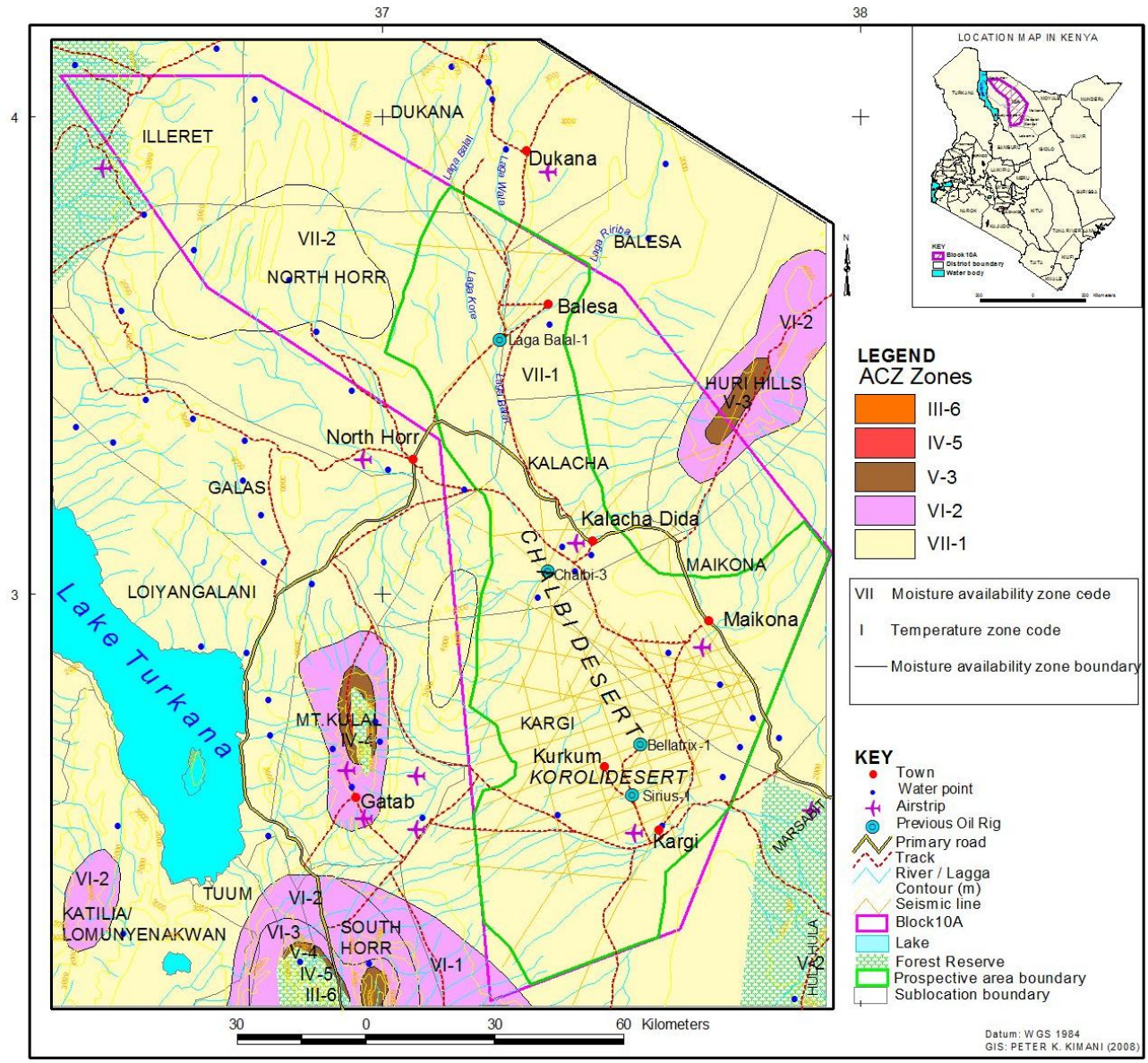


Figure 3.3: The agro-climatic zones of the study area.

3.5 Air Quality

The study area is sparsely populated, undeveloped and more or less in a rural setting far from major towns, cities, agricultural and industrial centres that are the major contributors of air pollution. Despite this, the area is arid and semi-arid, is characterized by strong winds and whirlwinds due to the sparse vegetation or absence of vegetation cover to block the winds. As a result of the strong winds and whirlwinds in such arid and semi-arid zones, dust and soils are continuously blown from one area to another and this has resulted in formation of sand dunes and dust deposits (Plate 25). This is the significant contributor of natural particulate air pollution in the area.

Plate 25: Sand dune (Barchan) in North Horr area and Whirlwind in Chalbi desert.

Some few areas have relatively thick vegetation cover and tree canopy which play a crucial role in blocking the strong winds and filtering windblown sand and dust (Plate 26).

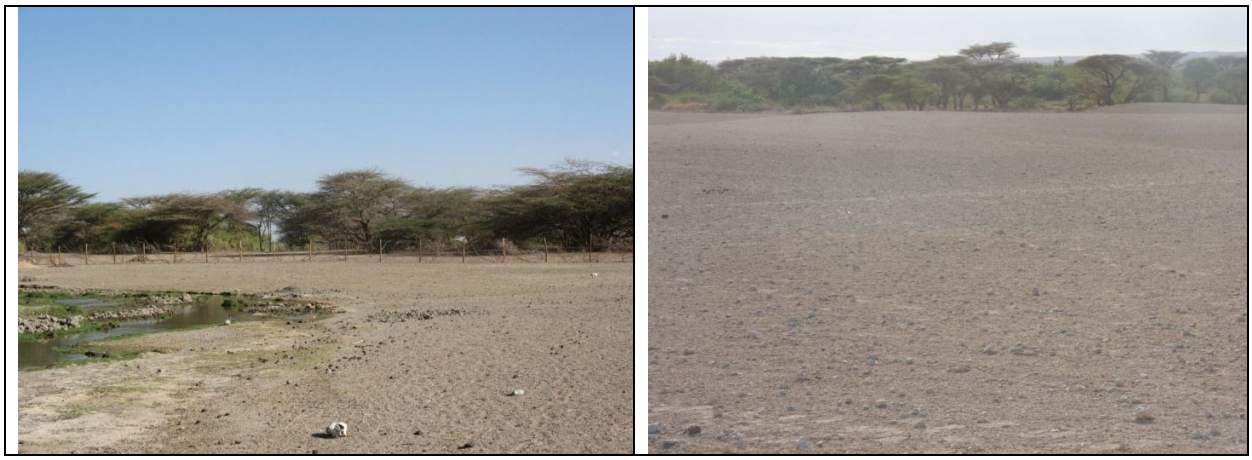
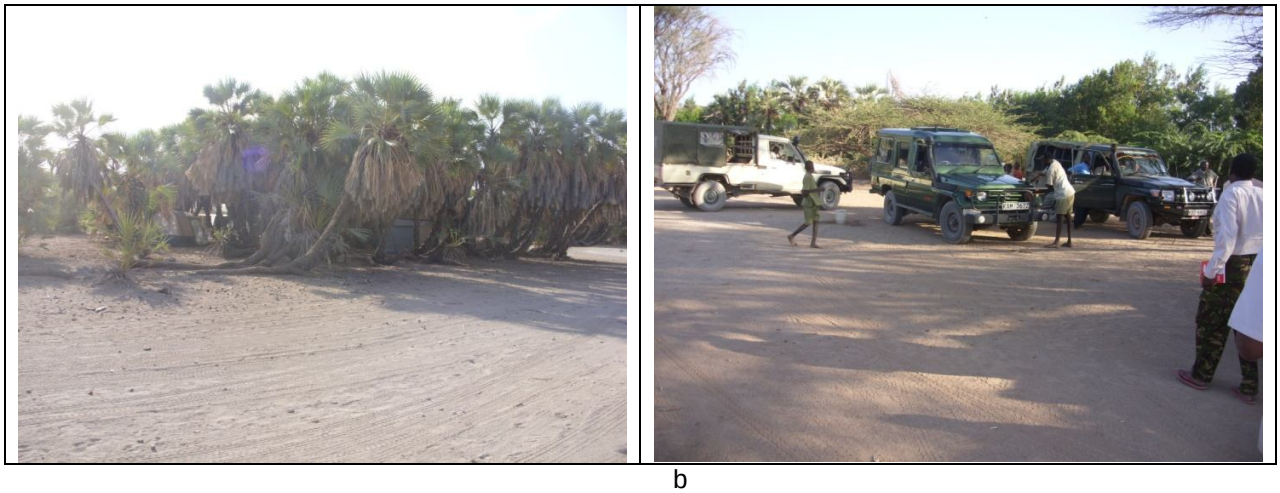


Plate 26: Acacia tortilis forming a tree canopy in (a) Maikona and (b) Kalacha areas.



b

Plate 27: (a) Hyphaena compressa (Duom palm) in Kalacha area; (b) some of the vehicles as noted in Kalacha area.

Further, minimal and transient air pollution also occurs as a result of the few vehicles traversing the survey area and raising dust as well as releasing exhaust fumes (Plate 3.6b). In addition, herds of grazing animals contribute to minimal air pollution as they raise dust in the course of movement from one point to another.

3.6 Surface and Groundwater Resources and Effluents

3.6.1 Surface water

Block 10A is characterised by extremely poor surface water potential. Surface water is rather scarce and Lake Turkana, about 60-120 km west of the project area is the nearest and only main surface water source. Other sources of surface water are seasonal rivers (Luggas) flowing during and shortly after the rains which are rather erratic. The study area has relatively few water pans and earth dams. However, most of the water flowing after the rains drains to lower elevation areas such as North Horr, Kalacha, Maikona and the Chalbi desert to replenish the groundwater supplies in these areas. The main river draining through the study area is river Balesa which is seasonal and this is in turn fed Ririba, Wata and Bulal Luggas. Other luggas draining through the area are Dambito and Sangai. Block 10A is characterised by a NNE-SSW water divide which is formed by the Kalacha terrace due to occurrence of Dida Galgalla lava plains. Luggas to the east of this water divide have an easterly flow pattern while those to the west of the water divide have a westerly and N-S flow pattern (Charley, 1987; Key, 1987; Key and Watkins, 1988). The latter flow pattern is responsible for locally replenishing aquifers in Kalacha, Maikona and North Horr areas and also significantly contributes to the occurrence of several localized springs in these areas such as Horr Gudha and Gamura in North Horr and Maikona, and oases such as Kalacha Dida and Koroli in Kalacha and Koroli desert respectively Plate 28). The flow pattern is also responsible for regionally replenishing the vast Merti aquifer which extends as far as block 9 in Isiolo and Wajir districts.

a b

Plate 28: (a) Gamura and Horr Gudha springs; (b) Koroli and Kalacha Dida oasis

3.6.2 Groundwater

Groundwater resources form the most available source of water supply in the study area. The groundwater is exploited through shallow wells which are either open or are fitted with hand pumps and have been excavated in luggas within the study area. The water is often clean and has fairly low contents of total dissolved solids (TDS). The water is used for both domestic and livestock consumption. From the preceding discussion in section 3.6.1 above, the westerly and N-S flow pattern of water is responsible for replenishing aquifers in North Horr, Kalacha and Maikona. The flow pattern also feeds the various springs and oases. These areas have abundant supplies of groundwater, as they occur in discharge zones, which is tapped through shallow wells fitted with hand pumps. The groundwater generally occurs in perched aquifers at the contact zones of sediments/alluvial deposits and volcanic rocks. The areas to the north and south (Dukana, Balesa and Kargi respectively) have severe water shortage as they occur in the recharge zones. Abundant supplies of water are however expected if deep boreholes are drilled as the groundwater tends to occur at fairly deep levels in recharge zones.

In view of the foregoing discussion, it is evident that groundwater resources form the most available and rather reliable source of water supply in the study area. The discharge areas for the groundwater are Kalacha, Maikona, North Horr and the Chalbi desert whereas the recharge regions are Dukana, Balesa and Kargi areas. This fact

explains the occurrence of rather limited groundwater water supply in Dukana, Balesa and Kargi as opposed to Kalacha, Maikona, North Horr and the Chalbi desert. The groundwater is exploited through shallow wells, springs and oases in the area. The shallow wells have been excavated to relatively shallow depths of about 10 m or slightly more. Groundwater from shallow wells and boreholes is characterised by high salinity, low to moderately high alkalinity and high sodium, chloride, fluoride and nitrate levels. In contrast, water from springs has low salinity, moderately high alkalinity and high iron, fluoride, and nitrate levels. Despite this fact, the water is currently being used for both domestic and livestock consumption.

a b

Plate 29: (a) Shallow wells fitted with hand pumps; (b) Open well (e.g. Balesa and Dukana) and severe water problem at Kargi.

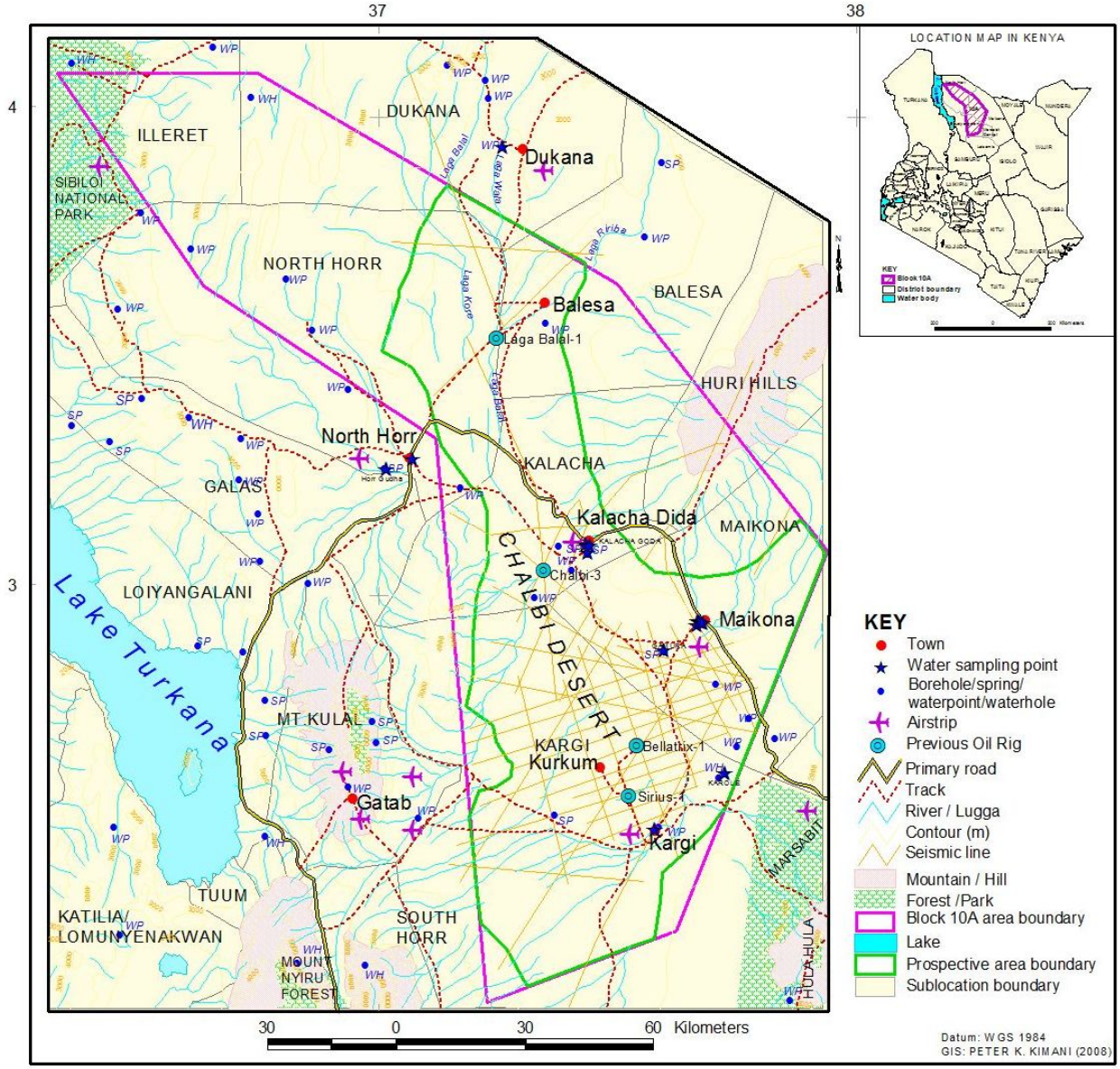


Figure 3.4: Water points of the study area.

3.6.3 Water Quality

Practically all types of water, i.e. surface water, groundwater and even rainwater, contain some dissolved salts and impurities. If certain elements are present in high concentrations, the application of the water for a particular purpose may be limited. It is therefore important that chemical analysis of water is undertaken so as to determine the suitability of the water for various purposes.

Water sampling was carried out from selected locations within Block 10A for the purpose of water quality analysis. The water sampling can be categorized into three main groups: (i) Shallow wells/boreholes, (ii) Springs, and (iii) Oasis.

The quality analysis results of water from shallow wells/boreholes show that the water is slightly to moderately alkaline (7.89 – 8.72). Most of the water is saline and hard, and some chemical constituents such as Sodium, Chloride, Fluoride and Nitrate are above the W.H.O recommended limits (W.H.O., 1993). Of the nine shallow wells/boreholes sampled (See appendix 5), only one well at Kalacha AIC church is chemically suitable water for domestic purposes. Most of the water may require demineralization/ desalination before it can be used for domestic purposes. The other chemical characteristics are however satisfactory.

Three springs were sampled and these include Gamura spring near Maikona, Kalacha Bada spring and Horr Gudha spring in North Horr (See appendix 5). The results of chemical analysis of water from all the springs indicate that the water is suitable for domestic purposes. The spring water is moderately alkaline and shows a north-south decrease in alkalinity which varies from 8.69 (North Horr), 8.44 (Kalacha Bada) to 8.38 (Gamura spring).

One oasis, the Koroli oasis, was sampled during the present study (See appendix 5). The oasis water is slightly turbid and has high content of Iron, Fluoride, and Nitrate. The other chemical characteristics are however satisfactory. Based on the chemical characteristics, the water in the study area is highly variable; some is good for domestic, agricultural and industrial purposes, whereas some is not suitable for these purposes. The lack of agricultural activities in the project area signifies that the major source of nitrate in the water is from human and livestock excrement.

The World Health Organization (W.H.O, 1993) and the European Community have stipulated guidelines for maximum permissible concentrations of various ionic substances in water as well as the uses for such waters. Such guidelines should be strictly adhered to so as to determine the suitability of groundwater for various uses. Currently, the groundwater in the study area is being used for domestic and livestock consumption. Since groundwater is essential for human and livestock consumption as well as for industrial use, it is recommended that thorough chemical analysis be undertaken to determine its suitability for the various purposes.

Table 3.4: The variations of chemical constituents in various water sources.

PARAMETERS								
Lab Sample Nos.	**2293**	**2294**	**2295**	**2296**	**2297**	**2298**	**2299**	**WHO limits**
pH	7.89	8.44	8.69	8.49	8.48	8.23	8.38	6.5-8.5
Colour (mgPt/l)	5	5	< 5	5	5	5	5	15
Turbidity (NTU)	9	8	10	75	9	88	9	5
PV (mgO_2/l)	<0.4	<0.4	1.58	3.55	<0.4	4.74	<0.4	
Conductivity (25°C) (□S/l)	1685	1226	1056	1283	1362	5380	1729	
Fe (mg/l)	0.107	<0.01	0.699	2.39	0.04	0.77	0.08	
Mn (mg/l)	< 0.01	< 0.01	< 0.01	<0.01	0.14	0.4	<0.01	
Ca (mg/l)	24	24	8	4	20	152	24	
Mg (mg/l)	67.7	44.24	19.93	9.24	12.16	218.75	53.95	
Na (mg/l)	226.5	165.5	192.6	252	263.8	637.5	259.4	200
K (mg/l)	8.4	6.8	4.8	34	5.4	10	12.5	
Total Hardness ($mgCaCO_3$/l)	336	292	102	48	100	256	282	500
Total Alkalinity ($mgCaCO_3$/l)	502	310	318	142	386	826	346	
Cl (mg/l)	180	130	90	200	120	1120	310	250
F (mg/l)	0.72	0.82	2	4.5	1.9	0.63	0.21	1.5
Nitrate (mg/l)	0.4	18.4	8.3	34	18.6	4.1	6.8	10
Nitrite (mg/l)	0.027	0.025	0.0447	0.121	0.027	0.027	0.032	
Ammonia (mgN/1)	-	-	-	-	-	-	-	
Total Nitrogen	-	-	-	-	-	-	-	
Sulphate (mg/l)	76.9	47.4	44.571	77.43	50	237	48.86	400
TSS (mg/l)	-	-	-	-	-	-	-	
Oil and Grease (mg/l)	-	-	-	-	-	-	-	
Free Carbon Dioxide (mg/l)	2	2	Nil	Nil	2	2	2	
Dissolved O_2 (mg/l)	-	-	-	-	-	-	-	
Total Disolved Solids (mg/l)	1044.7	760.1	654.7	795.4	44.4	3335.6	1071.9	1000
others	-	-	-	-	-		-	

PARAMETERS							
Lab Sample Nos.	**2300**	**2301**	**2302**	**2303**	**2304**	**2305**	**WHO limits**
pH	8.61	8.72	8.34	8.44	8.67	8.56	6.5-8.5
Colour (mgPt/l)	5	5	5	5	5	5	15
Turbidity (NTU)	8	9	9	49	2	7	5
PV (mgO_2/l)	1.58	<0.4	0.79	4.74	<0.4	0.79	
Conductivity (25°C) (□S/l)	2080	2310	1537	3980	1327	623	
Fe (mg/l)	0.05	0.04	0.08	0.1	0.05	0.16	
Mn (mg/l)	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	
Ca (mg/l)	20	32	24	92	20	44	
Mg (mg/l)	49.32	60.27	31.11	132	42.77	34.53	
Na (mg/l)	354.4	372	258	542.2	194	26	200
K (mg/l)	11	11.5	13	22	10.5	1.5	
Total Hardness ($mgCaCO_3$/l)	208	328	188	776	226	252	500
Total Alkalinity ($mgCaCO_3$/l)	456	572	314	608	340	210	
Cl (mg/l)	290	350	240	880	100	30	250
F (mg/l)	0.36	2.9	2.9	0.8	6.3	0.7	1.5
Nitrate (mg/l)	27.4	0.34	15	8.3	8	15.9	10
Nitrite (mg/l)	0.17	0.024	0.34	0.31	0.38	0.27	
Ammonia (mgN/1)	-	-	-	-	-	-	
Total Nitrogen	-	-	-	-	-	-	
Sulphate (mg/l)	68.29	71.43	48.57	89.43	101.14	<0.3	400
TSS (mg/l)	-	-	-	-	-	-	
Oil and Grease (mg/l)	-	-	-	-	-	-	
Free Carbon Dioxide (mg/l)	Nil	2	2	2	2	2	
Dissolved O_2 (mg/l)	-	-	-	-	-	-	
Total Disolved Solids (mg/l)	1289.6	1432.2	952.9	2467.6	822.7	386.2	1000
others	-	-	-	-	-	-	

3.6.4 Water Supply

Groundwater resources form the most available source of water supply in the study area. The groundwater is exploited through shallow wells, either open or fitted with hand pumps. Where groundwater supply is limited, the wells are excavated close to Luggas within the study area. The sediments and alluvial deposits act as natural purifiers. The water is used both for domestic and livestock consumption. Some shallow wells, however, have limited supplies of water due to lack of recharge which has contributed to fluctuating levels of the water table whereas others have slightly saline water.

3.7 Terrestrial Environment: Flora and Fauna

3.7.1 Terrestrial Flora

Block 10A falls under the ecoregion that is phytogenically described as the Somali-Masai regional center of endemism. The vegetation is mapped as 'Somali-Masai semi-desert grassland and shrubland' (White, 1983). The region is located in the northern

part of Kenya and extreme southwestern Ethiopia. It encompasses most of Lake Turkana and the Omo River Delta, and grades into the savanna woodlands of the Northern *Acacia-Commiphora* Bushland and Thicket ecoregion to the west and the Somali *Acacia-Commiphora* Bushland and Thicket to the east. Mostly lying between 200 and 700 m elevation and gently undulating, it includes the Chalbi Desert, a large flat depression between 435 m and 500 m formed from the bed of an ancient lake.

The climate is hot and dry over most of the year, with mean maximum temperatures of around 30°C and a mean minimum temperature of between 18°C and 21° C. There is a short wet season between March and June as the Intercontinental Convergence Zone moves north. Mean annual rainfall is between 200 and 400 mm. In years of high rainfall, huge areas of semi-desert annual grasslands are found. *Aristida adcensionis* and *Aristida mutabilis* dominate, but during droughts these species and the grasslands can be absent for many years. The next most extensive vegetation types are dwarf shrublands, dominated by *Duosperma eremophilum* on heavier, wetter sedimentary soils and *Indigofera spinosa* on stabilized dunes (White 1983). The shore of Lake Turkana is mostly rocky or sandy with little aquatic vegetation, and around the lake there are grassy plains on which yellow spear grass and doum palms, *Hyphaene compressa* are predominant.

The mixture of habitats encountered in Block 10A ranged from barren landscapes (parts of Maikona, Chalbi and Karoli Deserts), near barren landscapes interspersed with pockets of dwarf shrubs and *Acacia* spp in areas such as North Horr, Balesa, Kalacha, Dukana, Kargi, and Maikona. Dense bushland of *Salvodora persica* and *Acacia tortilis* were encountered in hilly areas of Maikona and Kurkum respectively. Areas of North Horr (Dabandable Hills), Ririma area of Kargi, and Kurkum experienced sparse bushland habitat types dominated by Acacia spp, *Balanites aegyptica,* and/ or *Cadaba* sp. Dwarf shrublands of *Indigofera spinosa* and *Euphorbia cuneata* are found in parts of North Horr, Elgade and Balesa. There were pocket of riverine forests in cohorts with shrubs of *Salvadora persica* and, *Calotropis juliflora.* This habitat type was commonly found along luggas and water causes. In addition, areas of Ririma- Hautinahass and Kalacha had stretches of Acacia sp woodland along water causes and the adjacent environments.

The area was not very rich in terms of species diversity with very few species of woody plants. In some instances single stands were observed. The most common floral species were: *Acacia mellifera, Acacia tortilis, Commiphora africana, Balanites aegyptiaca, Indigofera spinosa, Cadaba* sp*, Salvadora persica,* and *Euphorbia cuneata.* On a broader scale, the ecosystem in Block 10A could be categorised into 7 habitat sub-types namely;

- Barren
- Near-barren
- Dense Bushland
- Sparse Bushland
- Riverine forest
- Dwarf shrublands

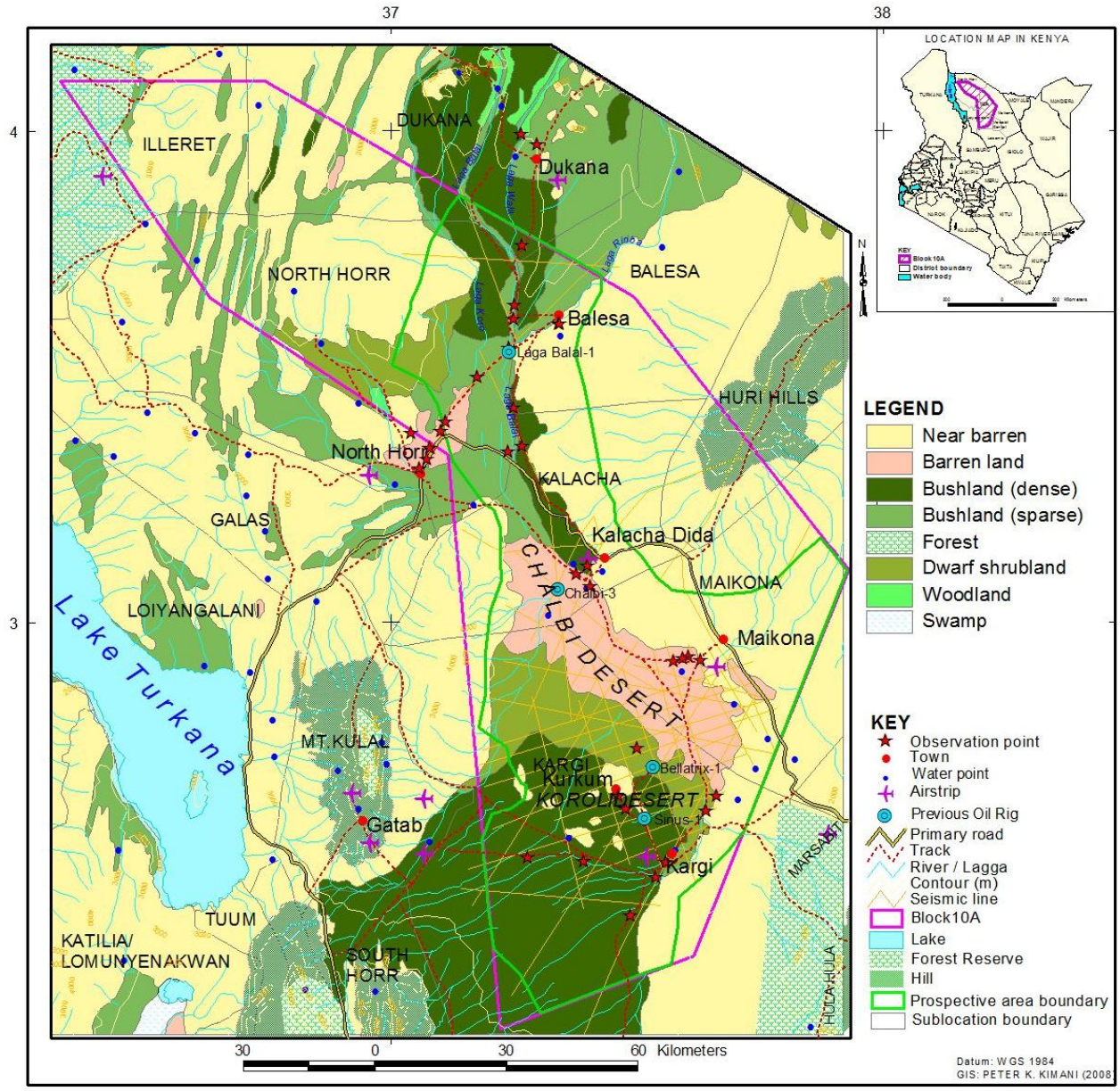


Figure 3.5: Vegetation map of the study area

Barren (B)

This habitat type can be described as those ecosystems in which less than 20% has vegetation or other cover. In general, barren landscapes have thin soils, sands or rock. Barren lands include deserts, dry salt flats, beaches, sand dunes, exposed rock, strip mines, quarries, and gravel pits. This type of habitat was observed at Chalbi desert and parts of North Horr.

Plate 30: Barren landscape at Chalbi desert

Plate 31: Barren land, North horr.

Near-barren (NB)

Near barren habitat conditions can be described as in barren landscapes above, the only difference is that woody vegetation contributes more. The study area had a crown cover of approximately 10% woody plants with the dominant species being *Acacia tortilis*, and *Balanites aegyptica*.Near barren conditions were found in areas around North Horr, Balesa, Kalacha, Dukana, Kargi, and Maikona. Plate 32 below represents near barren conditions encountered at the site

Plate 32: Near barren landscape Kargi area(a) and North Horr (b). Note the sand dune forming in the background.

Dwarf shrubland (DS)

Dwarf shrubland habitat conditions can be described as landscapes where woody plants are dominant and are hardly ever more than one metre in height. The woody plants observed were dominated by *Acacia tortilis, Indigofera spinosa, Balanites aegyptica, Cadaba farinosa and Euphorbia cuneata shrubs* .In situations where depressional areas were encountered and the soils were deeper the vegetation where observed to grow into shrubs that were taller than one metre. This habitat type was found in North horr, Balesa, Kalacha, Kargi,Dukana and Maikona..

Plate 33: Dwarf shrubland in the high level plains of Dukana

Dense bushlands

This habitat type is primarily composed of woody plants that reach a maximum height of 6 metres and bushes make up more than 50 % of the vegetal matter observed. This habitat type was found in areas such as Kurkum and Maikona. The dominant bush species were *Acacia sp* and *Salvadora persica* respectively. The most dominant species in this habitat type was often interspersed with other species of shrubs, on occasion *Acacia seyal*, and *Boscia coriacea.* In some areas where *Salvadora persica* was absent, especially in areas where there was anthropogenic influence such as settlements along flood plains, the invader species *Prosopis juliflora* and *Calotropis procera* were common.

Plate 34: A dense bushland in Gatab area, vegetation is dominated by Acacia mellifera and Acacia tortilis bushes. Reticulated giraffes can be found in such habitats

Sparse bushlands

This habitat can be described as an ecotype between grassland and bush, with woody vegetation contributing between 20%-50% of the vegetal cover. Species were dominated by *Acacia tortilis, Balanites aegyptiaca, Salvadora persica, Cadaba farinose* and occasionally *Euphorbia cuneata* along roads. This habitat type was found around areas adjacent to Radaptimalal hills and Ririma hills, around Kurkum areas, North horr and Kargi. The vegetation followed the lacustrine plains and alluvial floodplains while *Euphorbia cuneata and Indogofera spinosa* bushed formed the boundary. The presence of *Euphorbia cuneata* was a probable indicator of a high water table and probably alkaline substrate conditions.

Plate 35: Sparse bushland in Kargi area

Riverine forests

This is a habitat type that is composed of woody vegetation that are generally of a height of more than 6 metres, trees can grow up to a height of 18 metres. They are commonly found growing along waterways, floodplains and along luggas. These habitat types were found along mid level sedimentary plains hills such as Hautinahas hill. The woodland vegetation significantly comprised of *Acacia tortilis*, which were on occasion interrupted by *Commiphora africana*.

Plate 36: Woody vegetation along a floodplain in the Balesa.

3.7.2 Terrestrial Fauna

The ecoregion is moderately rich in species, but has a low level of endemism. Mt. Kulal and Mt. Marsabit (which are both outside Block 10A area to the west and east respectively) both have some endemic plants, but these occur mainly at higher elevations, located in other ecoregions. The grasses, shrubs and trees of the ecoregion are fire-tolerant because fires are frequent in the dry season. The arid-adapted mammalian fauna include Burchell's zebra (*Equus burchelli*), Grevy's zebra (*Equus grevyi*, Endangered), Beisa oryx (*Oryx beisa beisa*, Least concern), Grant's gazelle (*Gazella granti*), Topi (*Damaliscus lunatus*), Lion (*Panthera leo*), and Cheetah (*Acinonyx jubatus*, Vulnerable) (Boitani, 1999 & East, 1999). These species are all found in Sibiloi National Park and other areas within the ecoregion. Other mammals include Leopard (*Panthera pardus*), Reticulated giraffe (*Giraffa camelpardalis reticulata*), and Elephant (*Loxodonta africana*). Among the small mammals there is also a near-endemic Gerbil, *Gerbillus pulvinatus*. The populations of large wild mammals are greatly reduced. In particular, the Black rhino (*Diceros bicornis*, critically endangered) used to occur here, but has been exterminated through over-hunting.

Lake Turkana about 100 Kilometres west of the lake has more than 350 species of aquatic and terrestrial birds, and is also an important flyway for migrant birds. Central Island has a breeding population of African skimmers (*Rhyncops flavirostris*) that nest in banks.

Reptilian, amphibian and arthropod counts were low but a relatively high insectivorous bird species count suggests that the arthropod life was rich.

Mammals

Despite the fact that a good majority of the habitats encountered were not very productive the area had a moderate diversity of mammal species. Mammals sited in the area included; the olive baboon, *Papio anubis,* The black backed jackal, *Canis mesomelas,* Guenther's dik dik, *Madoqua quentheri,* Spotted hyaena, *Crocuta crocuta,* Porcupine, *Hystirx cristata*, Grants gazelle, *Gazzela granti*, Gerenuk, *Litocranius walleri* ,Ground Squirrels, *Xerus inauris,* Cape hare, *Lepus capensis,* Grevy's Zebra*, Equus grevyi*, warthog *Phacochoerus africanus*, Grant's gazelle *Gazella granti*, reticulated giraffe *Giraffa camelopardalis reticulata*, Beisa oryx *Oryx gazella beisa*. The *Grevy's zebra Equus g*revyi are classified as endangerd by IUCN. Additionally, indirect observations were also made; porcupines were identified indirectly from the evidence of their quills observed at Kalacha-Goda watering hole.

Plate 37: A Dikdik shading itself from the harsh sun , they were commonly sighted hiding in and around shrubs

Birdlife

The area has diverse habitats ranging from woodland, dense bush lands to springs/oases in the desert. These varied habitats were an ornithological heaven for birdlife, such as: Spotted thick-knee, Spur winged plover, Egyptian vulture, Chestnut Sandgrouse, yellow-billed hornbill, Yellow throated spur fowl, Common bulbul, Egyptian goose, White-faced whistling duck among others. For full list of common and scientific names see appendix (Number 6 and 7).

Plate 38: A couple of Spotted thick-knees (Red arrow) enjoying the shade under a bush in Kurkum area

Arthropods

The insect species present in the area included various species of Carpenter bees, moths, butterflies, sand flies, bottle flies, grasshoppers, tsetse flies, praying mantis, itch mites, beetles, aphids, wasps and dragon flies. Other arthropods also present in significant numbers were centipedes, spiders, ticks, and scorpions.

Plate 39: Some observations were made indirectly, note the hole leading into a Wasp's nest.

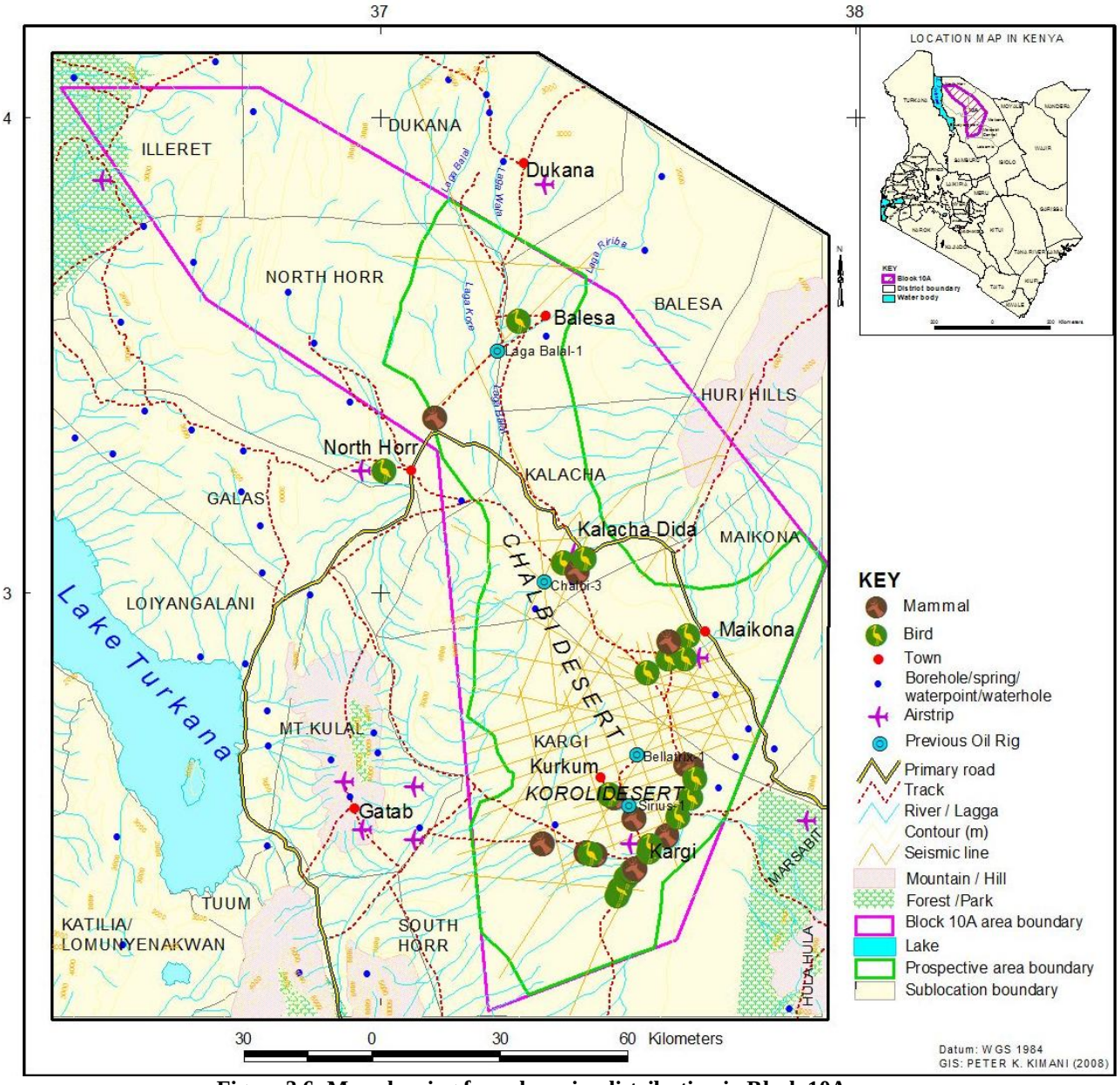


Figure 3.6: Map showing faunal species distribution in Block 10A

3.8 Aquatic Environment

Block 10A falls under the equatorial desert region known as the *Somali- Maasai* arid zone which formed as a result as a result of the rain-shadow effect of the Ethiopian highlands and the cold currents of Somalia. The desert blankets much of Somalia, Eastern Ethiopia and Northern Kenya. In the latter, it includes the Chalbi desert; a large, flat depression with undulating terrain (elevation of between 435 m and 500 m) formed from the bed of an ancient extinct lake and the Koroli desert. The major aquatic ecosystems within Block 10A are springs, wells, oases, floodplains, and a few ephemeral streams (luggas) systems.

3.8.1 Springs

A spring is a place on the earth's surface where groundwater emerges naturally. The water source of most springs is rainfall that seeps into the ground uphill from the spring outlet. Spring water moves downhill through soil or cracks in rock until it is forced out of the ground by natural pressure. The amount, or yield, of available water form springs may vary with the time of year and rainfall. Groundwater obtained from springs is similar to water pumped from shallow wells. Springs may be ephemeral (intermittent) or perennial (continuous) depending on the constancy of the water source (rainfall or snowmelt that infiltrates the earth).

There are two major springs in Block 10A;

a) Horr Gudha Water Spring

This spring is located in North Horr area and serves as a lifeline in terms of water supply for domestic, livestock and wildlife use for the people of North Horr and the surrounding environs as far as Balesa. Floral species in the spring area include the doum palm *(Hyphaene compressa),* swamp grasses*,* sedges *(Cyperacea* sp*),* papyrus, reeds (*Phragmites* sp) and cattails (*Typha* sp)(plate 11).

Plate 40: Wetland vegetation at Horr Gudha oasis

The spring also serves as a habitat for various aquatic species such as the Mud turtles (*Pelusios broadleyi*), Guppies, and a variety of insects and birds species (Plate 12 a, b, c, d, e and f).

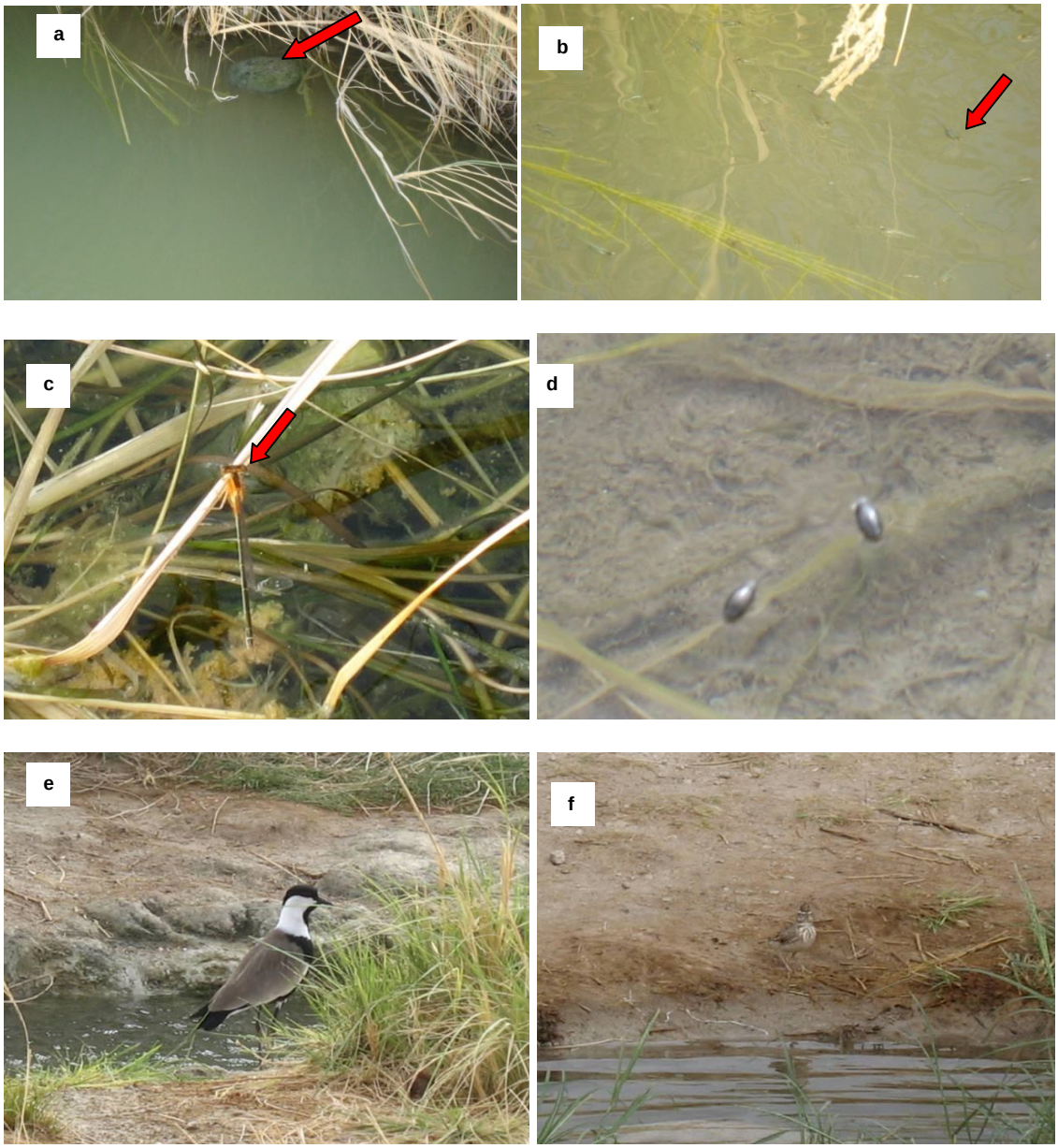


Plate 41a) Mud turtles (red arrow), b) Guppies (red arrow), c) Dragon fly (red arrow), d) Whirligig / water beetles, e) Spur winged plover , and f) Crested lark

Uses: The spring is used as a water source for domestic, livestock and wild animals alike. It also serves as an income generating activity for the local women group through the provision of fodder / hay grass (*Pennisetum* spp) which is sold locally to livestock owners, and provision of raw materials for weaving (doum palm) (Plate 13 a, b, and c)

Plate 42a) Camels watering at the Horr Gudah Oasis, b) Gabbra woman harvesting fodder (Pennisetum spp), and c) Gabbra woman weaving a mat using Doum palm leaves

Conservation: The spring water source has been protected from contamination by animals through the erection of a perimeter fence through the assistance of the USAID and Family Health International (FHI) (Plate 14 a and b). The local women have also formed a women's group that has initiated a project to protect the adjacent spring land through the establishment of a tree nursery and replanting of trees such as *Salvadora persica)*, Date palms *(Phoenix dactylifera)* among others which are important medically, nutritionally, and economically (Plate 14 c).

Plate 43a) Perimeter fence, b) Signpost, and c) Young Date palms, and Salvadora persica

b) Gamura Spring - Maikona

This spring is located at the periphery of an Acacia woodland in Maikona area and provides water for domestic use, livestock and wild animals. The water is slightly saline in nature. The spring wetland area is devoid of diverse emergent macrophtyes with sedges *(Cyperacea* sp*)* being the dominant plant species (Plate 15 a and b). However, the area is highly endowed with a diverse number of terrestrial and aquatic birds' species (Plate 15 c, d, and e).

Plate 44a and b) Wetland and adjacent environmental settings at the spring, c) Ruff and Black winged stilt, d) Speckled pigeon, e) Egyptian geese and Sacred Ibis

Conservation: An outlet pipe and a shed have been constructed to protect the water/ spring source from contamination (Plate 16a and b)

Plate 45 a) An outlet pipe and b) Shed

3.8.2 Artesian Well

An artesian aquifer is a confined aquifer containing groundwater that will flow upwards through a well without the need for pumping. Water may even spurt out of the ground if the natural pressure is high enough. An aquifer provides the water for an artesian well. An aquifer is the layer of permeable rock, like limestone or sand stone that absorbs water from an inlet path at high elevation such as the top of a mountain. The water source might be fed by snowmelt or precipitation. The porous stone is sandwiched between a top and bottom layer of an impermeable substance like clay soil or shale rock. This keeps the water pressure high, so that when one gets to a point below the entryway of the flow, there is enough pressure to bring the water up.

a) Kalacha Goda

The term "*Goda"* in Gabbra means hidden or an area with caves. The term is used to describe the location of the well which is located at the slopes of rocky hills in Kalacha area. The well at Kalacha Goda serves as a critical source of water for the residents of Kalacha area and their surrounding neighbours even as far as the slopes of the Huri Hills. The slightly saline water is used for domestic purposes (Plate 17 b), watering of livestock and wildlife alike and also for agricultural purposes in the Kalacha Irrigation Scheme.

Plate 46a) Kalacha Goda artesian well and b) A woman drawing water from the main water furrow near the source.

The irrigation scheme initially concentrated in the production of horticultural crops such as pawpaws, carrots, kales, tomatoes among others but the venture was abandoned due to the constant crop raids by the Olive Baboons *(Papio anubis).* At present, the scheme mainly concentrates on the production of fodder crops such as Jerusalem Thorn (*Parkinsonia aculeate*), Leucaena (*Leucaena leucocephala*), napier grass (*Pennisetum purpureum*), Rhodes grass *(Chloris gayana)* for livestock and medicinal plants such the Neem tree (*Azadirachta indica*) and the drumstick tree / horseradish tree (*Moringa oleifera*) through furrow irrigation (Plate 18 a, b and c).

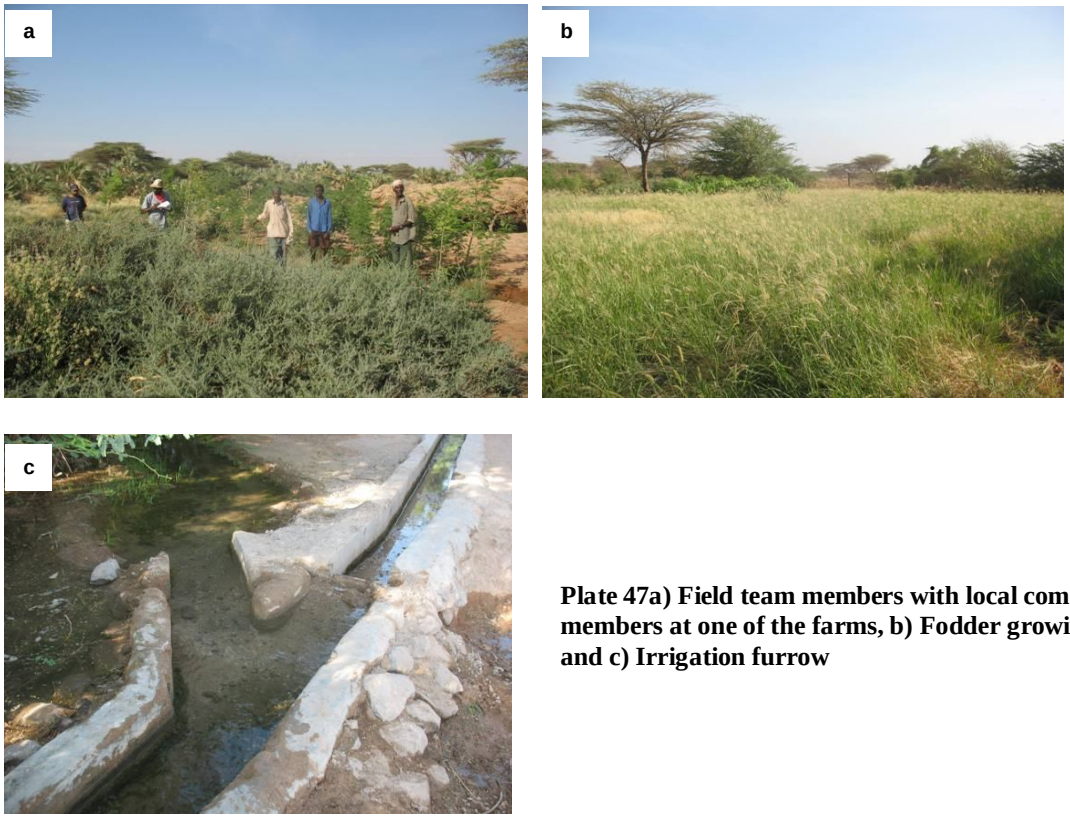


Plate 47a) Field team members with local community members at one of the farms, b) Fodder growing in a farm and c) Irrigation furrow

Water seepage from the high water table in the area around the well source has led to the development of wetland habitats. The floral species in these wetland areas include species such cyanobacteria / blue-green algae, sedge grass (*Cyperacea* spp) and cattail (*Typha* sp) within the confines of the wetland (Plate 19), doum palm *(Hyphaene compressa), Acacia tortilis, Prosopis juliflora, Azadirachta indica, Acacia condyloclada, Moringa oleifera, Solanum* spp and *Salvadora persica.*

Plate 48: Wetland vegetation (Doum palm, sedges and cattail (Typha sp) (red arrow) at Kalacha goda

Faunal diversity include aquatic insects such water striders, water beetles, dragon flies (Plate 20 a), frogs (*Phrynobatrachus* spp) (Plate 20b) and diverse birds such as the Egyptian geese, sand grouses, sacred ibises, African spoonbills, Spur-winged plovers, Egyptian vultures, lappet faced vultures, and the yellow necked spur fowls (Plates 20 c, d, and e). Mammals include the olive baboons (Plate 20 f), porcupines, ground squirrels, cape hares, and hyenas.

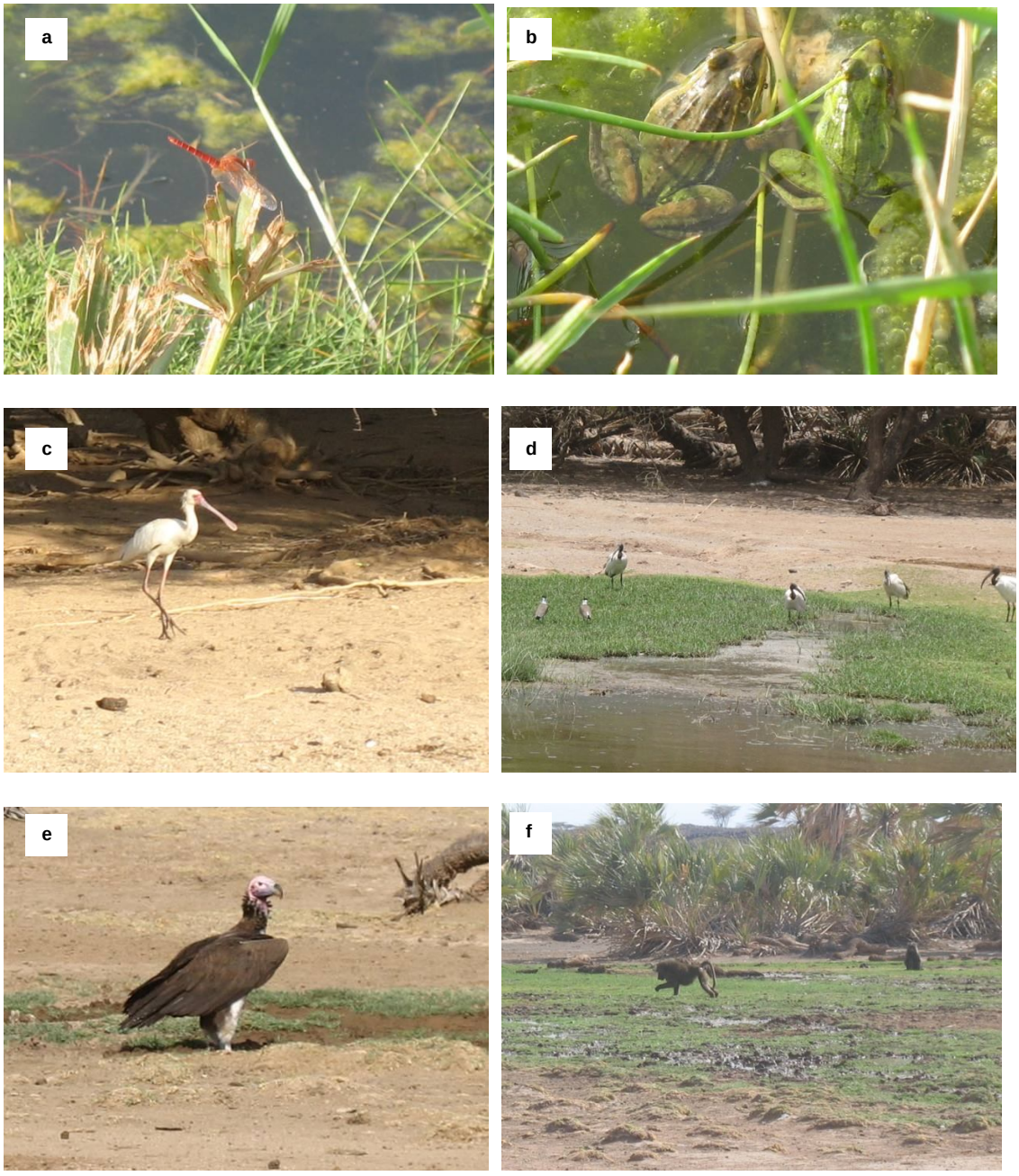


Plate 49a) Dragon fly, b) Frogs, c) African Spoonbill, d) Spur winged plovers and Sacred Ibises, e) Lappet-faced Vulture, and f) Olive Baboons

3.8.3 Oases

An oasis (*pl: Oases)* is a spot in the desert where the elevation is low enough that the water table is right underneath the surface, resulting in the presence of springs. Oases are formed from underground rivers or aquifers such as an artesian aquifer, where water can reach the surface naturally by pressure or by man made wells. Occasional brief thunderstorms provide subterranean water to sustain natural oases. Substrata of impermeable rock and stone can trap water and retain it in pockets; or on long faulting subsurface ridges. Volcanic dykes can collect water that later percolates to the surface.

a) Kalacha Dida Oasis

The term "*Dida"* is used by the Gabbra people to refer to a plain. This oasis is located in the plains of the Chalbi desert and is an important source of water for people, livestock and wildlife. Floral diversity is minimal around the oasis with the major plant species being cyanobacteria, sedge grass (*Cyperacea* spp) and doum palm (*Hyphaene compressa*) (Plate 21).

Plate 50: Kalacha Dida Oasis

Fauna species include various water invertebrates and frogs (their presence indirectly indicated by the presence of birds such as the yellow billed stork and the white faced whistling duck that feed on aquatic invertebrates, frogs and other food sources). Birds in the oasis include the Yellow billed stork, White faced whistling duck, Egyptian goose, Spur winged plover and Cape rook (Plate 22 a and b)

Plate 51a) Yellow billed storks, b) White faced whistling duck, and c) Livestock watering at the oasis

b) Koroli Desert Oasis

This oasis is located in the Koroli desert region. Despite the water being saline, it is a source of water for domestic use, livestock and even wildlife. The location of this oasis in the desert can be linked to high numbers of ostriches and Grevy zebras encountered in the confines of the oasis. Floral diversity is minimal around the oasis with the major plant species being blue-green algae (Plates 23 a and b), sedge grass (*Cyperacea* spp) and doum palm (*Hyphaene compressa*).

Plate 52a) and b) Oasis water with blue-green algae

Faunal species include various water invertebrates, birds such the Spur winged plover and the Somali ostriches. Two herds of Grevy Zebras (plate 24) were encountered near the water source.

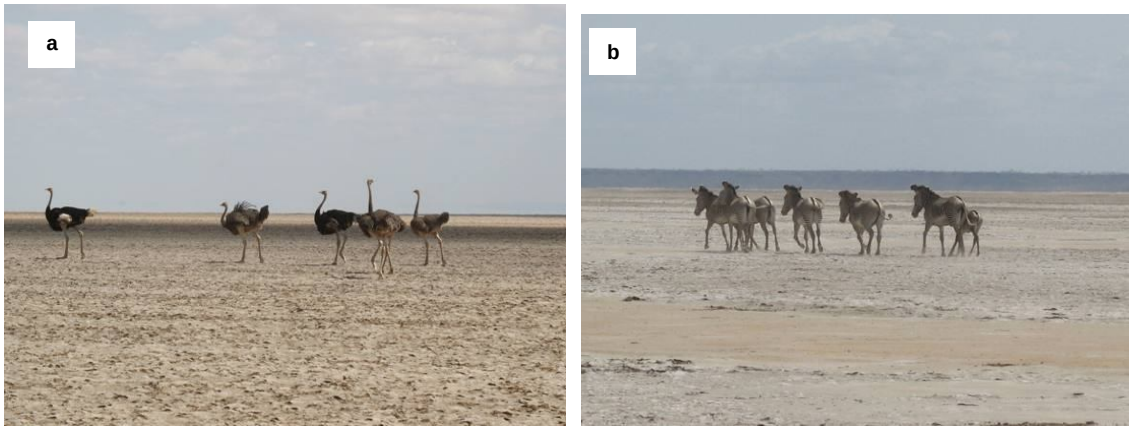


Plate 53a) Somali Ostriches and b) a herd of Grevy Zebras

3.8.4 Floodplains and Luggas

a) Floodplains

Floodplains are areas that are periodically inundated by the lateral overflow of rivers or lakes and/or by rainfall or groundwater. Biota in these environments responds to the flooding by morphological, anatomical, physiological, phenological and/or ethological adaptations. Through these, characteristic community structures are formed (Junk *et al.* 1989). Luggas on the other hand are dry beds. Within Block 10A, luggas and floodplains were encountered in areas of North Horr, Balesa, Elgade and Chalbi desert (Plate 15 a, b, c and d). The latter forms a basin ' Lake Chalbi' which may at times occupy an area of roughly 500km^2 following occasional heavy rain (Nyamweru, 1986). Sparse riverine forests are common along luggas or areas that are seasonally inundated (Plate 25 a, b and c). These forests are not very rich in terms of species diversity but instead have very few species of woody plants. The dominant floral species include *Acacia tortilis*, *Calotropis procera*, and *Hyphaene compressa.*

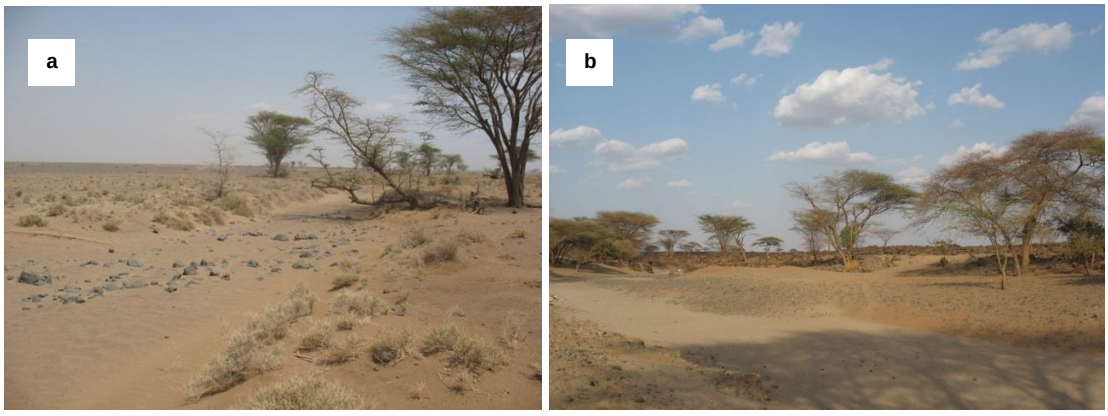


Plate 54a) and b) Shows a Lugga with Acacia tortilis stands North Horr and Balesa areas respectively, c) Lugga crossing with Calotropis procera shrubs in Elgade area, and d) Section of the Chalbi basin

3.9 Land Resources and Natural Heritage Sites

Marsabit North, Marsabit Central and Marsabit South together cover an area of 66,000 km^2 and have varied land resources. Resources vary from lake ecosystem to the west where we have part of Lake Turkana, to desert and mountainous conditions. Mountainous regions include Huri Hills, Mount Marsabit and Kulal Mountains while arid ecosystems are found in the Koroli and Chalbi deserts. There are two national reserves that are proximal to the study area Marsabit National Reserve and the Sibiloi National Park near Lake Turkana.

The Marsabit forest is the largest in the area and covers an area of 15,280 hectares. Within the forest is the crater lake, Lake Paradise that is currently facing degradation due to destruction of headwaters and over-exploitation of ground water around the forest. Marsabit district is home to rare wildlife species such as the Grevy zebra, reticulated giraffe and gerenuk. Other wildlife species in the area include elephants, lions, Masai ostrich and grant gazelle among others.

There have been earlier attempts for oil and gas prospecting in the area in the late eighties. Results from these activities show possible deposits of mature hydrocarbons in the area that can be harnessed. Some parts of the Chalbi desert have salt deposits that may be considered for harnessing.

The main land resource in the project area is livestock that forms the backbone of the local people's livelihood. The main livestock in the area are camels, goats, sheep, donkeys and a few herds of cattle. Water resources are scarce with certain area like Balesa, Kargi and Dukana experiencing acute water shortage. Other area like Kalacha and North Horr have average supply of water for both domestic and livestock use. Along the luggas in the area there is the duom palm whose palms are used for basketry and thatching temporary houses.

The following land resources available in the study area are as follows:

- **Water**
  There are natural springs (Oasis) that occur in North Horr, Kalacha and the Koroli Desert. These springs yield unlimited water resources throughout the year. Local communities comprising of the Gabra and Rendile and their Livestock depend on this water for sustenance. The springs are also habitats to abundant flora and fauna (covered elsewhere in this document).

Plate 55: Oasis at north Horr. Note a boy scooping water for domestic use in the foreground and camels drinking from a trench

- **Agricultural**

  There is active agricultural enterprise in North Horr and Kalacha areas. In North Horr the local women groups use the oasis as a source for irrigation water. Grass is grown in the bottomland that forms the oasis and is harvested and sold to the community at Ksh 20 per sack. In the same area, the women have planted a palm known locally as *Tende* whose fruit is edible. The palm takes a year to mature and bare fruit. *Salvadora persica* (*Ade* in the local dialect) is grown for its fruits and tooth brush twigs. Other trees grown for medicinal purposes are *Roga* and *Chalkeida*. The women also process the *Duom palm* growing around the oases by seperating the fronds into strips. The strips are further divided into grass like twine material that together form the textile used to make carpets. The carpets form the walling material for the houses and are culturally of value since a newly wed bride must be provided with the building material by her mother in-

law for her new home. The *Duom palm* also provides poles used as fencing material and for house building.

In Kalacha there used to be a very lucrative commercial agricultural enterprise that dealt with irrigated farming. The source of water was the Kalacha Oasis. Tomatoes, carrots, sugarcane, pawpaw, sweet potatoes, onions, kales and forages were grown using the irrigation water from the oasis. However this enterprise was terminated around 2002 due to Baboons' menace. The primates fed on all crops save for forages. Today, forage grasses and trees are planted by individuals, groups and the Kalacha primary school. *Rhodes and Napier grass, Alfalfa, Lucaena leaucosephalia, Moringa oleifera* are planted for fodder while *Azadirachta indica (Neem)* tree is grown for medicinal use. The grass is harvested and formed into bales that are sold when dry at Ksh 50 per 50kg bag. The trees go for Ksh 10 per seedling. Other trees planted are: *Acacia condyluclada (Idado), Parkinsonia aculeate* (exotic species) for pole production; *Furr* a thorny shrub, *Urte* a pine like plant and *Ilbete a* purple flowered shrub among others that camels specifically feed on. The fringes of the farm have been invaded by *Prosopis juliflora* (*Alguroba* in Gabra dialect) and threaten to invade the actual farm if not checked.

Plate 57: tree nursery at kalacha irrigation scheme

Plate 56: Rhodes grass grown at one farm in kalacha irrigation scheme

Attempts at rainfed agriculture have been done by GTZ at Elgade area where basins meant for water harvesting were constructed. The project however did not take off due to unclear reasons.
A rain fed grass forage trial farm at Kargi managed by KARI has not yielded much and it is reported that grass harvesting was only managed during the El Nino rains of 1997/98.

- **Mining**

Oil and gas prospecting has been done previously by Amoco at Balal near the Dukana-Balesa junction where a well was sank and at Kurkum site in the late

1980's. The Kurkum site brought a lot of controversy due to the use by Amoco of a white material that could pass for salt like substance but essentially a special clay material used to cool the drill bits. The dumping of the same and other material was ill advised since claims about related health issues by the local communities were abundant such as claims of livestock dying and cancer affecting the locals.

The Chalbi desert has potential for mining of gypsum (calcium sulphate dehydrate), calcite (calcium carbonate) and the manufacture of quicklime (calcium oxide) and slaked lime (calcium hydroxide), but their commercial viability needs detailed assessment.

Plate 58: Surface salt crystals showing after water had been poured

- **Wind**

The study area has strong winds that blow in the better part of the day and night. North Horr and Kalacha have the most strong winds with speeds of 65 km/hr and greater. The wind energy can be harnessed to run borehole water pumps and electrical power generators which can be used for various domestic and industrial purposes. Safaricom Company has realised this potential and currently is running a transceiver station based on wind energy for its mast at North Horr. The local residents informed us the Kenya Energy generating company (Kengen) have been exploring possibility of harnessing wind in the area to generate electric power.

Plate 59: Harnessing of wind power (Note the windmill on the background used to power the transceiver)

3.10 Visual Aesthetics

The study area has an immaculate scenic beauty with low to high ridges and rugged hills, expansive desert and extensive plains, traversed by several sand rivers and streams (luggas). This varying landscape is psychologically somewhat soothing and spots of interest manifests themselves as surface exposures of basalts, carbonates and the Dida Galgalla lava plain which forms a volcanic terrace, the Kalacha terrace. In addition, wind deposits in form of sand dunes (barchans) and dust deposits are common on the plains where vegetation cover is sparse or rather stunted. The presence of abundant birdlife especially around springs and oasis and cryptic wildlife augment the aesthetic effect of the environment.

3.11 Noise and Vibrations

The study area is generally rural and therefore has fairly low noise levels. The variation in the noise levels which range between 47.1-89.6 dB as indicated in Figure 3.7 is due to fluctuations in wind speeds and lack of vegetation cover.

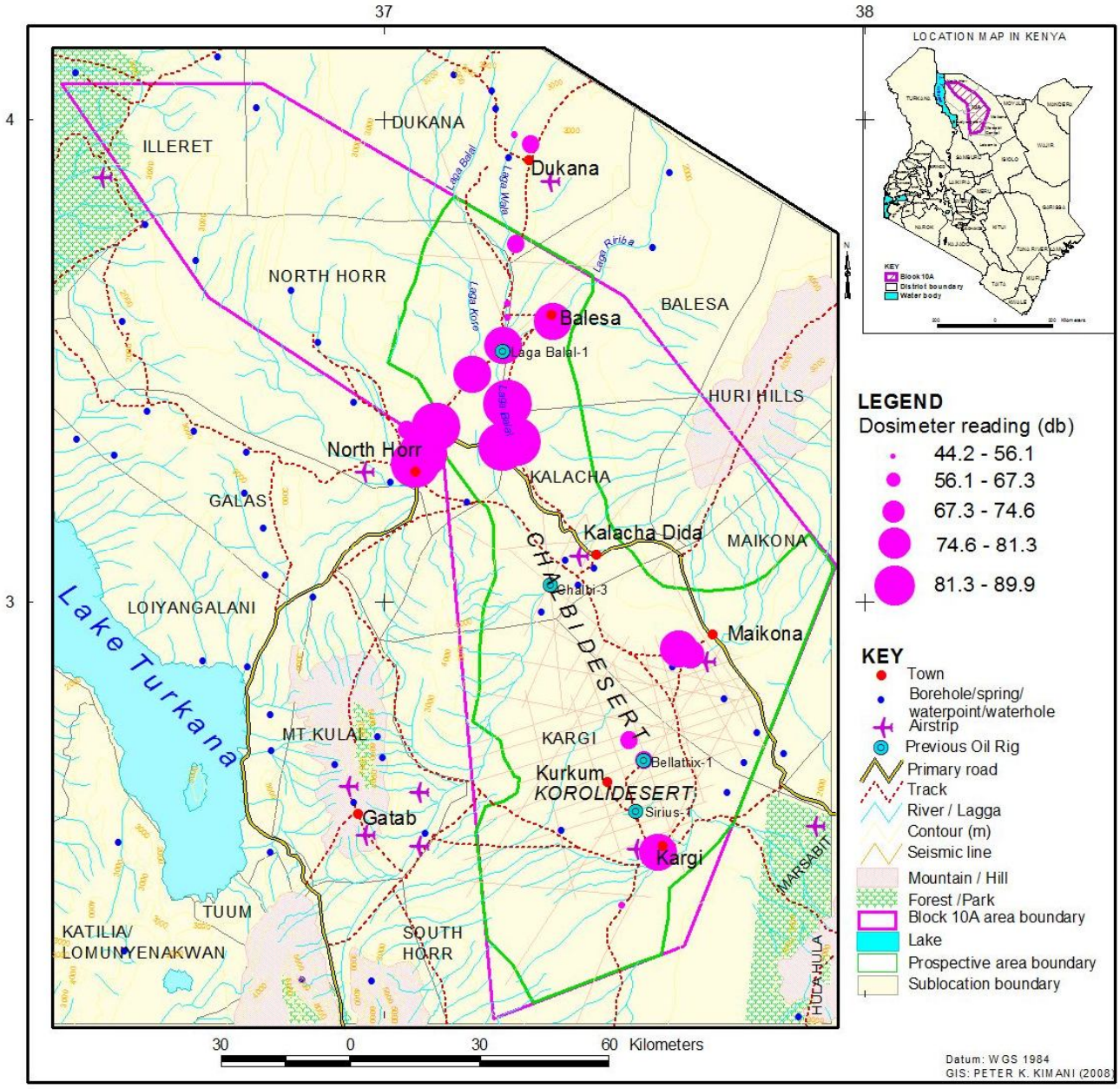


Figure 3.7 Noise readings (in decibels) in the project area.

3.12 Offensive Odours

No offensive odours were detected other than the areas surrounding the settlements, and more specifically, locally associated with pit latrines used by the local communities.

3.13 Archaeological, Historical, Cultural Sites and Landscape

The proposed project area is predominantly home to the culturally rich Gabra and Rendile communities. The Gabra occupy Dukana, Balesa, North Horr, Kalacha and

Maikona area while the Rendille are found in Kargi within the block. There are historical and cultural sites within the block, which the communities would like the exploration activity not to interfere with. These sites are listed in the table 3.5 below:

Table 3.5: Historical and cultural sites

AREA	SITE TYPE	IDENTIFICATIOIN CRITERIA/ LOCATION	COMMENTS
1. Kargi	1. Livestock Ritual/ Cleansing Site	Fare and Algas	Livestock are cleansed here to keep off any invaders. The sites have stacked stones and signify the origin of the Rendille community
	2. Livestock Watering Point	Koroli Oasis within the Chalbi Desert	This a very important livestock watering point for the community.
2. Dukana	1. Sacred/ Artefact Places	Dakabariche Site (Identified by dotted stones)	Used as a religious ritual place.
	2. Sacred places	Mangup and Dipis Hills	Used for religious/ sacrificaial sites
	3. Maalim	Site (identified with huge trees)	Meeting sites for elders
3. General	1. Cultural/ Religious (Yaa) Sites	Found on hilly areas only. There are 5 sites found in Balesa (about 25km from the centre), Turbi, Huri Hills, Bobisa (near Marsabit town) and Elgade (near North Horr).	Yaa are the community's elders' shrines where the traditional religious elders who intercede for the community. Each of the five Gabra clans has its shrine. These sites are revered and should not be interfered with whatsoever.
4. Kalacha Area	Artefact Site (Not gazetted yet)	Afkaba found in a gorge about 12 kilometres from Kalacha town centre	These are community guarded caves that have ancient drawings depicting the origin of the Gabra community.

3.14 Solid Wastes and Waste Oils

Solid waste management in the project area is through collection, sorting and incineration in open area. For instance at North Horr urban centre solid wastes is collected into designated collection bins and incinerated in the open fields. Plastic wastes management is a major problem across the urban centres in the area. Waste oils are not a major issue in the area as vehicular operations is limited and no industrial plants are in the area. The proposed project will bring in additional people and facilities that will generate more solid wastes and waste oils from machineries. A simple but efficient waste management program will be put in place.

3.15 Socio-Economic Characteristics

3.15.1 Social Characteristics

Demography

The current project site will cover three districts Marsabit South (Laisamis) and Marsabit North (Chalbi) that have been carved off the larger Marsabit District (Marsabit central). According to the 1999 population census the larger Marsabit district had a population of 121,478 with an average annual growth of 3 %. This translates to a current population of approximately 150,500 people. The larger Marsabit district has one local authority, Marsabit County Council. The former vast Marsabit districts had six administrative divisions with population statistics as shown below:

Table 3.6: Summary of Population figures in the area.

	Population*	**Urban pop.***	**Headquarters**
Central	25,100	10,619	Marsabit
Gadamoji	12,345	0	,,
Laisamis	24,011	2,817	Laisamis
Loiyangalani	16,965	1,054	Marsabit
Maikona	19,518	-	Maikona
North Horr	23,539	2,343	North Horr
Total	***121,478***	***16,833***	

Source: 1999 population census

Education Situation

The project site being in an area that has been neglected in terms of socio-economic development over the years is still faced with low school enrolment rate. There are only 14 primary schools and 3 secondary schools in the project area. The secondary schools are at Maikona (2) and at North Horr (1). This has inevitably led to low transitional rate from primary to secondary school. Other issues affecting the education sector in the area include:

- Pastoralism – where parents move with their children in search of water and pasture
- Early marriages especially among girls
- Famine – there has been a severe drought in the past year
- Lack of teachers and other teaching aid

Plate 60: North Horr Primary School in North Horr Township

Table 3.7 below summarizes the number of schools in the area, their location and estimated student population.

Table 3.7: Educational facilities in the project area

Town Centre	Primary Schools (No.)	Approximate No. of Students	Secondary Schools (No.)	Approximate No. of Students
Kargi	2	700	None	
Maikona	2	500	2	188
Kalacha	2	650	None	
North Horr	3	700	1	200
Dukana	2	620	None	
Balesa	3	410	None	

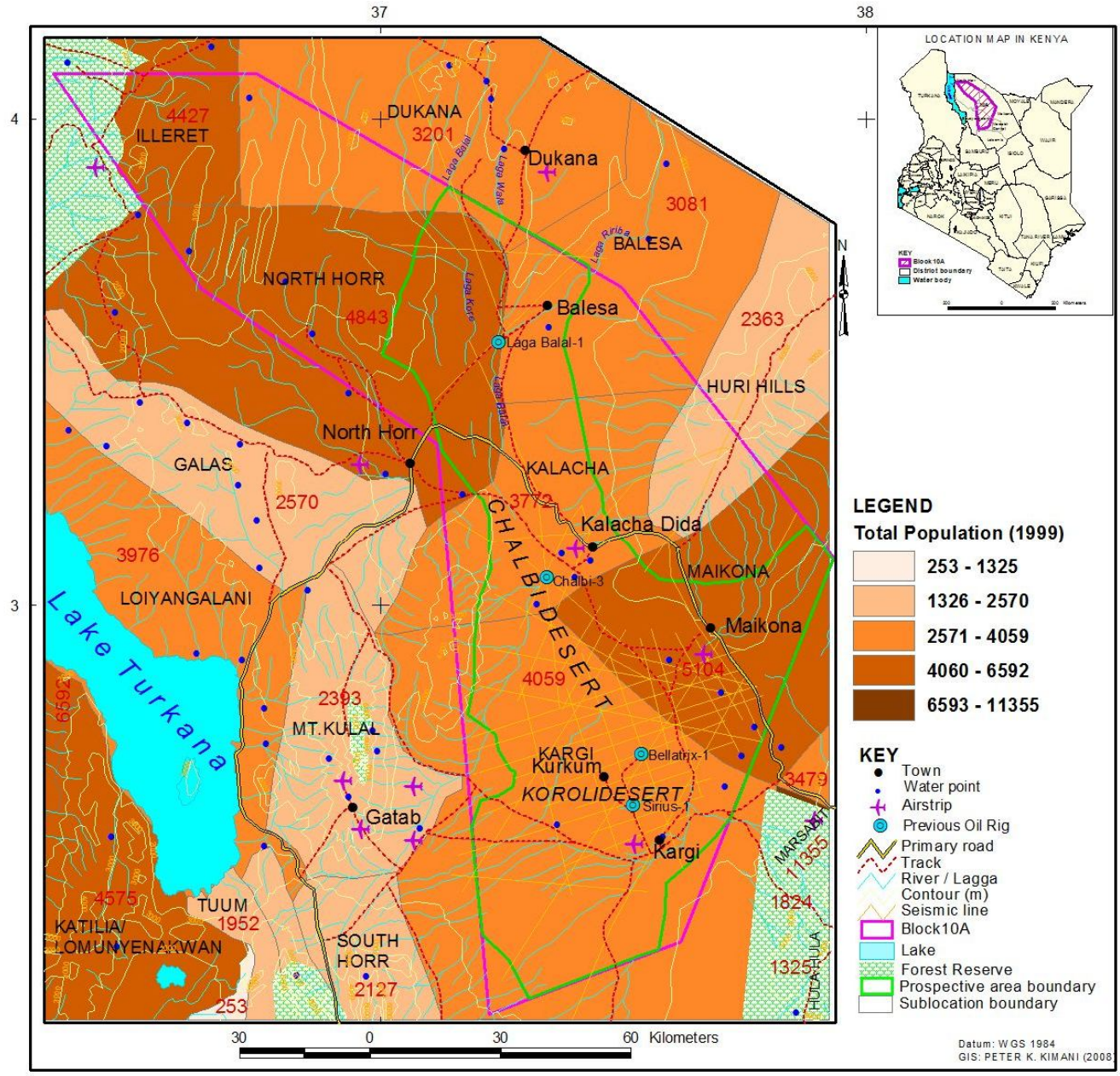


Figure 3.8: population of the study area

Housing

Housing in the project area varies from permanent to temporary structures. Human settlements are concentrated within town centres where other social amenities like water, schools and dispensaries are available. There are permanent brick houses complete with iron sheet roofing as well as semi-permanent houses with mud walls and iron sheet roofing. There are also scattered temporary houses locally referred to as Manyatta within the urban centres and also in the larger project site. Minimal commercial activities for instance shop keeping, food kiosks, and bars among others take place within the town centres. Housing type has also been influenced by religion in the area with the Catholic Church, AIC and Islam leading in development of permanent worship sites in the major urban centres.

Land Tenure System

Land in the project area is owned communally and is gazetted as a trust land. The Marsabit County Council acts as the trustees on behalf of the government of Kenya. Community elders play a critical role in communal land management and demarcation and their input will be important in selecting camp sites for the company's operation.

Plate 61: Catholic Church at North Horr Township

Plate 62: Housing type vary from temporary to permanent units at Balesa township

Social Support Services

The project area being in an arid area is faced with major socio-economic challenges. Human settlements are mainly concentrated in areas with social amenities like schools, water supply and health facilities. The town centres have health facilities and schools supported by the government and religious based organizations like the Catholic and African Inland Churches. Catholic Church supports health and school facilities at Kargi, Maikona, North Horr and Dukana while the AIC runs a dispensary at Kalacha.

The project area has adequate security personnel with several police units in various locations. There are two police stations at Dukana and North Horr while Administration Police camps are located at Kargi, Maikona, Kalacha, North Horr and Dukana. There are two General Service Unit (GSU) camps at Dukana and Illeret. Judicial services for the project area can be accessed at Marsabit Law Courts in Marsabit town. Village elders also play a crucial role in resolving family and societal disputes that occassionally arise.

Water for domestic and livestock purposes is mainly sourced from shallow wells and springs. The project area has no existing sewerage system and liquid effluent is managed through use of pit latrines. A local NGO called Solidarites has been instrumental in provision of sanitation facilities in the area.

The new districts carved out of the larger Marsabit District are yet to constitute District Emergency committees and all emergency activities are still coordinated from Marsabit district headquarters.

Community Stability and Culture

The project site lies in an area occupied mainly by the culturally rich Gabra and Rendille communities, other communities are the Borana, Dassanech and the El molo. These communities are still closely knit together and can be described as closed communities. There are strong cultural beliefs and norms that still bind the communities. Certain cultural ceremonies like birth of baby boys, rites of passage (circumcision), marriage and funerals are significant activities that bring the communities together. Other important activities that promote community bonds are the siting of the New Moon, Sorio and Almado ceremonies. Local community elders play a significant role in these ceremonies, in decision making as well as in internal conflict resolution. The community is also united in its livestock herding practices, livestock watering and in defending the livestock against rustlers.

3.15.2 Economic Settings

The proposed project site is found in an arid area that has minimal economic activities. The main source of livelihood is pastoralism that accounts for up to 80% of the population. The major livestock in the area are camel, goats, sheep, donkeys and a few cattle. Other economic activities in the project site include small scale business, basketry and weaving, construction (brick making) and formal employment. There are no industrial activities in the project area and minimal irrigation agriculture has been attempted at Kalacha and Elgade area. This, however, is faced with key challenges like invasion by wildlife particularly baboons and lack of capital.

Tourism is a potential economic activity that can be harnessed in the area. Found in the area are some of the world's rare and endangered animal and bird species. The communities also have rich cultures that can be harnessed to promote ecotourism. Of significant awe are the oases found in the desert and the unique sand dunes that can be key tourist attraction.

Other key resources in areas close to the project area are fish industry at Loiyangalani division near Lake Turkana, sand harvesting, solar and wind energy.

Plate 63: A Gabra Woman weaving

Plate 64: Brick Making at Maikona Urban centre

Labour Force

The proposed project site is vast and covers approximately 14,747 square kilometers. The site has six major town centres thus Kargi, Maikona, Kalacha, North Horr, Balesa and Dukana with an estimated youth population of 30,000 people. Most of the youths in the area have acquired basic education qualification though unemployment levels are high. This situation has led to high levels of poverty in the larger Marsabit district. Unskilled labour as well as a minimal technical labour force shall be readily available in the project area.

Transport and Traffic

The transport system in the area is dependant primarily on road and to a much lesser extent, air. The vehicle types that can withstand the harsh terrain in the area are lorries and four wheel drive vehicles. Lorries are used to ferry goods and people to and from Nairobi to the area while four wheel drive vehicles are used for various operations in the

area. Traffic levels in the area and along the main Isiolo – Moyale highway are low as there few economic activities taking place. There are several airstrips in the area and chartered flights can be used to access the project site.

3.16 Health and Public Safety

Health Services

The health sector in the project area is not adequately developed. Most of the health facilities are ill-equipped in terms of facilities and personnel. Religious based organizations like the Catholic Church and Africa Inland Church (AIC) in collaboration with the government play a leading role in support and provision of health care in the area. The general assessment of the health care facilities in the area indicates that they cannot handle medical emergencies of a big scale like a major outbreak or accident.

The Marsabit district hospital is still the referral centre for complex medical situations that can not be handled at the health centres. The hospital is fairly well equipped with staff and facilities. The hospital has 4 doctors, over 50 nurses, 1 operating theatre and has 2 ambulances. The hospital has a bed capacity of 90 inpatients and has several donors including Unicef and the World Health Organization (WHO).

The challenges facing the hospital currently include acute water shortage that has also hit Marsabit town, inadequate storage space and lack of a pediatric ward.

Table 3.8 below shows the health care facilities in the project area and their current status.

Table 3.8: Health facilities in the project area

Town Centre	Health Facilties (No)	Status
Kargi	1	Run by Catholic Mission
Maikona	1	Run by Catholic Mission has 3 nurses only
Kalacha	2	- Run by the Ministry of Health - Run by AIC Mission
North Horr	1	Run by Catholic Mission. Has adequate facilities and personnel
Dukana	1	Run by Ministry of Health has 2 nurses and one public health officer
Balesa	1	Run by Ministry of Health No staff member at the moment

Diseases

The most prevalent diseases in the project area are malaria, diarrhea, pulmonary TB, typhoid, respiratory complications and cancerous conditions in that order. The hospital has a Voluntary, Counseling and Testing (VCT) unit that undertakes counseling, testing and provision of anti-retro viral (ARV) drugs to those afflicted with HIV/AIDS. The only other health centre with a VCT in the area is at North Horr but lacks the anti-retro viral drugs. HIV/AIDS prevalence rates in the project area are still relatively low though affected persons face social stigma.

According to the Marsabit district hospital Nursing Officer in Charge cases of cancerous symptoms have increased over the years. The officer, however, said that the hospital has no capacity to diagnose cancer and refers patients to Meru or Nanyuki district hospitals. He confirmed that several patients have tested positive for esophagus cancer after visiting the said hospitals. The officers observed that there is no conclusive research to link the increase in cancer with the seismic operations of former oil prospecting companies in the area. Most of these patients have been from Kargi and Maikona area. This position agrees with the findings of a government committee on hazardous wastes in Eastern and North Eastern provinces formed in 2004 to investigate the allegations of sicknesses perceived to arise from activities of the Amoco company in the 1980s. The report concludes that “the claims of the presence of esophagus cancer in the region were everywhere the team visited and concern is overwhelmingly evident as reported by medical personnel and local community. However, this could not be linked to presence of any ionizing radiation as none was detected”.

Security and Public Safety

The project site being in a pastoralists dominated area is prone to livestock rustling from neighboring communities. Livestock rustling has been a traditional way of life in Northern Kenya, however, it took a different dimension with the proliferation of small arms into the country from neighboring war torn countries. The government has taken measures to provide adequate security to the nomadic communities. In the past one year there have been no major security incidents in the area. According to the local administration, nomadic communities now have areas demarcated for their livestock grazing during dry seasons to minimize conflict among them.

The project area is, however, considered to be generally secure. It is, however, important to put in place adequate security measures to protect people and property during the proposed seismic survey operations.

Public health in the area is well taken care of by government agencies and non governmental organizations. Solidarities is an NGO is involved in provision of sanitation facilities in the main urban centres while the government in collaboration with the Red Cross and the Catholic Church provides relief food on a monthly basis. The Church and the Christian Children Fund (CCF) have also initiated early childhood nutrition programmes in primary schools.

Plate 65: North Horr Health Centre supported by the Catholic Church and MOH

3.17 Corporate Social Responsibility

3.17.1 Community Views

Members of the public interviewed in the course of the EIA study cautiously welcomed the project, however, they want the process to be as open as possibly can be. This will help the community to erase the lingering fears about oil prospecting in the area. The community members are aware of Lundin's corporate social responsibility programmes but have also requested the company to consider the following projects in future:

- Potable water supply projects particularly in Kargi, Balesa and Dukana
- Harnessing of solar and wind energy to run borehole generators and for institutional use
- Construction of access roads in the interior parts of the project area. The community members also observed that the cut lines can be used as roads to access the interior parts.
- Re-forestation programme to cover for the vegetation that may be destroyed during cut lines construction.
- Support to women and youth groups through grants and soft loans

According to the Lundin's community liaison officer who accompanied the team during the study, the company is conscious about cultivating a cordial working relationship with the community. The company will give preference for employment opportunities to qualified people from the local communities as appropriate. In addition, for the first year

of operation the company has lined up the following projects as part of their Cooperate Social Responsibility initiatives:-

- Provision of portable solar cookers to selected women and youth groups
- The company will fund one project for each secondary school within the block. The school administration and board of governors will select the project of their choice. The projects could be library, classrooms, and laboratories among others.
- The company will also pay secondary school fees for a year for the best students in each location within the block. This will commence in January 2009 after the KCPE results for the examinations to be done later this year.

The representative mentioned that the local NGO known as Pastoralist Integrated Support Programme (PISP) will implement the above projects on behalf of the company. The local leaders shall also be involved in selecting the beneficiaries of the bursary scheme. Lundin will monitor the implementation of the projects in order to ensure that their CSR objectives are fully met.

3.17.2 Housing and Recreational Facilities for CONTRACTOR/LUNDIN Staff

A base camp will be constructed a place selected in consultation with the community leaders and local administration. It will be a safari style/ camp, consisting of fabricated containers and tents. Offices, clinic and kitchens will be air-conditioned containers.

Fuel storage facilities will be subcontracted and provided at the base camp There will be tented workshops for cable repair and mechanical repairs that will comply with relevant HSE standards.

Proper hygienic conditions will be maintained including water and sanitation .

Adequate medical supplies and treatment facilities shall be provided.

CHAPTER 4:

POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

4.1 Policy Framework

Environment and Development Policy

The Environment and Development Policy is outlined in the draft Sessional Paper No.6 of 1999. It covers the following environment and development issues: biological diversity; land and land based resources; water resources; fisheries and marine resources; energy resources; atmospheric resources; waste management; management of toxic and dangerous chemicals; radiation management; environmental health and occupational safety; human settlements; disaster management; implementation strategies; priorities for action; human resources development; environmental planning; environmental laws; environmental impact assessment; environment and land use practices; environment, industry and economic development; environment, research and technology coordination and participation; regional and international cooperation; and environmental management authority.

It outlines the following principles, goals and objectives:

Principles

a) Environmental protection is an integral part of sustainable development.
b) The environment and its natural resources can meet the needs of present as well as those of future generations if used sustainably.
c) All the people have the right to benefit equally from the use of natural resources as well as an equal entitlement to a clean and healthy environment.
d) Poverty reduction is an indispensable requirement for sustainable development.
e) Sustainable development and higher quality of life can be achieved by reducing or eliminating unsustainable practices of production and consumption; and by promoting appropriate demographic policies.
f) Endogenous capacity building is essential for development, adaptation, diffusion, and transfer of technologies for sustainable development.
g) Indigenous/ traditional knowledge and skills are vital in environmental management and sustainable development.
h) Effective public participation is enhanced by access to information concerning the environment and the opportunity to participate in decision-making processes.
i) Public participation including women and youths is essential in proper environmental management.
j) For sustainable management, the polluter pays principle should apply.
k) Access to judicial and administrative proceedings, including redress and remedy, is essential to environmental conservation and management.
l) Private sector participation in environmental management is essential for sustainable development.
m) Effective measures should be taken to prevent any threats of damage to the

environment, notwithstanding lack of full scientific certainty.
n) Peace, security, development, and environmental protection are interdependent and indivisible.
o) International co-operation and collaboration is essential in the management of environmental resources shared by two or more states.

Overall Goal

The overall goal is to integrate environmental concerns into the national planning and management processes and provide guidelines for environmentally sustainable development.

Specific Goals

a) To incorporate environmental management and economic development as integral aspects of the process of sustainable development.
b) To promote maintenance of a quality environment that permits a life of dignity and well being for all.
c) To encourage sustainable use of resources and ecosystems for the benefit of the present generations, while ensuring their potential to meet the needs of future generations.
d) To promote maintenance of ecosystems and ecological processes essential for the functioning of the biosphere.
e) To promote the preservation of genetic resources, biological diversity, their cultural values and their natural heritage.
f) To incorporate indigenous knowledge, skills, and interests for effective participation of local communities in environmental management and sustainable development.

Objectives

a) To conserve and manage the natural resources of Kenya including air, land, flora, and fauna.
b) To promote environmental conservation with regard to soil fertility, soil conservation, biodiversity, and to foster afforestation activities;
c) To protect water catchment areas;
d) To enhance public awareness and appreciation of the essential linkages between development and environment;
e) To initiate and encourage well coordinated programmes of environmental education and training at levels of society;
f) To involve NGOs, private sector, and local communities in the management of natural resources and their living environment;
g) To support a coordinated approach to policy formulation on environmental matters;
h) To ensure development policies, programmes, and projects take environmental considerations into account;
i) To ensure that an acceptable environmental impact assessment report is

undertaken for all public and private projects and programmes;
j) To develop and enforce environmental standards;
k) To enhance, review regularly, harmonize, implement, and enforce laws for the management, sustainable utilization, and conservation of the natural resources;
l) To provide economic and financial incentives for sustainable utilization, conservation, and management of natural resources;
m) To apply market forces, taxation, and other economic instruments including incentives and sanctions to protect the environment and influence attitudes and behavior towards the environment;
n) To ensure adherence to the polluter pays principle; and
o) To develop adequate national laws regarding liability and compensation for the victims of pollution and other environmental damage.

National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999)

The management of water resources in Kenya is guided by four specific policy objectives, namely:

1. Preserve, conserve and protect available water resources and allocate it in a sustainable, rational and economic way.
2. Supply water of good quality in sufficient quantities to meet the various water needs, including poverty alleviation, while ensuring the safe disposal of wastewater and environmental protection.
3. Establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector.
4. Develop a sound and sustainable financing system for effective water resources management, water supply and sanitation development.

Energy Policy (Sessional Paper No.4 of 2004)

The broad objective of the national energy policy is to ensure adequate, quality, cost effective and affordable supply of energy to meet development needs, while protecting and conserving the environment. The specific objectives are to:

(i) provide sustainable quality energy services for development;
(ii) utilise energy as tool to accelerate economic empowerment for urban and rural development;
(iii) improve access to affordable energy services;
(iv) provide an enabling environment for the provision of energy services;
(v) enhance security of supply;
(vi) promote development of indigenous energy resources; and
(vii) promote energy efficiency and conservation as well as prudent environmental, health and safety practices.

Mining Policy

The National Mineral Resources and Mining Policy are currently at an advanced stage of being adopted. In tandem with this process, the Government has developed a new mining legislation to replace the *Mining Act, Cap.306* of 1940, which is both antiquated and ineffective. Under the new mining legislation, rights and interests in minerals of all kinds, including commonly found minerals, will be regulated. The new mining legislation is being harmonised with existing environmental legislation. In particular, mining companies will be required to comply with the requirements of the Environment Management Authority Act and other applicable environmental legislation and, the new legislation will provide that mining licences may not be granted unless the applicant has obtained an Environmental Impact Assessment ('EIA') Licence.

Health Policy[1]

The Kenya Health Policy Framework (1994) sets out the policy agenda for the health sector up to the year 2010. This includes strengthening of the central public policy role of the Ministry of Health, adoption of an explicit strategy to reduce the burden of disease, and definition of an essential cost effective health care package. To operationalise this Health Policy Framework Paper, the National Health Sector Strategic Plan (NHSSP, 1999-2004) was developed in 1994. The strategic plan emphasized the decentralization of health care delivery through redistribution of health services to rural areas. The plan is currently being revised to reflect the Poverty Reduction Strategy Paper (2001-2004) agenda. The new plan focuses on the essential key priority packages based on the burden of disease and the required support systems to deliver these services to the Kenyans. Major players in the health sector include the government represented by the Ministry of Health (MoH) and the Local Government, private sector and non-governmental organization (NGOs). The organization of Kenya's health care delivery system revolves around three levels, namely the MoH headquarters, the provinces and the districts. The headquarter sets policies, coordinates the activities of NGOs and manages, monitors and evaluates policy formulation and implementation. The provincial tier acts as an intermediary between the central ministry and the districts. It oversees the implementation of health policy at the district level, maintains quality standards and coordinates and controls all district health activities. In addition, it monitors and supervises district health management boards (DHMBS), which supervises the operations of health activities at the district level.

Economic Recovery for Wealth and Employment Creation Strategy

The overall goal of the Strategy is to ensure clear improvements in social and economic wellbeing of all Kenyans, thereby giving Kenyans a better deal in their lives and in their struggle to build a modern and prosperous nation (GVEP Kenya, 2006). The key areas covered in the Strategy are:

(i) expanding and improving infrastructures;
(ii) reforms in Trade and Industry;
(iii) reforms in forestry;
(iv) affordable shelter and housing;
(v) developing arid and semi-arid lands; and
(vi) safeguarding environment and natural resources.

The Strategy, which has commanded a great deal of attention in the last four years, essentially subsumes the Poverty Reduction Strategy Paper (PRSP).

4.2 Legal and Institutional Framework

Environment considerations for new and existing developments are subject primarily to the Environment Management and Co-ordination Act (EMCA), 1999. The Act establishes certain institutions indicated below, with the functions directly relevant to this Environmental Impact Assessment outlined as follows.

1. The National Environment Council has the following functions:

a) Responsible for policy formulation and direction for purposes of this Act;
b) Set national goals and objectives and determine policies and priorities for the protection of the environment;
c) Promote co-operation among public departments, local authorities, private sector, Non-Governmental Organisations and such other organizations engaged in environmental protection programmes; and
d) Perform such other functions as are assigned under this Act.

2. National Environmental Management Authority

1. The object and purpose for which the Authority is established is to exercise general supervision and co-ordination over all matters relating to the environment and to the principal instrument of government in the implementation of all policies relating to the environment.

3. Without prejudice to the generality of the foregoing, the Authority shall:

a) Co-ordinate the various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plans, programmes and projects with a view to ensuring the proper management and rational utilisation of environmental resources on a sustainable yield basis for the improvement of the quality of human life in Kenya;
b) Take stock of the natural resources in Kenya and their utilisation and conservation;
c) Establish and review in consultation with the relevant lead agencies, land use guidelines;
d) Examine land use patterns to determine their impact on the quality and quantity of natural resources.

e) Carry out surveys which will assist in the proper management and conservation of the environment;
f) Advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements in the field of environment, as the case may be;
g) Advise the Government on regional and international environmental conventions, treaties and agreements to which Kenya should be a party and follow up the implementation of such agreements where Kenya is a party;
h) Undertake and co-ordinate research, investigation and surveys in the field of environment and collect, collate and disseminate information about the findings of such research investigation or survey;
i) Mobilise and monitor the use of financial and human resources for environmental management;
j) Identify projects and programmes or types of projects and programmes, plans and policies for which environmental audit or environmental monitoring must be conducted under this Act;
k) Monitor and assess activities, including activities being carried out by relevant lead agencies, in order to ensure that the environment is not degraded by such activities, environmental management objectives are adhered to and adequate early warning on impending environmental emergencies is given;
l) Undertake, in co-operation with relevant lead agencies programmes intended to enhance environmental education and public awareness about the need for sound environmental management as well as for enlisting public support and encouraging the effort made by other entities in that regard;
m) Publish and disseminate manuals, codes or guidelines relating to environmental management and preventing or abatement of environmental degradation;
n) Render advice and technical support, where possible, to entities engaged in natural resources management and environmental protection so as to enable them carry out their responsibility satisfactorily.
o) Prepare and issue an annual report on the state of the environment in Kenya and in this regard may direct any lead agency to prepare and submit to it a report on the state of the sector of the environment under the administration of that lead agency;
p) Perform such other functions as the Government may assign to the Authority or as are incidental or conducive to the exercise by the Authority of any or all of the functions provided under this Act.

The minister shall lay every annual report on the state of the environment prepared under subsection (2) (p) before the National Assembly as soon as reasonably practicable after its publication where the National Assembly is in session, or where not in session, within twenty-one days of the day the National Assembly next sits after such publication.

4. Provincial and District Environment Committee shall:

- Be responsible for the proper management of the environment within the province or district in respect of which they are appointed.
- Perform such additional functions as are prescribed by this Act or as may, from time to time, be assigned by the Minister by notice in the Gazette.

Other Acts of relevance are (cf. Mumma, 2002):

- Public Health Act, Cap 242
- Water Act 2002
- Factories Act, Cap 515
- Local Government Act, Cap 265
- Local Government Act, Cap 265
- Penal Code, Cap 63
- Mining Act, Cap 309
- Electric Power Act, 1997

The Water Act 2002

This is one of the most up to date environment-related statutes in the country (Okidi, 2006). It has introduced comprehensive and, in many instances, radical, changes to the legal framework for the management of the water sector in Kenya (Mumma, 2005). These reforms revolve around the following four themes (Mumma, 2005): the separation of the management of water resources from the provision of water services; the separation of policy making from day to day administration and regulation; decentralization of functions to lower level state organs; and the involvement of non-government entities in the management of water resources and in the provision of water services. The role of non-government entities in the management of water resources and in provision of water services is thus clearly recognized. The Water Act goes hand in hand with the Water Quality Regulations, Legal Notice No.120 (Kenya Gazette Supplement No.68, 29th September 2006 – Legislative Supplement No.36) which regulates, amongst others, water for industrial use and effluent discharge, providing standards and monitoring guidelines for effluent discharge into the environment.

The Energy Act, 2006

This Act has now superseded the Electric Power Act 1997 that has been inadequate in providing incentives to the private sector and in accelerating electrification in the country, and the Petroleum Act Cap 116 that has been wanting in offering an effective regulatory framework for the petroleum industry (GVEP Kenya 2006). The Energy Act 2006 stipulates that petroleum based projects should comply with Environment Management and Co-ordination Act (1999) and the Environmental (Impact Assessment and Audit) Regulations, 2003, with respect to mandatory environmental impact assessments and that no licenses be granted prior to their implementation.

The Petroleum Act, Cap 308

This Act specifies the role of the exploration company in the project area and indicates circumstances upon which compensation for destruction of the environment should be made. Section 9 (i) stipulates that exploration should be conducted in accordance with sound professional and technical skills and adopt measures necessary for the conservation of petroleum and other resources and the protection of the environment and human life. Sub section (g) also gives preference to the use of products, equipment and services that are locally available in the project area. Section 10 (2) and (3) deals with issues of private land and compensation thereof if exploration activities is to use part of the land. The section also gives situations where a legal redress can be sought by the private land owners in case of dissatisfaction.

The Public Health Act

The Act contains a comprehensive provision on discharges of pollutants into watercourses (Mumma, 2002). The Act makes it the duty of every local authority (in the capacity of "health" authority) to take all lawful, necessary and reasonably practicable measures to safeguard and promote public health (s.13). Part IX of the Act deals with sanitation and housing, and is of most significance for the control of polluting discharges. S.116 imposes a duty on every local authority to maintain its district in a clean and sanitary condition, to prevent nuisances and prosecute those responsible for nuisances. Nuisances include drains and sewers for the discharge of pollutants into watercourses and lakes.

Section 126 of the Public Health Act empowers the Minister to make rules on:

- The drainage of lands, streets or premises, the disposal of offensive liquids, and the removal of, *inter alia*, waste matters;
- The standards of purity of any liquid which, after treatment in any purification works, may be discharged as effluent;
- The establishment and carrying on of factories or trade premises which are liable to cause effluent, or to discharge liquid liable to, *inter alia*, pollute streams.

Similarly, under section 126A local authorities have the power to make by-laws to regulate drainage and sewers (Mumma, 2002). The act also makes provision for protecting from pollution sources of drinking water supply. Section 129 makes it the duty of the local authorities to prevent such pollution, to purity a pollution supply and to prosecute the polluters. The Minister may make, and require local authorities to enforce, rules for preventing polluting activities threatening such drinking water supply, and for purifying polluted water.

The Public Health (Drainage and Latrine) Rules made under Section 126 of the Act, makes more specific provision for drainage (Mumma, 2002). The Rules –

- Require the drainage of new buildings;
- Prohibit the drainage of surface water into foul water sewers;

- Prohibit the discharged into sewers of matter which may interface with the free flow of the sewage or injure the sewer;
- Empower the local authority to prohibit the discharge of injurious matter into sewers;
- Empower the local authority to require the treatment of effluent before discharge into sewers ; and
- Impose a requirement for permits to be obtained from the local authority before the making of sewer connections or the construction of sewage treatment works.

The Factories Act Cap 514

This is the primary Occupational Safety and Health Act. The Act has been revised several times in order to reflect not only developments in technology and knowledge but also to address new areas of coverage other than factories/ industries (Muchiri, 2005). The last such amendment was in 1990 when the Act was amended to include among others:

- "Other places of work"
- List of occupational diseases
- Establishment of health and hygiene standards
- Reporting of occupational diseases
- Direct penalties for medical practitioners failing to report occupational diseases that they diagnose
- Pre-employment, periodic and post-employment medical examinations
- Research into causes of work-related diseases among others

A new Bill "Occupational Safety and Health Bill" was drafted in 2003 to replace the "Factories and Other Places of Work" and currently awaits parliamentary debate (Muchiri, 2005). This Bill is closely linked to the draft Bill on "Work Injury Benefits Act" that will also cover OSH financing, including rehabilitation, prevention and promotional activities among others. The Bill awaits parliamentary debate and once passed, both these two Acts will be implemented under the same management (Muchiri, 2005).

The Local Government Act

Also contains provisions empowering local authorities to control discharges. Under section 163 (a) local authority may control or prohibit activities, both industrial and domestic, which constitutes 'a source of danger, discomfort or annoyance to the neighbourhood', as an offensive trade or as have been gazetted by the Minister (Mumma, 2002). One further way of control is for the local authority to refuse to licence the activity on the ground that the treatment method proposed is not adequate [s.165]. Generally, it is the local authority's duty to establish and maintain sewerage and drainage works within its area (s.168). It may charge for this service [s.176 (2)], and the charge is recoverable from the owner of any land or premises served (Mumma, 2002).

The Physical Planning Act 1996

This Act makes provision for development control. Persons wishing to undertake development must apply for and obtain consent from the local authority. The planning authority when considering a planning application shall have regard, *inter alia*, "to the health, amenities, and convenience of the community generally, and the proper planning and density of development and use of land in the area (Mumma, 2002).

Conditions imposed in granting consent to a planning application may require or prohibit specified activity. They may also require the applicant to enter into an undertaking to observe the conditions imposed and to furnish security to this end (Mumma, 2002).

The Food, Drugs and Chemical Substances Act

This Act makes it an offence to use or dispose of chemical substances in a manner likely to cause contamination of food or water for human consumption (section 24) (Mumma, 2002).

Registration of Land Act

Private land is registered under the Land Titles Act, Chapter 281 of the Registration of Land Act (RLA), Chapter 300. The RLA provides for the issuance to land owners of a title deed, and in cases of leasehold interests, a certificate of lease, which shall be the only prima facie evidence of ownership of the land (Mumma, 2005). The RLA provides that the registration of a person as the proprietor of land vests in that person the absolute ownership of that land together with all rights and privileges belonging or appurtenant thereto and free from all other interests and claims whatsoever.

Land registration, granting private ownership, has been completed in those regions of the country with high agricultural potential whereas in the areas in which pastoralism is predominant communal tenure is recognized by the law. But despite the registration of land in the names of private individuals empirical evidence suggests that, even in high agricultural potential areas, among rural communities, land use and access rights continue to be based largely on customary and traditional systems, statutory law, notwithstanding. Indeed studies have revealed what one author (Migot-Adhola et al, 1990) has described as "a surprising recalcitrance of indigenous institutions and land use practices" (Mumma 2005)

Mining Act, Cap. 306 of 1940

While the Mining Act still remains effective, efforts are underway and at an advanced stage to replace this old and ineffective Act with a new one. Under the new mining legislation, rights and interests in minerals of all kinds, including commonly found minerals, will be regulated. The environmental and social standards under which economic activities should be conducted in Kenya and the methods by which the Government seeks to enforce them is already part of established national policy and regulatory framework established under the Environmental Management and

Coordination Act 1999 ('Environment Act'). The Government's objective is to achieve a socially acceptable balance, within this framework, between mining and the physical, ecological and human environment and to ensure that internationally accepted standards of health, mining safety, human rights and environmental protection are observed by all participants in the mining sector. The new mining legislation is being harmonised with existing environmental legislation. In particular, mining companies will be required to comply with the requirements of the Environment Act and other applicable environmental legislation and, the new legislation will provide that mining licences may not be granted unless the applicant has obtained an Environmental Impact Assessment ('EIA') Licence.

4.3 Lundin Kenya B.V commitment to Environment protection

Lundin, for its corporate environmental requirements, refers to the Company's Code of Conduct, Environmental Policy, as well as its Health, Safety and Environmental Management System (HSEMS) manual that is called "The Green Book". The main objective of the HSEMS is to ensure that HSE concerns are managed in a comprehensive and effective manner. It expresses the Company's commitment to the safety of its staff, contractors, and the public as well as to minimising the effects of its activities on the environment.

The HSEMS has five policy segments, namely:

- **Health and Safety Policy:** This policy aims to provide a safe working environment for employees, contract personnel, and members of the public who may be put at risk by the activities of the company.

- **Environmental Policy:** This policy aims to ensure that exploration and production operations are conducted in compliance with all applicable environmental laws and regulations and, as a minimum, meet company-specified environmental procedures and programmes. It underscores the Company's commitment to conservation, pollution minimisation, cooperation with other stakeholders in relation to environmental protection, training of personnel to ensure capacity to undertake sound environmental practices, and compliance monitoring and auditing.

- **HSE Policy Integration:** This aspect of the policy framework integrates aspects of the health and safety policy and the environment policy. It aims to ensure safe working environments, environment protection, stakeholder awareness of the HSE implications of its operations, and high standards of training amongst its employees, contractors and other business partners. It also integrates international and national legislative requirements.
- **Corporate HSE Policies:** This policy relates to the cascading of responsibilities in relation to HSEMS implementation within the company and to business partners and other stakeholders, with the ultimate responsibility resting upon the CEO.

- **Local HSE Policies:** These relate to the formulation of activity- or operation-specific policies in the Company's diverse business units, with the responsibility for their implementation, monitoring and auditing resting upon the General Managers.

Responsibilities: Lundin has set up a responsibilities structure that cascades downwards from the Chief Executive Officer (CEO), through the Chief Operating Officer (COO), Vice-President Corporate Responsibility (VPCR), General Manager (GM), to Operation Manager (OM). The 'Green Book" clearly specifies the roles and duties of the officers.

Planning: Lundin's planning framework has been summarised in the Figure below. The main elements of the HSE planning are: identification of business and regulatory requirements; development of country objectives and targets; emergency and contingency planning; and review of achievements. The planning framework helps the Company to define HSE aspects that are relevant to its operations and aids in the development of strategies to address them.

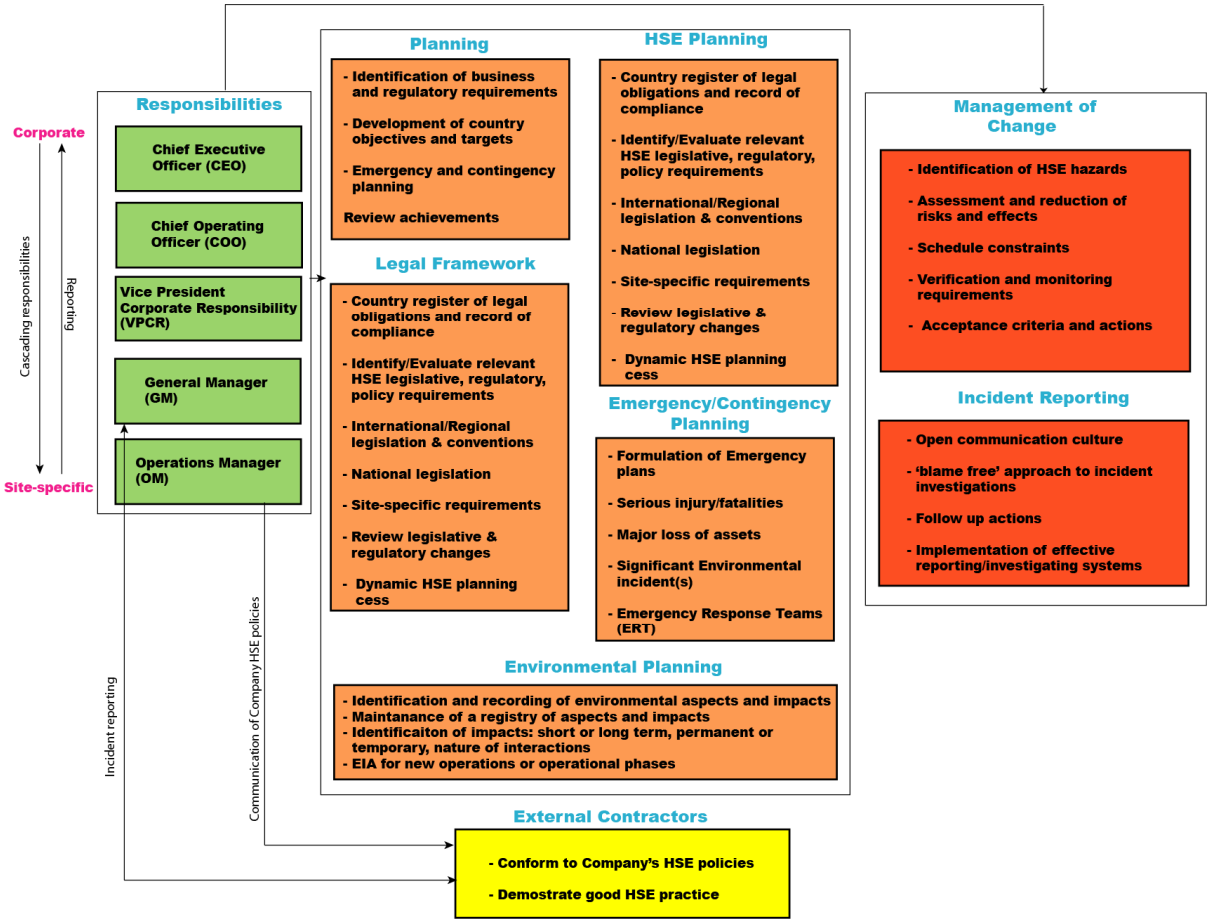


Figure 4.1: Lundin HSE Planning framework (simplified from the 'Green Book') (Earthview Geoconsultants, 2008).

Implementation and Operation: Under this issue, employees and contracted staff are to be made familiar with all relevant procedures and instructions prior to commencing their duties. There are provisions of HSE officers. The Company is committed to ensuring that all personnel and contractors are suitably equipped to carry out their assignments. It is noted that the Company enforces a prohibition on drugs, alcohol and smoking at operational sites and effects this policy in compliance with the local context and laws. HSE awareness, skills enhancement and compliance is maintained through training using a variety of methods, and through exchange of information, ideas and practices amongst its employees. The Green Book notes that good external communications are essential in maintaining public confidence in the integrity of the Company's operations and good relations with regulators, as well as during emergency situations. The stakeholders include the local community, government and others. Auditing of HSE issues are based on a detailed Documentation Control procedure.

Assessment and Management of Risk: For all its activities, products and services, the Company undertakes to identify the potential adverse HSE impacts, assess the risks, and institute appropriate control measures. Risk management options will be based on sound science.

Monitoring and Evaluation: There shall be periodic reviews of the HSEMS to determine the effectiveness of its performance and continuing suitability, and to identify any improvements that may be required. Regular HSE audits and inspections shall be undertaken.

3.4.2 Code of Conduct

Lundin Kenya B.V. subscribes to the Lundin Petroleum AB's Code of Conduct, adopted in the year 2001 and effected since then to date in its operations internationally. This section will highlight the key aspects of the Code of Conduct as applicable to the Environmental Impact Assessment in Block 10A.

Vision and Values: Lundin aims not only to find oil and gas but is also committed to developing the resources in the best socio-economic manner possible for the benefit of all its partners, including the host country and local communities. The Code of Conduct Vision Statement emphasises social responsibility, environmental acceptability, and benefit sharing amongst its employees and with its shareholders and co-venturers. The Code of Conduct Values Statement is particularly pertinent, as it outlines Lundin's commitment to:

1. Act in a fair, honest and equitable way
2. Observe local laws and regulations
3. Respect local customs and traditions
4. Observe applicable international laws and standards
5. Uphold generally accepted principles on the protection of human rights and the environment.

Responsibilities: The outlined responsibilities include provision of safe and rewarding working environment for employees, contribution to local development and higher living standards of local communities.

Principles: Some of the pertinent principles as relate to attitude towards business include: maintaining transparency in the manner in which their business is conducted; honouring of commitments; use of appropriate and adequate means to protect its staff and operations; refrain from accepting/offering improper payments, gifts or engaging in bribery or corrupt business practices, and; seeking similar standards from co-venturers and sub-contractors. Attitude towards employees includes an optimal working environment where employee safety, health, rights, working conditions, individual potential, cultural diversity are respected and without discrimination on the basis of age, culture, disability, gender, race, religion, etc. The company also commits to maintaining good relations with the host countries in which it operates, including adhering to local lows and rules. Two further statements on the (1) attitude towards local communities and (2) the attitude towards the environment are some notable keystone features of the Code of Conduct, as they are extremely relevant to the situation that exists in Block 10A where the seismic survey will be carried out. These are therefore listed in further detail in the table below.

Attitude towards Local Communities	**Attitude towards the Environment**
Encourage employment of indigenous people	Comply with applicable environmental laws and regulations and international standards
Engage in capacity building through the transfer of skills and technologies	Adhere to the HSEMS
Work with local communities by contributing to improve their health, education and welfare	Use sound technologies
Respect indigenous people and their traditions	Cooperate with industry, government and the public on programs to protect the environment
Minimise disturbances that may be caused by their operations	Minimise and mitigate the effects of pollution within the scope of its operations
Be mindful of the impact of its security arrangements on the communities	Review and monitor its environmental performance
Refrain from any implications in tribal or internal armed conflicts or acts of violence	

Compliance: Compliance with the Code of Conduct is taken seriously and is an integral part of the Company's employment contracts, and is promoted through training, assessment and reporting requirements.

CHAPTER 5:

ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Impact Identification, Evaluation, Prediction and Mitigation

5.1.1 Physiography and Geology

No alterations to physiography and geology are envisaged. Natural geohazards are relatively insignificant in the area. Based on the available but rather limited seismic data, the area can generally be categorised as aseismic and flat lying. Earthquake risk is rather low. There is however a potential risk of landslides in form of rock fall, rock slide and slumping especially along Kalacha terrace where basalts are loosely deposited.

Suggested mitigation:

- The Vibroseis *shot points* should be located as far as possible from Kalacha terrace where basalts are loosely deposited so as to minimise the risk of landslides in the form of rock fall, rock slides and slumping. The company is however proposing to use low vibrator drive levels.
- Vibrators will be run at *low drive levels* with increased number of sweeps to make up energy input.

5.1.2 Soils

The lacustrine plains (mapping units PI1,PI2,PI3,PI4,) that comprise the Chalbi desert and the sedimentary plains (mapping units PS1, PS2 and PS3) to the south of Chalbi, are susceptible to flooding and water logging potential during the wet season. The road that traverses these units from Kargi through Chalbi to North Horr and Kalacha via Balesa turnoff to North Horr, are impassable during the wet season. The bridge constructed at the North Horr-Kalacha road is poorly constructed and lacks a culvert for storm water discharge. Consequently gully formation at various points along the bridge has made the frequent repairs to the bridge inconsequential. Wind erosion has further degraded the environment in these mapping units. Seismic lines excavated within these depleted units could be potentially destructive to the environment where they cross roads, luggas and drainage lines. This is basically due to the potential triggering of gully formation that could be exacerbated by the presence of sodium (a dispersion agent) in the soil units. Seismic lines may also necessitate the removal of scarce vegetation found within the lacustrine and sedimentary plains along the prescribed transects and roadways where equipment and machinery would traverse. Salinity in these units has also contributed to low vegetal matter, thus removal of the same would affect the environment negatively. Further, use of heavy machinery in these units would compact the soils increasing their bulk densities and consequently affecting the drainage characteristics.

Suggested mitigation:

- The seismic lines, where possible, should be made in such away as to avoid natural drainage lines, luggas and road crossings. Existing access ways should be considered for usage as much as possible.
- Where seismic lines and roads cross luggas, local reinforcing by stone gabions and mortar should be done. This would control gulley formation due to the combined effect of wind and water erosion. Further, due to salinity and sodicity constraints in these units, it would be prudent where the seismic lines cross large luggas, for culverts to be constructed to control storm water discharge.
- Equipment load should be adapted to the existing road and bridge infrastructure.
- The seismic lines and transport corridors should avoid the existing oasis and their immediate environs that also act as cropping land. These natural springs are very important in a fragile environment. Livestock for example move from Dukana and Balesa to Kalacha for water. The same water source is used by the community for life sustenance.

5.1.3 Climate

There are no significant impacts envisaged on the microclimate and the general climatic condition of the oil prospect area.

Suggested mitigation:

- None

5.1.4 Air Quality

Dust emanating from construction of seismic transects, base camps and access ways as well as that generated by moving trucks and equipment are likely to enhance air pollution in addition to the natural air pollution from windblown sand and dust deposits. Further, the disturbed surface with fine textured soils as a result of site clearance would be susceptible to wind erosion. In addition, burning of the resultant litter, exhaust fumes from the fleet of seismic survey trucks and service vehicles would also contribute to air pollution. The effects of these particulate/aerosol pollutants on air quality will be transient and localized.

Suggested mitigation:

- Limit traffic speed and restrict movement of vehicles as is reasonable to minimize sand and dust generation. Machinery and vehicles should be switched off when not in use as appropriate.
- Minimize site clearance as much as possible.
- Burning of litter should be done rapidly and in a time of low wind movement, preferably in areas shielded by vegetation.
- Regular servicing of all trucks, service vehicles and machinery powered using fossil fuels is recommended so as to reduce exhaust emissions.

- Employees ought to be provided with proper personal protective equipments (PPE) throughout the entire operation
- Periodic watering of ground surface in the camp areas to reduce dust levels in dry seasons.

5.1.5 Surface and Ground Water Resources and Effluents

Water is a key resource in the project area since the inhabitants are mainly pastoralists. Its scarcity has often led to conflicts and there is need to protect the numerous sources of water such as springs, oasis and wells currently available in the project area. It is evident that the construction and exploration phases of the project will create additional demand of the water supply due to increase in the number of people within the project area and water demand requirements for the seismic survey operations itself. The project area does not have piped water and Lundin Kenya B.V. shall have to consider alternative means of sourcing water for use during the seismic operations. Members of the community consulted feel that the seismic tracks/transects may disrupt the natural water-course ways, springs and oasis where animals converge from far and wide for watering. Effluent management along the seismic tracks/transects would be a challenge as there is no sewage network in the project area. There being no sewerage or septic system within the project site, the disposal of human excrement would be a challenge. This includes effluent management in the base camps. The installation of water closets and a septic system may not be feasible at this stage considering the project period and the cost implication.

Suggested mitigation:

- Encourage water re-use and/or conservation especially at the base camps during seismic tracks construction and operation phases of the project.
- Liquid effluent, if any, should preferably be treated before discharge.
- Hazards and toxic waste material should be managed according to international protocols and practices and comply with local regulations as well.
- The seismic crew should separate grey and black water which should be fed to evaporation pits. These should then be treated and filled at the end of the survey and camp occupation.
- Seismic survey operations should be minimised as is reasonable when conducted close to watercourses.
- Install drainage channels on roads where reasonable natural drainage may be affected.

5.1.6 Terrestrial Environment: Flora and Fauna

Given the arid and semi arid outlook of the block, it is anticipated that large sections of the seismic acquisition area will be exposed to wind and water erosion as most of the land is fragile characterised by loose soils, undulating landscapes and sparse vegetal cover. In addition, vibration from the heavy machinery and clearing tracks of land to lay cut-lines are also anticipated to have an impact on the resident flora and fauna and the

wider ecosystem. Direct impacts are anticipated to be: clearing and excavation of vegetal matter during construction, interfering with dry season grazing refuges, destruction and disturbance of nesting, roosting and foraging sites, population increase in the area leading to pressures on the limited terrestrial environmental resources.

Suggested mitigation:

- Clearing and excavation of vegetal matter should be minimized as much as possible to a reasonable level. However, if unavoidable, it should take place during the dry season in order to reduce the chances of wind and water based soil erosion accruing as a result of the proponent's exploratory activity.
- Amenities and other facilities that will/ might be used by the proponent should be if not inevitable; sited away from critical habitats patches such as foraging grounds, roosting, nesting and dry season grazing refuges.
- In order to ease against population pressures, measures can be taken to ensure that the available resources are utilized in a conservative way, and/or the practice of recycling is encouraged.
- During the planning of seismic lines, established vegetation, sensitive soils and hilly terrain, should be avoided if possible. if inevitable considerations should be made to follow established access roads and river crossings.

5.1.7 Aquatic Environment

Block 10A lies in a very arid area with one of the biggest desert regions in Kenya. Rainfall in this area is low and often highly variable on a spatial and temporal scale. Therefore, owing to the physiographical nature and fragility of the ecosystems present, the aquatic environments will be susceptible to contamination of surface water, especially during rainstorms. Soil excavation may have an impact on the resident aquatic flora and fauna and the wider ecosystem. Contamination of the water sources include sedimentation as a result of surface run-off, refuse/ garbage disposal /septic systems, and fuel and other oils tanks located upslope or within the confines of the water source. Any of these processes may lead to a change in the ecology of the present aquatic environments and also the socio-economic well being of the local communities as a consequence of related possible reduced productivity of the aquatic habitats in the area.

Suggested mitigation:

- The seismic survey should be acquired in such a manner that necessary measures are taken to protect the vegetation cover as much as possible. Where possible seismic lines to be cleared minimally and root stock be left in the ground uncut.
- The use of heavy machineries and vehicles over the uphill water bearing layer, on steep slopes and ecologically sensitive areas should be avoided to prevent compaction that may lead to reduced water flows and also irreversible environmental damage.

- Clearing of vegetation cover should be avoided as much as possible, and the activity, if inevitable, should preferably take place in the dry season in order to avoid unnecessary removal of vegetation cover and topsoil layer, thus reducing water based soil erosion.
- Riverine forests are vital habitats for a variety of fauna species; therefore seismic operations in these areas should be avoided.
- Seismic lines should be deviated as much as possible to avoid crossing over water sources, established vegetation and sensitive soil areas.
- Incase the camps will be established near water sources, all surface run-off from the camp establishments should be diverted away from the water source to reduce chances of contamination.

5.1.8 Land Resources and Natural Heritage Sites

The proposed cut lines construction could lead to destruction of land resources like the duom palm and degradation of soil through compaction and erosion. Use of heavy machineries may lead to temporary degradation of land and destruction of vegetation and trees. This may also lead to destruction of browse and pasture areas for both wildlife and livestock. Proposed cut lines may pass through natural heritage sites, cause damage and lead to conflict with the communities.

Suggested mitigation:

- Use of heavy machineries should be limited within the cut lines only.
- Cutting of trees and clearing of vegetation should only be done where absolutely necessary. The proponent should remediate through re-vegetation of affected sites in the area
- Consultation with local leaders and elders should be done prior to cutting of any trees or clearing of vegetation and in the selection of final transect lines in order to avoid interference with the identified community and natural heritage sites.

5.1.9 Visual Aesthetics

It is anticipated that there will be minimal disruption of the aesthetics of the pristine environment which is characterised by vast plains comprised of basalts, carbonates and sand and dust deposits and indigenous vegetation. Interferences will result from the constructions within the base camps, seismic tracks and access ways and the requisite infrastructure. It was observed in the field that the previous operator's cut lines that were used in the 1980s are no longer noticeable, indicating that robust re-vegetation of these areas occurs in a period less than 20 years.

Suggested mitigation:

- Backfilling any excavated and remediation of degraded areas should be considered. Re-vegetation to restore the environment to its original form during the

project decommissioning at specific sites should be done if the community so requests.

5.1.10 Noise and Vibrations

The use of heavy road construction and exploration machinery is likely to be a major potential source of environmental pollution in form of noise generation and vibrations. The vibroseis and other equipment would generate noise and vibration along the seismic lines during the exploration exercises. The support and service vehicles and recording truck which will move in the survey areas would further contribute to noise pollution. Contractor mobilization and the exploration machineries will also create vehicular noise along the access roads. The base camp site may also be a source of noise pollution.

Suggested mitigation:

- As is reasonable, equip vehicles with compliant silencers to muffle noise.
- Provision of full protective gear for workers like helmets and earplugs. Workers should also be sensitized on hazards likely to be encountered in such work environment.
- As is reasonable, the operations should avoid the wells, oasis, springs, buildings and/or settlements.
- Use local leaders to sensitize the neighbouring community about the project and its possible noise and vibration impacts. The communities should be informed in advance when a seismic survey operation is to be executed along a given seismic transect/location.
- The seismic team should monitor the noise levels during the survey
- Use quiet and efficient generators at camp sites and effect a noise mitigation policy for all operations.

5.1.11 Offensive Odours

Offensive odours may be limited in a spatial extent and would be related to sanitation and combustion of fossil fuels expected from the construction and exploration machinery.

Suggested mitigation:

- Put in place proper sanitation facilities for workers at the campsite.
- Ensure that vehicles are properly equipped, defective exhausts are repaired and routine maintenance is undertaken appropriately.
- Sanitary disposal of waste material should be implemented.

5.1.12 Archaeological, Historical, Cultural Sites and Landscape

The local communities have significant cultural, historical and heritage sites scattered within the block. These sites include the Yaa shrines used by clan and spiritual elders, revered sites used for livestock cleansing among the Rendille community, special sites used as meeting points for elders, sites with historic artifacts and burial sites. The burial sites are stacked with stones and can be easily identified.

Suggested mitigation:

- The exploration team should work closely with local elders to help them identify the sacred sites.
- The exploration team should also be acquainted with the local cultures prior to commencement of works in the area.

Besides the cultural and historical sites highlighted above it is important to note that there are special ceremonies undertaken by the communities. These ceremonies done by both the Gabra and Rendille communities are:

1. Sorio
2. Almado
3. New Moon Celebrations

These are seasonal ceremonies and the village elders normally announce when they are due. The company should allow members of these communities to attend these ceremonies. It is also important for employees of the company to respect the cultures of the two communities. Of great importance is respect for married women, unmarried women and warriors locally referred to as Warani. Employees should be advised that any contact with local girls is not allowed whatsoever.

5.1.13 Solid Wastes, Waste Oils

The proposed seismic operation will bring in more people in the area leading to generation of more solid waste particularly at the base camp. Solid waste like plastic cans/ bags, organic waste and waste paper is likely to increase. Waste oils and petroleum used in vehicles and exploration machineries and in garage areas at campsite may spill or leak into the ground. This may degrade soils and water quality thus affecting livestock and domestic water users in the area.

Suggested mitigation:

- All waste generated at the camp site should be sorted, separated and dumped in designated dustbins and either incinerated or recycled where applicable.
- Any hazardous and toxic waste materials should be disposed off in accordance to national and internationally accepted standards.

- Oil drip traps should be regularly maintained as per a maintenance schedule for maximum performance particularly in the garage area.

5.1.14 Social Impacts

The proposed project has the potential of attracting an influx of people into the area. They may come in as business people or as employees. The influx of people could negatively affect the current close cultural fabric exhibited by the local communities. Similarly the entrance of new sources of income occasioned by the project may disrupt the inherent pastoral life of the local people. Some of the social issues identified by the community members and their leaders include:-

- Displacement of pastoralists from their pasture land.
- The operation of the project may lead to some minimal fencing off of land thus blocking livestock trails, pasture land and watering points.
- The project may lead to strain on the already scarce water resources in the area.
- There may be aggression from neighboring countries if oil is struck in the area.
- There is fear among residents occasioned by the poor operation and decommissioning processes undertaken by the previous oil prospecting companies like Amoco Kenya Limited.
- The project may lead to increase in immoral social behaviors like prostitution, drug abuse and crime.
- The emergence of new ways of income generation in the area may erode pastoralism as a way of life in the area.
- The proposed project may interfere with the strict culturally life pattern observed by the Gabra and Rendille communities and thus lead to conflicts.
- Explosion of human population and livestock in the area has exerted pressure on land and the entrance of the new project may further constrain scarce land resources.
- Unskilled labour vacancies should be given to local people without corruption or undue influence.

Suggested mitigation:

- There is need to have a cordial working relationship between the company and the community to avoid any conflict. The company has employed a consultant, who is a local resident, to guide them during project mobilization stage. . His employment or that of a similarly qualified local should be maintained throughout the seismic cooperation.
- The community members need to be informed about the outcome of various research projects undertaken by the government and any other agencies on the issue of the alleged nuclear waste disposal in Northern Kenya during decommissioning stage of the previous oil prospecting endeavors.
- Employees from outside the two prominent communities in the area should be acquainted with the cultural lifestyle of the local people prior to work

commencement. It was suggested that the camp site should be located at a reasonable distance from the town and large settlements.

- The company should give preference to qualified locals for employment opportunities
- During seismic operations the company should minimize fencing off the operations area order to allow free movement of livestock and the pastoralists
- The company should liaise with the local elders during seismic operation in order to alert residents who may be affected by the cut line construction and seismic operations.
- The company should sustain public information and sensitization programmes before and during project operation.
- The company should liaise with the provincial administration and police department to provide adequate security during operation.
- The company should consider compensating and/ or relocating affected families during cut line construction and seismic operations.
- The company should cooperate with the local authority, local leaders and non governmental organizations in the area to create synergy in tackling socio-economic issues or problems that may arise that affect the communities.

5.1.15 Economic Impacts

The proposed project is sited in a vast area with minimal economic activities. Thus unemployment levels among the youth are high and the area is amongst the poorest in Kenya. Economic activities are further hampered by poor or non existent infrastructure, persistence drought, illiteracy and livestock rustling from neighboring communities. The major economic activity in the area is pastoralism. There are pockets of small scale traders concentrated in urban centres across the block.

The proposed seismic operations will have significant positive economic impact in the area. There shall be direct employment opportunities for non-skilled labour and business opportunities for traders from both within and outside the block. The proposed entrance of an oil prospecting company in the area is also likely to spur investments from other industries. These industries include public transport, communication, tourism, salt mining, building and construction as well as energy generating companies that can harness wind and solar power in the area.

Suggested mitigation:

- The company should give preference to qualified locals for employment opportunities
- Local leaders should be consulted throughout the proposed project phases.
- The company should seek to encourage related companies particularly communication companies to venture into the area as it has a high business potential.

5.1.16 Health and Safety Impacts

During the proposed works, there may be increased hazards to health and safety as a result of dust, air, and vibration pollution. The workforce and general public living at, or near the construction and exploration site would be more subjected to these environmental hazards and disturbances.

There are no fire fighting engines at Marsabit district and the roads to the project area are in a state of disrepair. There are several airstrips in the area that can be useful to Lundin staff and every effort must be put to make their condition safe and usable. The project area is relatively safe; however, the company needs to ensure adequate security at the camps and in the field sites during survey.

Suggested mitigation:

- The company should construct the operational base away from settlements.
- Worker health and safety should be assured through the development and implementation of standard workplace practices and the company HSE/OHS policies.
- Health and safety in nearby communities should be assured through implementation of safe operating practices by workers, restrictions on activities that produce loud noises during night time hours, restrictions on earthmoving and refuse burning activities to preclude downwind impacts on communities or sensitive receptors, and installation and maintenance of adequate site security to prohibit entry by unauthorized persons.
- Sanitary facilities shall be provided and cleanliness shall be ensured as per set health standards at the camps.
- Safety awareness on machinery use will be created through training and regular safety meetings held.
- Adherence to environmental health and safety regulations shall be ensured.
- It is recommended that the company should have a fully equipped first aid kit during operation and ensure that only well trained personnel handle the equipment.
- The company should ensure that it has adequate fire fighting equipment available and trained personnel to man the equipment.
- The company should implement a risk assessment and security plans in conjunction with the local authorities and provincial administration.
- The company should carry out equipment checks and implementation of a maintenance schedule

5.1.17 Positive Impacts Perceived by the Communities

The local communities in the project area perceive several positive impacts associated with the proposed project. The majority of the members are, however, skeptical about the project following the poor operation and decommissioning processes undertaken by

the previous oil prospecting companies in the area in the late 1980s. Some of the positive aspects identified include:-

- The project will provide employment opportunities to the youth.
- The project will directly/ indirectly promote infrastructural development for instance roads, communication facilities and electricity among others.
- The project will lead to new sources of income generation through employment and small scale trade in the area thus an improvement in living standards.
- The project may spur industrialization in the area for instance salt harvesting, wind and solar energy development. Players in these industries may want to harness the potential in the area.
- The project may improve trade and commerce through opening up of more market opportunities for livestock and livestock products.
- The project is likely to lead to development of more social amenities like schools, health centres, banking, livestock auction yards and water supply points among others. This may occur to cater for the influx of people in the area.
- The project may help open up the area and market its potentials to the rest of world.
- It may lead to improved security in the area.
- The project may help promote local youth and women groups through access to grants and loans.
- Cut lines may also be used as roads into remote parts of the block.

The local leaders and residents are cautiously positive about the proposed project. The community members emphasized the need for sustained public information and sensitization about the project. They see this as the only way to help the community come to terms with the new project and erase the fear occasioned by the negative experiences of previous oil prospecting companies. As recommended elsewhere in this report public awareness and information should be an ongoing process throughout the project cycle.

5.2 Categories and Significance of Impacts

This categorisation of the impacts, contrasting baseline with all components of the survey and post-survey impacts of the project, takes into account the likely potential effects, *in the event of non-compliance with the mitigation measures specified above*.

The criteria for significance determination are shown in the table below (Table 5.1). After considerations of the criteria, the environmental impacts are scored as follows:
Score 0 = no known impact; Score -1 = slight negative impact; Score -2 = moderate negative impact; Score -3 = strong negative impact; Score +1 = slight positive impact; Score +2 = moderate positive impact; Score +3 = strong positive impact.

The impacts are further classified as: actual or potential; direct or indirect; short term or long term. Risk levels are classified as low, medium and high.

Table 5.1: Scoping scores and impact classification

Parameter assessed	Baseline				Development and Operation			
	Pressures/Impacts	Duration of Impacts	Risk Level	Impact Score	Pressures/Impacts	Duration of Impacts	Risk Level	Impact Score
Physiography and Geology	None	-	-	0	None	-	-	0
Soils	Compaction by grazing animals and machinery, wind erosion, water erosion	Long-term	HIGH	-2	Gullying, excavations, aggregate materials, compaction by animals, vehicles and machinery	Long-term	HIGH	-2
Climate	Global climate change	Long-term	HIGH	-1	None	-	-	0
Air Quality	Dust generated by wind and enhanced by low vegetation cover	Long-term	MEDIUM	-1	Spread of mainly dust and exhaust gases by vehicular traffic and exposed surfaces (track lines)	Short/Long-term	medium	-2
Surface and Ground water	Pollution of shallow groundwater in luggas from humans and livestock	Short/long-term	HIGH	-2	Alteration of water courses, pollution (human)	Short/long-term	HIGH	-2
	High demand for potable groundwater sources	Short/long-term	N/A	-3	New boreholes commissioned	Short/long-term	N/A	
Terrestrial environment	Land degradation	Long - term	MEDIUM	-1	Flora and Faunal disturbance.	Short/Long-term	medium	-1
Aquatic environment	water source contamination siltation / Land degradation	Long-term	MEDIUM	-1	-Water contamination and siltation. -Wildlife disturbance, siltation	Short/ long-term	Medium	-1
Land Resources	Land degradation	Long-term	MEDIUM	-1	Obstruction of pasture access routes and water points, Land use change in camp areas	Short-term	LOW	-1
Offensive Odours	Local, related to human/livestock organic wastes	Short-term	LOW	0	Improper disposal of effluent and solid waste and uncontrolled exhaust emissions	Short/ Long-term	MEDIUM	-1
Archaeological, cultural sites, Landscape	Sacred sites, Yaa Shrines, Oasis	Long-term	LOW	0	Disturbance of Sacred sites and Yaa Shrines	Long-term	HIGH	-2
Economic setting	Slow economic growth rate	Long-term	LOW	-1	Diversification of alternative livelihoods, job creation, etc. New investors coming to the area	Short/Long-term	LOW	2
Social setting	Stable community	Long-term	MEDIUM	2	Opening of markets, migrants, etc. Interaction with outside world	Long-term	MEDIUM	-1
Health setting	Inadequate provision of services	Long-term	MEDIUM	-1	Vulnerability to dusts/gases, accidents at workplace and surrounding areas Impact related to solid waste disposal during decommissioning	Short/Long-term	HIGH	-2

CHAPTER 6:

ANALYSIS OF PROJECT ALTERNATIVES

6.1 Project Sites

The Kenyan government through previous exploration works by various companies has identified a number of 'blocks' with potential for oil and gas. These blocks are found in coast, eastern, north-eastern and rift valley provinces and Kenya's territorial waters and exclusive economic zones in the Indian Ocean. Lundin Kenya B.V. has been granted the exploration licence for Block 10A in North Western Kenya. For this reason, the concept of 'alternative site' does not apply, as each block within the country is agreed upon by the Government of Kenya and the interested party and subsequently licensed. Other blocks have been licensed to other companies.

6.1.1 Seismic Acquisition Program at the study area

The seismic contractor will be responsible for the construction of the main seismic base camp. The camp will be constructed with advice from recognised security professionals and the location will be selected in conjunction with the local communities and subject to their approval. The base camp will be located at a reasonable distance away from any village. The camp will be fenced off and access controlled by a guarded gate. The base camp will be so placed to be central to the acquisition program area.

The seismic crew will be subject to a strict no alcohol / drugs policy and personnel will be advised that contacts with the local populace should be for work related issue only. The crew will be advised that contact with local females in the area of the survey is totally forbidden and any reported contact will be grounds for immediate dismissal.

The crew will operate in a professional manner and will not interact with local village personnel. They will be polite and observe all local customs.

Due to the length of the seismic lines and the size of the program it will be necessary for the contractor to utilise a series of fly-camps, as the travel times to and from the base camp each day would be excessive and the company operates a policy of no night time driving.
These camps are small, portable and highly mobile and can quickly be moved in the direction of seismic acquisition progress. The line clearance, survey, reflection recording and LVL / Uphole crews will all operate out of fly camps.

6.2 Design, Technology, Scale and Extent

6.2.1 Seismic Field Crews

Field crews and camp personnel generally fall into the following distinct groups listed below; the numbers of personnel are indicative as the operational situation may prescribe otherwise.

1. Permit and community/ security liaison team. 4-5 persons
2. Survey crew and line clearance (2 teams). 20 persons
3. LVL crew 8 persons
4. Uphole crew 8 persons
5. Main reflection recording crew. 40 persons
6. Fly camp staff 10 persons
7. Local line guards 30 persons
8. Base camp staff (including Lundin supervisors) 30 persons

6.2.1.1 Permit crew / community liaison team

Prior to operations commencing the team will visit the local authorities, and village elders in the area of operations and adjacent areas. They will operate with the full assistance of the local police and will be supported by experienced security professionals.
They will also, in simplistic terms, present a briefing on the companies activities, seismic acquisition and indicate how long the seismic crew is expected be in the area. They will emphasise the need for local people, especially children, to stay away from the potentially hazardous heavy vehicles and clearance equipment.
The team will liaise with local communities and advise on the operational activities, on a regular basis and will be the focal point for community issues and grievances. They will advise where seismic line will be located which communities will be affected and deal with crop, livestock and permit claims. They will also arrange the supply of local line guards from the local villages.

6.2.1.2 Survey and line clearance

The seismic lines are laid out using differential GPS survey (Global Positioning System). There will be two teams operating in two locations simultaneously.

Lines are cleared using bulldozers and graders. The seismic crew will operate in a sympathetic environmental mode where minimal clearance and disruption will be the order of the day. They will clear lines in a manner that will not affect local water courses and not clear bush or trees when it is unnecessary. Where bush is cleared they will leave behind the rootstock.
It is anticipated that the survey / clearance team can obtain a combined total daily production of around 10-15km.
All source and receiver layout for the reflection recording spread will be carried out using dual frequency GPS receivers with real-time kinematic (RTK) mode. A survey base station is set up to operate during RTK survey. Base stations will be moved to comply with contractual specifications.

6.2.1.3 LVL crew (Low Velocity Layer)

The LVL crew (refraction) is a small team that operates independently of the main reflection recording crew. This crew acquires near surface soil weathering information that is used to generate static correction values that are applied to the final reflection recording data during the data processing phase of operations. This data is calibrated using Uphole velocity information (see uphole section).

Plate 66: LVL weight drop unit

The team uses a small recording spread of some 250m in length with 24 geophone channels using a small digital recording system. Typically recordings are made every 2-3 km. A small weight drop system is used as the energy source.
The operation is very unobtrusive environmentally and leaves little to no trace behind

6.2.1.4 Uphole recording crew

The seismic acquisition contract includes provision for an unspecified number of upholes, with contractual depths of up to 90 metres.

Plate 67: Typical Uphole drill rig

Uphole recording is intended to confirm and support the results of the refraction survey in determining and mapping the low-velocity layer over the 2D prospect area.
An uphole computation yields true interval velocities, of the shallow strata, as opposed to refraction records which depict average velocities to surface. The contract calls for a nominal uphole spacing of 20 kilometres. Logging will normally be at 2.5 metre intervals to 30 metres depth and at 5 metre intervals from 30 metres to bottom hole depth.

A downhole geophone will be used for recording the signal complete with a spring loaded wall clamp to aid coupling to the side of the hole.
The source is normally a sledgehammer on a steel plate offset 4 metres from the top of the hole with the trigger geophone placed underneath the steel plate. Shots are stacked vertically as required to obtain good first breaks.
The hole is drilled using either water or air and the rig used is similar to those used to drill water wells.
When logging of the hole is completed it is backfilled and the top of the hole set with a concrete plug just below ground level. All traces of the drilling operation are cleared up prior to moving to the next location.

6.2.1.5 Reflection recording crew

Seismic reflection recording (main seismic crew) is accomplished using a state of the art telemetric recording system. It is envisaged that a spread of up to 480 active channels will be used.
Each channel consists of some 12 sensors called geophones which convert motion of the ground into a proportional electrical signal. The active spread will cover a distance of up to 12km. There will be additional spread ahead of that being used to roll into (up 6km).
Vibratory energy is input to the earth utilising a train of Vibrator units which move sequentially down the seismic line. This seismic wave so generated by the vibrators is reflected from the subterranean layers deep under the earth back to the surface where it is captured by the geophones. This now electrical signal is amplified and conditioned. The conditioned seismic data from the geophones is transmitted along cables to the recording vehicle where it is recorded onto magnetic media.
The data is later then transmitted to a centre where the data is processed. The processed data can then be loaded onto workstations at the company HQ where interpretation is carried out. This interpretation may latterly lead to the selection of hydrocarbon drill sites.
An anticipated daily recording production figure is around 10km, dependent on operational parameters and vibrator effort required.
The telemetric recording system and vibroseis control electronics will be installed in either a buggy or truck mounted carrier (recording cab).

Plate 68: Typical seismic recording Buggy

Plate 69: Fleet of Vibrators crossing dry river

The energy source for the survey will almost exclusively be via the Vibroseis technique.
This technique uses a train of some 5 vibrators vibrating synchronously for a period of some 6-8 seconds on each VP (each source point). It is likely that each source point will require between 4-6 sweeps per point. Each Vibrator unit is rated at 60,000lbs peak input force.
As each source point is recorded the train of vibrators moves forwards to the next source point and the sequence is repeated. A receiver point (geophones and cable) at the rear of the recording spread is then picked up. When sufficient geophones and cables have been picked up they are moved to the front of the recording spread and so the process continues in a leapfrog manner.

6.2.1.6 Seismic Base Camp

The seismic base camp will be positioned most conveniently and centrally for efficient operations and will not move during the course of the survey. The security of the area selected will also be extremely important and attempts will be made to locate it accordingly.
The main contractor supervisory staff, field data processing, security liaison and field QC staff will be all be based in the main base camp. The camp will also house the main fuel storage tanks, vehicular workshops and spares storage.
The majority of supplies and foodstuffs will be supplied from Nairobi. Where local produce is available it will be utilised.
Day to day food, water and fuel requirements will be supplied by cargo trucks from the base camp to the fly-camps.
Staff will be housed in trailer accommodation which in some cases will double as offices. Kitchen and catering facilities will be provided.
Data communications will be via state of the art satellite systems.
Radio communications from the base camp to the fly-camp and to Addis Ababa will be maintained on a 24 hour basis.
All individual field teams will carry at least one Thuraya satellite telephone. Lundin field supervisors will each have their own satellite telephone.

6.2.1.7 Fly Camp

The fly camp, if utilised, will normally be located in very close proximity to the main reflection recording activities. It may house between 60-70 people. Each day the

respective field teams will leave at around 6am and drive out to their daily work location. At the end of the working day they will return to the fly camp, which may have relocated during the day to keep up with the production achieved. They will ensure that they are back in the camp before darkness. The camp will not necessarily move each day.
The camps will be basic and light but will still provide an acceptable rudimentary living standard. There will be ablution and catering facilities and most likely tented sleeping accommodation.
Reports pertaining to the daily production of each team will be made in the evening from the fly camp to base camp. Communications will be maintained on a permanent basis, round the clock.

6.3 HSE MS

The Health Safety and Environmental management system of the selected contractor will be subject to full review by Lundin before contract award.

Lundin will have full time, expatriate, representatives on the seismic operation to ensure that the contractor not only complies with the technical aspects of the contract but that they fully comply with the HSE requirements.

The contractor will meet or exceed international IAGC (International Association of Geophysical contractors) standards.

The crew will be subject to a stringent a HSE audit before any operations are allowed to commence. This audit will also encompass all vehicles and plant.
Strict speed limits will be imposed on the tracks and roads around the operational area.
Journey management will be rigidly implemented.

6.4 Quality Control Officers (Technical & HSE)

Lundin East Africa will assign experienced Field Acquisition Supervisors, to monitor the seismic data acquisition and represent Lundin's interests in the field. The FAS position will be permanently manned on a back to back basis.
There will also be an experienced GPS Geodesists to ensure positioning fidelity and HSE QC supervisors to ensure safe and environmentally acceptable operations by the seismic contractor.
Supervisory staff will have a minimum 20 years experience in their specialised disciplines.

6.5 Emergency Response and field safety

An integrated emergency response plan will be developed to cover any situations which may occur in the field. This plan will be homogeneous and integrated system bridging the resources of Lundin and the seismic contractor.
Links to any other oil companies will be established and emergency resources shared.

There will be a strictly controlled journey management plan covering both field operations and between Nairobi and the operations area.
The seismic crew base camp will have a fully equipped clinic staffed with trauma trained medical personnel. The crew will also be equipped with a four wheel drive ambulance on permanent alert. All remote field crews will have a qualified para-medic within 30 minutes of their operations.
First aid training and re-training will be an integral element of the crews HSE procedures.

6.6 Community Relations and Local Labour Procedures

As detailed in the permit section to ensure there is harmonious relations with local villages and communities a very close working relationship must be established and maintained.
The elders and village leaders will be made aware that the seismic operations are at the very preliminary stages of oil exploration and at this time only limited community development (CD) can take place. It will be ensured that expectations are not heightened by incorrect information being passed to the local populace. Information will only be passed to the communities by the community relations team.
Fair crop damage payment systems will be agreed as will payment for any livestock losses. Access fees will be negotiated where appropriate.
Line cutting / clearance will be limited to the very minimum needed for efficient, safe seismic operations. Where water courses are temporarily closed (filled in) they will be reopened once the operation passes and access down the seismic lines is no longer needed.
Seismic lines will be positioned as such that they will not cause any disruption to villages, settlements or individual house and will be repositioned to avoid them where necessary. There will be no enforcement of any right of way with the seismic lines and lines will not be forced through villages.
Semi permanent jobs will be allocated on a percentage basis dependent on line density in specific village areas.

CHAPTER 7:

ENVIRONMENTAL MANAGEMENT PLAN

7.1 Institutional Arrangements

The policy, legal and institutional framework has been discussed at length in Chapter 4. The proponent will need to make local institutional arrangements in order to ensure the optimal functioning of the Environmental Management Plan (EMP). It will also be essential for Lundin to liaise with the local authorities in the area to keep them appraised of their operating procedures, changes, or developments that may be of concern to local interests. It is also essential that there is liaison with any emergency rescue teams. Finally, it is critical for the company to maintain good relations with the community through reliable and factual information distribution. The company should cooperate with other recognized community organizations in order to minimize environmental, social, health and safety impacts through coordinated awareness campaigns and other avenues of public education and information exchange.

7.2 Environmental Management Plan (EMP)

The EMP for the proposed project provides all the details of project activities, impacts, mitigation measures, time schedules, costs, responsibilities and commitments proposed to minimize environmental impacts of activities, including, monitoring and evaluation during implementation, operation and decommissioning phases of project.

Table 7.1: Environmental management plan (EMP)

Environmental Issue	Mitigation	Monitoring Parameters	Monitoring Frequency	Management Measures	Net Effect	E.g Cost (Ksh.)
Physiography and Geology	- None	None	None	-	-	Nil
Soils	- See section	Checking of soil stability by soil expert	Bi-monthly	- Avoid/minimize activities that can extensively impact on soil structure and stability	Soil conservation	As appropriate for compliance
Climate	- None	None	None	-	-	Nil
Air Quality	- See section	Check dust levels	Bi-monthly	- Monitor use and status of vehicles and machinery.	Preservation of air quality	As appropriate for compliance
Water Resources and Effluents	- See section	- Adherence to riparian zones - Microbial load in potable water - Treated effluent, if any	Bi-monthly	- Checks on adherence to riparian zones - Implementation of waste/effluent management plan	- Protected surface and groundwater resources - Safe water supply	Water Resources and Effluents
Terrestrial Environment: Flora and Fauna	- See section 5.1.6	- Protection of ecologically sensitive areas. - Area of vegetation	Bi-monthly	- Adherence to EMP - Rehabilitation	- Minimise disturbance of Flora and Fauna.	As appropriate for compliance

		cleared.		plan developed for post-survey period		
Aquatic Environment	- See section - 5.1.7	- Aquatic habitats - Areas cleared of vegetation	Bi-monthly	- Adherence to EMP - Rehabilitation plan developed for post-survey period	- Avoid alteration of aquatic habitats - Avoid disturbance to flora and fauna	As appropriate for compliance
Land Resources and Natural Heritage Sites	- See section 5.1.7	- Visual inspections	Bi-weekly	- Consultation with local stakeholders	- Protected and preserved land resources and natural heritage sites	As appropriate for compliance
Visual Aesthetics	- See section 5.1.8	None	None	- Project design and drawings refers (cut lines and camp sites)	- Acceptable visual effects	Nil
Noise and Vibrations	- See section 5.1.9	Noise levels using dosimeter	As appropriate	purchase vibrometer/dosimeter	Noise and vibration maintained at an acceptable level	As appropriate for compliance
Offensive Odours	- See section 5.1.10	- Regular checks and servicing on sanitation and machinery/vehicles	- Every other day for sanitation - As appropriate for machinery/vehicles	- Implementation of maintenance schedules	- Clean environment	As appropriate for compliance
Archaeological, Historical, Cultural Sites and Landscape	- See section 5.1.11	- Pre-survey check on locations of sacred sites, oasis, graves, Yaa shrines, etc.	-	- Consultation with local elders/ stakeholders	- Protected and preserved sites	As appropriate for compliance
Solid Wastes, Waste Oils	- See section 5.1.12	- Visual for solid wastes, oils and grease for waste oils	- Visual checks every other day	- Implementation of waste management plan	- Cleanliness maintained and pollution checked	As appropriate for compliance
Social Impacts	- See section 5.1.13	- Monitor social impacts	- As appropriate	- Regular consultation /discussions with local leaders/ stakeholders - Lundin complies with all applicable legislative, statutory, local by-laws & respects community traditions and culture	- Improved social harmony, acceptance, cooperation and community empowerment	As appropriate for compliance

Economic Impacts	- See section 5.1.14	- Periodic assessments of economic impact on the community	- As appropriate	- Regular consultations with local stakeholders - Employ local people as appropriate	- Quantified and measurable impacts	As appropriate for compliance
Health and Public Safety Impacts	- See section 5.1.15	- Inspection for compliance to OHS and HSE policies - Adherence to security protocols	- Every other day	- Lundin complies with all applicable legislative, statutory, local by-laws & communal rites. - Security protocols adhered - Relationship building with provincial administration - Enlighten community on government findings on alleged disposal of hazardous wastes	- Health well maintained - Safety assured	As appropriate for compliance

Objectives

The objectives of the EMP include the following:

- To bring the project into compliance with applicable international, national, and company requirements, policies and procedures.

- To outline mitigating/enhancing, monitoring, consultative and institutional measures required to prevent, minimize, mitigate or compensate for adverse environmental and social impacts, or enhance the project beneficial impacts.

7.3 Timeframe and Cost of Implementation of the Project

The EMP is outlined in the following table and is directly linked to issues outlined in Chapter 5 (sections outlining mitigation measures) and should therefore be implemented in that context.

No.	Milestone	Key Dates
1	Advance Party Mobilised	2H2009
2	Basic Party Mobilised	2H2009
3	Commencement of seismic recording	2H2009
4	Completion of the Work i.e. Completion Date	2010

CHAPTER 8:

CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary of the Project Components

Lundin Kenya B.V having signed a Production Sharing Contract (PSC) with the Kenya Government in October 2007 and obtained an Exclusive Prospecting Right (EPR) for Block 10A is proposing to undertake seismic operations within the block. The company's license allows it to exclusively prospect for gas and oil deposits. The current exploration programme will be conducted in the northern Anza graben which straddles Marsabit south and Marsabit north districts in Kenya. The initial area covers a stretch from Hedad and Kargi in the south to Dukana and Balesa in the north. The exercise will also be undertaken within the Chalbi desert.

The company having won the exploration licence for the block did undertake an initial airborne gravity/ magnetic survey to determine and detect the large-scale features of the sub-surface geology. The proposed seismic survey will use highly sophisticated and state-of-the-art technology, and conformity to international HSE standards will be ensured. There were earlier seismic surveys that were undertaken in the project area in the 1980s. These surveys were, however, done when the current EMCA law was not yet enacted and thus social and environmental aspects were not considered during the operation and decommissioning of the project. With the enactment of the EMCA 1999 Act, the legal framework has changed resulting in a different approach to development activities.

Lundin initially carried out a Social and Security Assessment in the area, followed by a Stakeholder Awareness Meeting with clan leaders. This resulted in the hiring of a Community Liaison. The Company has now undertaken an extensive EIA study that examined the current environmental, social, cultural and psychological setting on the ground. The company is therefore conscious about the need for a proactive environmental and social approach. There are possible impacts from the proposed seismic operation that have been identified and appropriate mitigation measures suggested. Members of the public interviewed had a positive view of the proposed project but insist that it should be undertaken in a more inclusive and open way as opposed to what was experienced in the eighties. The mitigation measure suggested in this report and the environment management plan developed will ensure that the project is technically, environmentally and socially sound and acceptable.

8.2 Recommendations

The construction of cut lines and seismic operation while involving considerable earthwork and temporary noise/ vibration pollution respectively will use proven state of the art techniques and conventional methods. Potentially minor adverse impacts can be avoided by good site management and construction practices, particularly related to cut line selection and construction.

The Environment management and monitoring plan suggested should be followed and the company should strive to set high environmental standards at all times. From an environmental point of view, it is therefore objective to conclude that the project is viable and will not adversely affect the environment. The following recommendations should be considered during construction of cut lines and operation of the seismic survey:

- The seismic lines, where possible, should be made in such a way as to avoid natural drainage lines and lugga and road crossings. Existing access ways should be considered for usage as much as possible.
- The company should regularly service all its trucks, service vehicles and machinery powered using fossil fuels so as to reduce exhaust emissions.
- During the planning of seismic lines, established vegetation, sensitive soils and hilly terrain, should be avoided if possible. If inevitable considerations should be made to follow established access roads and river crossings.
- The company should use local leaders to sensitize the neighbouring community about the project and its possible noise and vibration impacts. The communities should be informed in advance when a seismic survey operation is to be executed along a given seismic transect/location.
- Noise levels should be monitored by the seismic crew during the survey.
- Any hazardous and toxic waste materials should be disposed off in accordance to national and internationally accepted standards.
- Employees from outside the two prominent communities in the area should be acquainted with the cultural lifestyle of the local people prior to work commencement. It was suggested that camp site be located at a reasonable distance from the towns and large settlements.
- Preference should be given to qualified local people for employment opportunities
- During seismic operations, minimal fencing should be undertaken at the operation sites in order to allow free movement of livestock and the pastoralists
- The company should sustain public information and sensitization programmes before and during project operation.
- The company should construct the operational base at a reasonable distance from settlements and towns.
- The Vibroseis *shot points* should be located as far as possible from Kalacha terrace where basalts are loosely deposited so as to minimise the risk of landslides in form of rock fall, rock slides and slumping. The company proposes to utilise low vibrator drives
- Worker health and safety should be assured through the development and implementation of standard workplace practices and the company HSE/OHS policies.
- The company should implement a risk assessment and security plans in conjunction with the local authorities and provincial administration.
- The company should also encourage related companies particularly communication companies to venture into the area as it has a high business potential.

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Appendices

1. Minutes of meetings with Community and Community Leaders during the EIA study
2. Minutes of meetings during the scoping study of the project area
3. List of bird species encountered during the field study
4. List of mammals encountered during the field study
5. Copies of laboratory results
6. Certificates
7. Pin Number
8. Other relevant documents
9. Socio-economic questionnaire

Minutes of meetings with Community and Community Leaders during the EIA study

MINUTES FOR MEETING WITH LEADERS AND ELDERS AT DUKANA LOCATION ON 17TH SEPTEMBER 2008

PRESENT
Chief Tuye Katelo
Councillor Galgalo Ibrahim

The team leader Mr. Mulwa introduced the EIA team to the Chief and his team. He elaborated the objectives of the proposed project. He gave a brief overview of Lundin petroleum drilling contract and also explained the technology for proposed seismic operation.

The chief welcomed the team in the location and assured them of his office cooperation during the study.

He said there is inherent fear among residents in the area as concerns the proposed project. This he said is informed by the previous experiences of similar projects in the area. Some of the key concerns raised by the members about the proposed project are:-

- The possible impact to the community if oil drilling was to take place citing the case of the Niger Delta in Nigeria
- They noted that Amoco Kenya Limited drilled several oil wells in the 1980s and decommissioned the project without informing the community. The residents fear is that there could be a repeat of the same occurrence
- There has been allegation of increase in throat cancer since Amoco decommissioned their project. And this has also created fear among members of the public.
- It should be clarified if Amoco did indeed bury nuclear / hazardous wastes in the area during decommissioning stage. The members felt that there is need for government investigation to ascertain the true position.

The members said that these are the issues creating fear among the members of the public in the area.

In response Edwin explained to the members that there are clear international and national legal provisions guiding transportation and disposal of hazardous waste. He said that the issue of possible dumping of hazardous waste in had been raised in 2004. The government then formed an inter-ministerial committee led by NEMA to investigate the claims. He clarified that results from test by the University of Nairobi's Institute of Nuclear Science showed that no nuclear/ hazardous waste were buried in the abandoned wells.

He explained that there is the new EMCA law enacted in 1999 that makes it compulsory for enterprises to do EIA prior to project commencement. In this regard he said the community will be involved at all stages of the project and advised that the community must be keen throughout the project process.
Mr Mulwa explained that the only material used in drilling oil wells and indeed water borehole is bentonite, which is special clay. This clay when mixed with water becomes slurry, which helps in cooling the drilling bit. It also stabilizes the walls of the borehole such that the walls cannot cave-in. The bentonite slurry should be flushed out after use.

Some of the possible impacts of the clay if not flushed out are that it may completely block ground water and sub-surface water movement.

The community leaders also identified some of the possible negative impacts of the proposed exploration project thus:-

- It will interfere with vegetation and pasture area.
- Use of heavy machineries will affect soil stability through compaction and degradation.
- It will affect livestock enclosures, livestock trails and this may alter grazing patterns in the area.
- The cut lines construction may lead to destruction of temporary settlements referred to as *Manyatta* and temporary livestock enclosures referred to as *Fora* if prior arrangement to move the occupants is not made.
- Noise and vibration pollution from heavy machineries may have impact on livestock and people

The community members also suggested possible mitigation measures that they feel the company should put in place. These measures include:-

- Re-vegatation programmes in the area to cover for vegetation that shall be cleared during cut line construction. Members felt that the cut lines should be as few as possible.
- Resettle/compensate people whose homesteads shall be affected by cut line construction
- Carry out public awareness and sensitization exercise among public members prior to commencement of works
- The company should consider re-routing of cut lines to avoid interfering with sacred places, wells, pastures area and livestock trails.

Some of the sacred places the elders identified are: Dakabariche site where there are dotted stones, Mangup and Dipis Hills, Maalim Site (identified by presence of huge trees).

The elders also emphasised the need for the workers to uphold and respect the local culture. Some of the issues that need strict observance are:

- Relations with married and unmarried girls are not allowed. If found this can be met by stiff penalty that may include lynching
- Talking to maidens even those in pasture area is strictly not allowed.
- There are special community ceremonies revered by the residents that the company need to take note of. These include New Moon, Almado and Sorio. These are sacrificial ceremonies that should only be attended by Gabra Community members. Outsiders are not allowed near the ceremony area. The ceremonies are seasonal and public awareness shall be made when they are due. The company should allow workers from the Gabra (and Rendille) communities to attend these ceremonies.

The Lundin representative Mr. Fila explained that the company is conscious about the need to have a cordial working relation with the community. In this regard the company has lined up three projects to be undertaken this year within the block. These projects are:

- Provision of portable solar cookers to selected women and youth groups
- The company will fund one project for each secondary school within the block. The school administration and board of governors will select the project of their choice. The projects could be library, classrooms, and laboratories among others.
- The company will also sponsor secondary school fees for the best students in each location in the block.

The representative informed the members that a local NGO known as PIPS will implement the above projects on behalf of the company. The local leaders shall also be involved in selecting the beneficiaries of the bursary scheme.

Lundin will monitor the implementation of the projects in order to ensure that their CSR objectives are fully met.

On employment the company shall give preference to qualified local people on an open and competitive basis.

He also assured the members that the company will seek independent water sources for its operation.

MINUTES FOR MEETING WITH LEADERS AND ELDERS AT BALESA LOCATION ON 17TH SEPTEMBER 2008

The EIA team was introduced to the chief and his team by Mr. Mulwa. He explained the background of the proposed exploration project awarded to Lundin by the government.

He also informed the meeting of the new Environment Management and Coordination Act (EMCA 1999) that requires EIA studies to be done on projects prior to commencement.

Edwin explained the technology, extent and scope of the seismic operations and the possible impacts of the project.

The chief and local councilor welcomed the members and assured them of cooperation during the study. The local councilor sought to know if a larger audience of the local communities could be enlightened about the project before commencement.

The members felt that there is need to hold sensitization seminars/ barazas throughout the block in order to get the local peoples' input prior to the project commencement.

The members said that people are currently unaware of the possible benefits of the project as there is inherent fear about oil exploration projects in the area. These fears are informed by the earlier experience in the 1980s from the activities of Amoco Kenya Limited.

The members leveled the following allegation against Amoco Kenya Limited. (The previous operator that was involved in oil exploration in the area in the late eighties).

- The company destroyed forests and vegetation in the area without informing the public.
- Several oil well were allegedly dug near forests that led to drying up of trees in the forest
- The members alleged that oesophagus cancer has increased in the area since Amoco decommissioned the project. The members alleged that the company could have buried radioactive/ nuclear wastes during decommissioning stage.
- Most of the abandoned wells were dug and sealed and the communities members would like to know the exact nature of the wastes in order to dispel fears among residents.

On the proposed project the members made the following observations as the likely impacts on environment:

- There is fear of possible external aggression from neighboring countries should oil be struck
- The area is small and exploration exercise could lead to competition for land with pastoralists

- Water is scarce in the area and the exploration activities may strain water resources in the area
- The project may interfere with water points, pasture areas and livestock trails.

The members suggested the following as possible mitigation measures:

- Sensitize the public prior to project commencement
- Migration routes, water points and pasture lands should be avoided
- Unskilled labour vacancies should be reserved for local people.

The EIA team explained to the members that the new EMCA Act will take care of the community members concerns. The EIA study findings will also be put in the report and appropriate mitigation measures suggested to obviate any possible harmful impacts.

MINUTES FOR MEETING WITH LEADERS AND ELDERS AT KARGI LOCATION ON 19TH SEPTEMBER 2008

The meeting began by the area chief welcoming the EIA team to Kargi location. The chief assured the team of cooperation and support from his office and the community.

The team leader Mr Mulwa introduced the EIA team and gave an overview of the proposed Lundin seismic operations in the area. He explained the technology to be used, the scope of the project and the extent of the area to be covered.

Mr. Edwin explained to the members the requirements of the EMCA law and requested the members to air their concerns about the proposed project freely.

The community members raised the following issues and concerns:

- The explosion of human and livestock population over the years has put pressure on land and there may be no enough land for the proposed project
- There is fear that the company may fence off area of seismic operations thus deny livestock access to water points and pasture.
- What are the possible benefits of the proposed project to the Rendille community?
- The community suggested that their kin and kith in Merille and Laisamis be consulted before the project commences.
- There should be a signed memorandum of understanding between the community and the company outlining the levels of returns due to the community.
- Unskilled employment opportunities should be reserved for the local communities
- The initial exploration activities carried out by Amoco led to degradation of soil/ land and also polluted water points. These have negatively affected livestock and human health.
- The inter-ministerial report on discharge of nuclear waste in Northern Kenya should be made public through baraza by local administration.
- There is acute water problem in this area and the available one is not potable as it is very saline. The company should consider drilling a borehole for the community.
- The company should have a cordial working relationship with the local communities to minimize any conflicts.
- During operation and decommissioning the local community leaders should be allowed to assess inputs and outputs of such activities. That is the company should be as open with the community as possible is.

The community members also identified sacred places in the area that should not be tampered with. These include Fare, Algas (sacred places for livestock cleansing rituals) and Koroli (watering point within Chalbi desert).

The community also indicated that ceremonies like Sorio and Almado are exceptional and should only be attended by local community members.

The elders also want Warani (community warriors) and local girls respected and outsiders are strictly not allowed to interact with the girls.

The elders also said that employees of the company should not create any disturbances in the *manyattas* or in the villages. Other practices that are unwanted in the community are prostitution, mini skirt/ short trousers wearing and alcoholism.

The Lundin representative Mr. Fila explained that the company is conscious about the need to have a cordial working relation with the community. In this regard the company has lined up three projects to be undertaken this year within the block. These projects are:

- Provision of portable solar cookers to selected women and youth groups
- The company will fund one project for each secondary school within the block. The school administration and board of governors will select the project of their choice. The projects could be library, classrooms, and laboratories among others.
- The company will also sponsor secondary school fees for the best students in each location.

The representative informed the members that a local NGO known as PIPS will implement the above projects on behalf of the company. The local leaders shall also be involved in selecting the beneficiaries of the bursary scheme.

Lundin will monitor the implementation of the projects in order to ensure that their CSR objectives are fully met.

On employment the company shall give preference to qualified local people.

He also assured the members that the company will seek independent water sources for its operation.

MINUTES FOR MEETING WITH MARSABIT NORTH LEADERS AT KALACHA 20TH SEPTEMBER 2008

This meeting was attended by all leaders from Marsabit North District led by Member of Parliament Hon. Francis Chachu, Ward Councillors, Locational Chiefs, NGOs Leaders, Women Leaders and Youth Leaders.

The EIA team was welcomed to the meeting by Mr. Wario, Programme Manager PISP to brief the leaders about their mission in the area.

The EIA team was introduced by the Lundin representative Mr. Fila who welcomed the EIA team leader to give the background to the study.

Mr Mulwa informed the leaders about the EIA objectives, the proposed technology to be used by Lundin and the requirement by law for enterprises to undertake EIA prior to project commencement.

Mr. Omori also informed the leaders about the EIA process and emphasized that neighbours/ stakeholders comment is a critical component in the study.

He then requested the leaders to give their views/ concerns about the proposed project.

The following issues were raised by the leaders.

- The community members have fears about the project since they do not understand the possible negative and/ or positive impacts that will arise for the exploration exercise.
- Employment opportunities should be given to the local people.
- The leaders questioned why the seismic operation has targeted pastoralists land and wondered why it is not been undertaken elsewhere.
- The leaders want fear among residents to be dispelled through education and sensitization programmes.
- The area MP welcomed the EMCA law and observed that the law is primarily meant to protect the environment and local communities from any harmful development projects.
- He said pastoralism is the local way of life and it requires large tracts of land to be successful. He wondered how much land will be required fro exploration and if the land will be fenced in which case it shall curtail the movement of the pastoralists.
- He also observed that the area is prone to banditry that control it, thus the government should tighten security for the exploration team and the local people.
- Councillor from Maikona ward said there was fear among residents especially on the issues of land and use of hazardous chemicals during exploration.
- Illeret Councilor also wanted to know the impact of exploration on land.
- He wanted clarification if oil exploration would lead to high occurrence of earthquakes in the area.

- If oil is struck in the area it would lead to external aggression from neighboring countries. He also sought to know if there will be compensation to the community for their land that will be used to drill oil wells.
- The issue poor decommissioning plan by the earlier oil prospecting companies was raised. The companies were accused of leaving hazardous wastes in the project area that may have been the cause of increase in oesophagus cancer and strange livestock disease.
- The leaders also sited the case of Kobi Fora (Sibiloi National Park) that was gazetted into a park without consultation with the community. This has denied the community a safe haven for their livestock during dry seasons.
- The leaders also observed that oil brings in lots of money and can lead to growth of the economy in the area and the country at large.
- The leaders also sought to know the impact, extent and scope of vibration caused as a result of seismic operation.
- The leaders said that if oil prospecting succeeds and oil drilling permit is given, the company should have a written memorandum of understanding with the community specifying the benefits due to them.

In conclusion the leaders agreed that Lundin has tried to involve the community and the local leaders, however, more sensitization sessions need to be done to reach as many people as possible.

The leaders also requested that a committee involving the community members, the government representative and Lundin officials should be in close consultation during the proposed seismic operations.

The EIA team members enlighten the leaders on some of the issues raise and also assured them that cultural aspects and site shall be respected during operation.
The Lundin representative explained the company's proposed CSR project proposed for the first year of operation in the area.

MINUTES OF MEETING WITH COMMUNITY ELDERS AT KALACHA ON 21ST SEPTEMBER 2008

The team leader Mr Mulwa gave background information about Lundin petroleum exploration contract.

He also explained the technology to be employed during the proposed seismic operations.

Mr Omori explained the new legal framework requiring EIA to be undertaken for all new development projects. He asked the members of the public to raise any concerns/ issues about the proposed project

The following issues were raised by the community members

- The issue of waste deposited at Kirkum and Maikona area that have led to increase in cancer cases in the area
- The project may affect pastoralists' lifestyle – who only understands issued on water, pasture and livestock. If oil wells are found where there is water or pasture then what happens?
- Pastoralists immigrate a lot – if water is tampered with it will affect the community adversely?
- The community wanted to know how the machineries to be used in exploration will affect human
- The members also sought to know if it is true that where petroleum drilling is taking place people will migrate.
- The company wanted to know the benefits of oil – is there any memorandum of understanding between the company and the community?

The members of the community also suggested way forward to make the project a success

- The community should be sensitized on the benefits and impacts of the project.
- The community is not against the project, however, the truth about early hazardous deposits should be known
- The employees of the company should be acquainted to the local cultures
- Unskilled labour should be reserved for the local people

The EIA team took time to address the issues raised by the community members.

The Lundin representative Mr Fila explained the company's corporate social responsibility initiatives and how it shall be implemented.

MINUTES OF MEETING WITH COMMUNITY ELDERS AT MAIKONA ON 22ND SEPTEMBER 2008

The team leader Mr Mulwa introduced the EIA team and also gave a background of the proposed project.
Mr. Omori took the members through the EIA process and requested them to air their view openly.
The following issues were raised by the community members

- Local lack knowledge about oil exploration – the company should educate the local about the impact of the project first
- Gabra are pastoralists, now faced with insecurity and famine. If oil is drilled in the area pastoralist will be kicked out of their land and water points will dry.
- They wanted to know if the project is compatibility with pastoralism.
- Influx of people – will bring new cultures and displace local people.
- Sibiloi National Park was taken without consultations and this was a safe haven for the communities' livestock during dry spell. This will happen again as the government has already decided to go ahead with this project irrespective of our views.
- There is need wide consultation to get a consensus from all stakeholders including pastoralists in the pastures
- The earlier decommissioning stage by other companies was not beneficial to the community. It led to spread to diseases both for human and livestock. These diseases include pneumonia for livestock (goats) and cancer in humans
- The Company could be bringing in dangerous/ hazardous waste to dump in our land and thus an expert from the community must be involved in the exploration exercise.
- Pastoralist meeting resolved that the local people should be involved
- The community should not be told of the benefits and the company's CSR programmes at this stage. What is important is educated the public about the project's impact on community and the environment

The EIA team took the members through all the issues raised and assured them that the legal framework had changed for the better. This they observed would help in protecting the environment and the community at large.

The Lundin representative also briefed the members about the proposed project and the initiatives the company is taking to involve the public and safeguard the environment.

Minutes of meetings during the scoping study of the project area

MEETING WITH CHIEF DAVID KIWAMBILE (KARGI LOCATION) AND COUNCILLOR HENRY HALUWA (KARGI WARD) ON 18TH AUGUST 2008

The meeting began by the team leader Prof Opiyo making an introduction of the scoping exercise in the area. The chief informed the meeting that security situation in the area in the past one year has been good with no reported major incidents.

The meeting was informed that conflicts over water and pasture among the Rendile, Gabra and Borana communities who live in the area is commonplace and cannot in any way derail the proposed project.

The location has a total of 85 Kenya Police reservists and six administration police officers who work closely on security matters in the area.

The councilor and the chief informed the meeting that a camp site for the prospecting company employees can be agreed upon in consultation with the local elders. The chief said that the campsite should, however, be sited away from the town centre preferably 5 – 10 kilometres to avoid any conflicts with the residents.

The two leaders said that the employees to be involved in the survey work should be accustomed to the basic local cultural norms particularly pertaining to handling of women in the area. They informed the meeting that ladies and women in the area are regarded in high esteem and the employees should not at any time indulge with them or behave in suggestive manner towards them.

They said that the local communities should be sensitized about the activities of the prospecting company and the possible impacts that may arise due to their activities in the area.

The chief informed the meeting that the area is faced with water scarcity and the company should seek alternative sources of water during operation.

The meeting was informed that there are rumours in the area that a former prospecting company buried nuclear wastes in the area after their operation in the late eighties. These wastes they say have been suspected to cause cancerous diseases in the area. These allegation should, however, be collaborated with adequate research findings.

The leaders informed the meeting that the only revered sites in the area are at Fare and Algas where it is believed the Rendile communities originated. The sites are clearly marked with stacked stones and should not be interfered with in any way.

There are also temporary holding grounds for livestock referred to as *fora* and should not be moved during operation. Local leaders will assist in identifying the active *fora* in order to minimize conflicts with the local communities. The councilor added that the active *fora* normally have at least one person at any time.

On the proposed project the leaders said the project will improve the livelihoods of the local people through creating of employment opportunities for the youth.
On the flip side the project may affect water ways and livestock paths that are critical to the pastoralists.

MEETING WITH DISTRICT OFFICER (DUKANA DIVISION) MR THUKU ON BEHALF OF CHALBI DISTRICT COMMISSIONER ON 19TH AUGUST 2008

The team leader Prof Opiyo introduced the team to the DO and gave background information of the scoping exercise in the area. The DO informed the team that the district commissioner was away in Naivasha for a pastoralist leaders' meeting and was therefore holding brief for the commissioner.

He said that there were no major incidences of insecurity recorded in the area so far in the past one year.

The DO informed the members that the Gabra community has a strict cultural attachment particularly on marriage. He informed the meeting that the months of July and August are set aside for marriage ceremonies locally referred to as *Sorio ceremony* among the Gabra community.

He said that for the project to succeed the community must be fully involved through public awareness meetings – *baraza*. This he said would make the community own the project from inception and will help erase misinformation about the activities of a former company that did oil exploration in the late eighties.

He also cautioned against fencing off of land particularly along livestock paths. This he said may cause conflict with pastoralists who move from place to place in search of pasture and water. He said that livestock paths to pasture and water points should not be interfered with as livestock follow these paths over years.

On campsite selection the DO said that the locals have a clustered form of settlement and the camp should be sited away from the town centre. The DO said that the Gabra community elders should be involve in selection of the area to site the camp in order to give their blessing, which is important for the success of the project.

The DO informed the meeting that the new Chalbi district was carved off the larger Marsabit district and there were only few government officers in the area. Chalbi district has four divisions thus North Horr, Turbi, Dukana and Maikona. Most of the government operations are still coordinated from Marsabit district headquarters. The district has a district steering group that coordinates development activities in the entire area.

On water supply, the officer said there was scarcity in the area and advised that the company should seek independent water sources during their operation.

MEETING WITH CHIEF BONAYA SAKU (MAIKONA LOCATION) ON 19TH AUGUST 2008

The team leader gave a brief background of the scoping exercise and the intended EIA study for the proposed petroleum survey.

The chief recalled the earlier petroleum prospecting project undertaken in the area in the late eighties. During that time the public was not involved in the process and as such there still exist a lot of fears about oil prospecting projects among local residents.

The chief advised that there is need for public sensitization and awareness about the project in order to eliminate the existing negative perception about oil prospecting projects.

He said there is also misinformation about possible eviction of people from their current settlements should the project succeed.

He said the project would create job opportunities for the youth and positively change livelihoods in the area.

He said there are no significant sacred places in the area but advised that the company should liaise with local elders during operation.

MEETING WITH COUNCILLOR ALEX BITACHA (MAIKONA WARD) ON 19TH AUGUST 2008

The team leader Prof Opiyo gave a brief background of the proposed project scoping exercise to the councilor.

The councilor said there is a lot of fear among residents in the area occasioned by misinformation about the proposed project. He said that there are rumours in the area that the local Member of Parliament has been bribed to the tune of ksh 80,000,000 by the prospecting company in order for him to allow the project to proceed on Gabra peoples' land.

In addition there is fear that the project may negatively affect livestock in the area and that people may be moved from their current settlement to allow for the project operation.

He said approximately 90% of the local residents have negative information about the company's proposed activity and thus there is need for intense public awareness and sensitization programme about the project.

The company should also involve the local leaders and communities in order to distil fear among the local people. During the public awareness exercise the EIA team should allow as many community members as possible to air their views without limiting the number of speakers.

The councilor said there are potential benefits from the project and it should be marketed effectively as there are a number of non-governmental organizations in the area bent on spreading misinformation about oil prospecting activities. One such organization was identified as Pakadeo.

The councilor observed that the new district headquarters now based at Maikona had been opposed by residents. However, now they have started enjoying the benefits of the new district including increased recruitment opportunities for local youth into armed forces.

MEETING WITH CHIEF DUBA ALI (KALACHA WARD) ON 19TH AUGUST 2008

The team leader made elaborate background information about the proposed project and the current scoping exercise. He said that the legal framework governing project development had changed considerably to allow for the carrying out of Environmental Impact assessment study prior to project commencement.

The chief said there are rumours going among the local people about hazardous waste materials having been dumped in the area by a former oil prospecting company. These wastes it is alleged are causing an increase in cancer related diseases in the area.

The chief said that the new company should follow the laid down regulation and involve the public at all stages of the project. He proposed the use of public awareness forums like *baraza* to educate the locals about the proposed project.

He said that the company's employees should respect local peoples' culture particularly those related to local women and ladies.

The company should not destroy trees/ vegetation and should not interfere with water points meant for livestock. Similarly the project operation should not interfere with designated livestock trails.

The chief observed that the proposed cut lines may not affect pasture land as only a small section of the land will be used for their construction.

On security in the area the chief said the security situation in the area is excellent, however, as a practice the company security machineries should always be alert at all the times. He said there are a number of Kenya Police reservists in the area and also an administration police camp.

The chief said a camp site can be located in the area; however, this should be sited away from the town centre at least 5 – 10 kilometres.

He said human population in the area is increasing rapidly and there is pressure on water resources thus the company should seek alternative source of water during operation.

He said burial sites are sacred areas and should not be interfered with during operation. He said that local elders can help the company identify the burial sites during the proposed works. In addition there are sacred sites for community spiritual elders referred to as Yaa Community at Elgade near Balesa. He said that at Afkaba area there are artifacts and historical drawings done by the early man. These have been protected by the community over the years and should not be interfered with during the proposed project operation.

MEETING WITH SERGEANT KENNEDY KIVINDO, MAJOR NORTH HORR POLICE STATION ON 20TH AUGUST 2008

Mr. Omori gave brief background information on the proposed project and the current scoping exercise.

The sergeant said that the security situation in the past seven months has been excellent with no reported major security incidences. He said the proposed project site is very safe and there is free flow of vehicles in the area without police escorts.

He said that the Gabra people who are the dominant community in the area are hospitable and will give maximum support to outsiders as long as there do not interfere with their culture.

He said the cattle rustling incident reported within the week was at Galasa area about 150 kilometres west of North Horr town and should not scare away the company. He said that this was an isolated incidence that was under control.

He said that there is no need to beef up security at the proposed camp sites, however, as a common practice there is need to ensure the safety of property at all the times.

MEETING WITH MR. JAMES NYAMWAMBU DISTRICT OFFICER NORTH HORR DIVISION ON 20TH AUGUST 2008

Mr. Omori gave background information on the proposed project and the current scoping exercise in the area.

The DO informed the meeting that the security situation in the area is okay and there have been no reported major incidences of concern. He said there is improved security surveillance and peace building initiatives between neighboring communities in the common Kenya – Ethiopia border.

On the proposed project he said that the new company is coming on a backdrop of bad experience by the local people occasioned by the activities of Amoco Limited during its oil exploration exercise in the eighties. There are allegations of possible dumping of hazardous waste in the area by the company during its decommissioning stage. These allegations have, however, not been verified.

The DO said that intense series of public awareness and sensitization on the new project should be done prior to commencement of the project.

He said the area has a fragile ecosystem and use of heavy machineries may lead to soil compaction and land degradation given that the proposed project will cover a large area.

He said the area is faced with inadequate water supply for domestic and livestock use thus the company should seek alternative means of water supply preferably by sinking water boreholes.

He said the Gabra community is still a closed society and the outsiders coming to work in the area should be careful particularly with the local girls. He said even shaking hands with young maidens in the area is forbidden and thus the workers need to be accustomed to these norms before embarking on their work.

On campsite he said they should be sited away from pasture land and watering points. This should be done in consultation with local elders and local administration.

He informed the meeting that the operations of the local authority in the area are still under Marsabit County council.

On transport in the area he advised that operations should be done only during dry season as most roads in the area are impassable during wet season.

He also advised that the company should make a follow up on the allegation of hazardous waste dumping in the area and share the truth with the local people.

MEETING WITH COUNCILOR DIBA DAMBALA KALACHA WARD ON 20TH AUGUST 2008

The team leader Prof Opiyo informed the councilor about the mission of the team in the area and gave a background of the oil prospecting company.

The councilor said that majority of the people in the area were still in a political mood following last year's general election. This he said had affected peoples' perception of the proposed project.

The councilor observed that any activities that will impact negatively on the peoples' cultural norms shall be strongly opposed. He said that workers coming into the area should not be in physical contact with local maidens as this shall certainly cause friction with the community.

The councilor said that there is need for the company to establish if there is a conclusive link between the increases in cancer cases in the area with the supposedly dumping of hazardous wastes by Amoco limited in the area during the decommissioning phase of their oil prospecting project in the late eighties.

The leader requested that the results of the proposed survey should be shared with the community in order to avoid similar suspicions occasioned by the sudden departure of Amoco in the eighties.

The councilor said that local residents need to be educated about the project through public sensitization and awareness programmes.

The company should not use local water supply as there is scarcity of the resource sin the area. The councilor said that the local community is ready to host a camp site for the workers; however, the camp should be located 1 – 2 kilometres from the town centre.

MEETING WITH CHIEF CHRISTOPHER WATO BARILE DUKANA LOCATION ON 21ST AUGUST 2008

The acting team leader Mr Mulwa introduced the members and gave a background of the proposed project.

The chief welcomed the team in the area and assured them of his support throughout the proposed project process. He said security situation has been calm for the past one year. The chief said that there is cordial relationship between border communities of Kenya and Ethiopia as local leaders have embarked on peace building initiatives. Additionally business and trade between the two countries has improved in the past one year.

Dukana being a border town has a police station, a General Service Unit (GSU) Camp and the location has a total of 80 Kenya police reservists.

The chief said that Amoco Kenya limited is suspected to have buried radioactive waste in the area during their decommissioning phase and this has been linked to the increase in cancer cases in the area. Similarly these wastes have negatively affected livestock in the area.

The chief said that the Gabra community is hospitable and accommodative as long as the visitors respect their culture. He said that traditionally girls are forbidden from interacting with men until they are married.

The chief informed the meeting that there is an acute water shortage in the area and the company should seek independent sources of water during operation.

He said there are five Gabra community Yaa Shrines located at Turbi, Huri Hills, Bobisa (near Marsabit town), Elgade (near North Horr) and Balesa. These shrines are sacred areas and should not be interfered with. He, however, said that only Balesa shrine falls near the proposed project site about 25 kilometres from Balesa town.

On food security he said majority of the residents depend on government relief supplies for their survival. The relief food is distributed through the Red Cross Society.

The chief said that public meetings to create awareness to the local residents should be organized prior to the commencement of the proposed project.

MEETING WITH CHIEF JACOB GOUNE BALESA LOCATION ON 21ST AUGUST 2008

The team was formally introduced to the chief by the leader Mr. Mulwa Josphat. The chief welcomed the team in Balesa and assured them of his cooperation during their study.

The chief informed the team that the security situation is okay and there have been no any incidences for a long time. He said the border town centre of Elari sub location has also been peaceful with cross border trade with Ethiopia going on. The location has 10 Kenya police reservist officers.

On the proposed project he said there is still scanty information about the project and its possible impact. He said local residents still equate the proposed project to the initial project undertaken by Amoco Kenya limited that the communities had a lot of misgivings about.

Most residents fear that they could be resettled forcibly from their homes and livestock water points during operation of the project.
Thus the chief said there is an urgent need for public awareness and sensitization about the proposed project.

He said pastoralists move throughout the area and as such there is need for protection of water point and pasture area during project operation.

He informed the meeting that there is scarcity of water supply in the area and the company should therefore consider alternative sources of water during operation.

The chief advised that since there will be many advantages associated with the project proper negotiations with the local leaders and residents should be done to ensure the benefits gets to the grassroots.

He also advised that the company should involve local elders, civic leaders, area Member of Parliament and the provincial administration in order for the proposed project to succeed.

List of Bird species encountered during the field study.

Common Name	Scientific Name	Habitat Preference	Sighting Frequency
Namaqua Dove	*Oena capensis*	Dry bushland	Common
African Mourning Dove	*Strepopelia decipiens*	Dry country below 1400m ASL	Common
Ring necked dove	*Strepopelia capicolor*	Bush, savannah wood land and cultivation	Common
White bellied go-away bird	*Criniferoides leucogaster*	Bush and open Acacia woodland	Common
Speckled Pigeon	*Columba g. guinea*	Grasslands,savannahs,towns, cliffs	Common
Superb starling	*Spreo superbus*	Lightly wooded areas in semi arid areas, savannas	Common
White headed Buffalo weaver	*Dinemellia dinamelli*	Dry bushed and wooded savannah with Acacia	Common
Black bellied Bastard	*Eupodotis melanogaster*	pen and partly treed savannas	Rare
Sacred Ibis	*Threskiornis aethiopica*	Freswater margins	Rare
White browed sparrow weaver	*Plocepasser mahali*	Wooded Acacia savanna's in semi arid areas	Common
Somali courser	*Cursorius somalensis littoralis*	Semi arid plains in Northern Kenya	Common
Egyptian Vultures	*Neophron percnopterus*	Dry plains,savannahs,deserts and mountains	Rare
Chestnut bellied sandgrouse	*Pterocles exustus olivascens*	Widespread in dy bush and open country	Common
Common fiscal shrike	*Lanius collaris*	Savannah woodlands,semi arid scrub lands	Common
African Spoonbill	*Platelea alba*	Widespread on inland water bodies	Encountered in Kalacha and Maikona springs
Egyptian Goose	*Alopochen aegypticus*	Common on freshwater lakes, ponds, and river banks	Encountered in Kalacha and Maikona springs
Long toed plover	*Vanellus c. crassirostis*	Found in marshes and swamps	Encountered in North Horr, Kalacha and Maikona springs
Spur winged Plover	*Vanellus spinosa*	Found in marshes and swamps	Encountered in Maikona Springs
Ruff	*Philomachus pugnax*	Common on inland freshwater lakes, ponds, and river banks	Maikona springs
Black winged stilts	*Himantopus h. himantopus*	Widespread in wetlands	Maikona Springs
Yellow Necked Spur fowl	*Francolilinus leucoscepus*	Common in open light bush and savanna.	Ririma/ Kargi
Helmented guinea fowl	*Numida meleagris*	Widespread in bush, woodland, savanna and shubby grassland.	Kargi
Somali Ostrich	*Struthio c. molybdophanes*	Common in Eastern and North Eastern Kenya	Encountered in Balesa, Chalbi and Kargi
Spotted thick-knee	*Burhinus capensis*	Common in dry bush.	Rare, Encountered at kurkum
Vulturine Guinea	*Acryllium vulturinum*	Common in dry bush and savanna in	Rare

fowls		Northern and Eastern Kenya	
Kori Bastard	*Ardeotis kori struthuinculus*	Semi desert,savannah and grasslands	Rare
Tawny Eagle	*Aquila .r. rapax*	Open country	Rare
Brown Snake Eagle	*Circaetus cinerus*	Common in bush, savanna and open country	Maikona
Hoopoe	*Upupa epops*	Open country,savanna, and bushlands	Rare, encountered at Maikona
Eastern Yellow-billed hornbill	*Tockus flavirostris*	Common in Northern and Eastern Kenya	Rare
Cape rook	*Corvus capensis*	Semi desert, cultivation, grasslands	Common North Horr, Balesa, Kalacha and Kargi
Magpie Starling	*Speculipastor bicolor*	Flocks in nothern deserts, scrub, dry woodland, nomadic	Maikona
Fan tailed raven	*Corvus rhipidurus*	Common near cliffs and around rocky hills	Encountered in Kalacha,Balesa and North horr
Yellow vented bulbul	*Pycnonotus barbatus*	Common in dry bush.	Encounterd in Maikona
Yellow billed stock	*Mycteria ibis*	Common and widespread along shallow rivers and lakeshores.	Encountered at Kalacha dida springs
White-faced whistling duck	*Dendrocygna viduta*	Common and widespread in wetlands below 1500m	Encountered at Kalacha dida springs
White crowned starling	*Spreo albicapillus horrensis*	Rare in dry bush	Encountered at North horr

List of mammals encountered during the field study

Common Name	***Scientific Name***	**Habitat Preference**
Dik-dik	*Madoqua spp*	Arid thorn bush and forests lining streambeds
Porcupine	*Hysttrix sp*	
Black-backed jackal	*Canis mesomelas*	Savannas and woodlands
Ground squirrel	*Xerus rutilus*	Dry savannas and semi-arid deserts
Cape hare	*Lepus capensis*	Dry open savannas and deserts
Olive Baboon	*Papio anubis*	Different savannah associations, cliffs, large trees and around water sources.
Hyaena	*Crocuta crocuta*	Open and lightly wooded savanna, dense woodland, rugged, broken country and drier vegetated water ways
Grant's Gazelle	*Gazella granti*	Semi desert scrub land and woodland
Grevy Zebra	*Equus grevyi*	Semi desert plains, and dry open woodlands