# 10 SUMMARY AND CONCLUSIONS

## 10.1 EIA PROCESS

The objective of the EIA process is to aid decision-making and environmental accountability as part of safeguarding sustainable development. This EIA process for the Jubilee Phase 1 Development project has been carried out in accordance with the Ghana *Environmental Assessment Regulations (LI 652, 1999) as amended (2002).* The requirement for an EIA to be undertaken for projects that have the potential for significant environmental impacts is stipulated under this regulation and an EIA is mandatory for an oil and gas field development.

This EIA considered all project activities, including a range of project alternatives, that have the potential to cause significant environmental impacts and developed a range of mitigation measures to avoid or reduce potential impacts to As Low As Reasonably Practicable (ALARP) levels. A process of stakeholder consultations was undertaken to solicit input and to consider the issues and concerns that were raised.

## 10.2 SUMMARY OF IMPACTS AND MITIGATION

*Table 10.1* presents a summary of the assessment of impacts showing the magnitude of the potential impacts and the sensitivity or value of the receptors and resources that may be impacted. The significance rating for the potential impact is given along with the key mitigation measures and the significance of the residual impacts.

## 10.3 OVERALL CONCLUSION

The assessment of impacts is based on review of the project activities as described by the project proponent and addresses the issues identified during the EIA scoping phase and through stakeholder consultations. The assessment acknowledges that any development will have effects on the biophysical and socio-economic environment. The impact assessment did not identify any issue of major significance that could not be mitigated such that the proposed project was not acceptable from an environmental and social perspective. All potential negative impacts identified through the EIA could be mitigated to reduce severity and significance to acceptable levels or to ALARP through design, use of control technology and operational management controls. In addition, the project will result in a number of positive impacts that will benefit the government and people of Ghana.

Granting of environmental authorisation of the project by Ghana EPA will be contingent on the project implementing the safeguard measures described in the EIA and monitoring for potential environmental and social effects.

*Table 10.1 Summary of Impacts and Mitigation*

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| **Physical Footprint (physical, presence, noise and light)** | | | | | | |
| Subsea infrastructure | Physical impact on the seabed and benthic communities through placement / presence of subsea infrastructure. | **Medium**– long term but very localised impact to the seabed and benthic communities. | **Low** - generally featureless benthic habitat and homogeneous benthic fauna. | **Minor** | • Pre-installation sidescan sonar<br>• Pre- and post installation and ROV survey.<br>• Subsea flowlines to be laid directly on the seabed and avoid trenching. | **Minor** |
| Underwater noise | Impacts on marine fauna (cetaceans, turtles, fish, birds etc) due to underwater sound. | **Low** – localised effect on marine fauna from continuous or near continuous low energy underwater sound. | **Medium** – low to high ecological value of marine mammal species. Species and individuals differ in sound threshold level and sensitivity to sound characteristics. Mobile species can avoid adverse sound levels. | **Minor** | • Policy and procedures to ensure traffic and operations of project vessels minimise disturbance to mammals and turtles.<br>• Training vessel operators in marine mammal and turtle observation and monitoring. | **Minor** |
| Vessel presence on fish populations | Pelagic species will likely be attracted to vessels and floating objects. Exclusion zone may provide protection from fishing pressure. | **Low Positive** – long-term but very localised impact on pelagic species. | **Low** – sensitivity of pelagic fish populations to presence of infrastructure. | **Not significant** | • No mitigation proposed. | **Not significant** |
| | Installation of subsea infrastructure may disturb deepwater species. Presence of infrastructure will provide habitat. | **Low Negative** – long-term but very localised impact on deepwater species. | **Low** – sensitivity of deepwater fish communities to subsea infrastructure. | **Not significant** | • No mitigation proposed. | **Not Significant** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| **Operational Discharges** | | | | | | |
| Black water (sewage), grey water (washing) and macerated food waste | Discharges from project vessels may impact on water quality with secondary impacts on marine fauna. | **Low –** discharge of small volumes of black water, grey water and food waste is expected to have a localised impact. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Compliance with MARPOL requirements and good industry practice. | **Minor** |
| Deck drainage and bilge water | Discharges from project vessel contaminated with traces of hydrocarbons can affect water quality with secondary impacts on marine fauna. | **Low –** frequent but localised impact of small volumes. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Compliance with MARPOL requirements and good industry practice. | **Minor** |
| Produced water | Produced water discharges will contain some level of hydrocarbons and can impact on water quality. | **Low –** relatively large volumes of produced water discharges will have a localised effect on water quality. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Three stage treatment process.<br>• Continuous monitoring.<br>• Compliance with IFC guidelines to maintain oil concentration. | **Minor** |
| Completion and workover fluids | Completion fluids and occasional discharge of workover fluids from the MODUs. | **Low –** discharges of completion and workover fluid will be occasional and short-term. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Selection and use of completion and workover fluids taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard. | **Minor** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| Hydraulic fluid | Hydraulic fluid from daily subsea valve activation can impact on water quality. | **Low –** occasional discharges of small volumes of hydraulic fluids will have a short-term, localised effect on water quality. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Water based, low toxicity and biodegradable hydraulic fluid. | **Not Significant** |
| Ballast water | Discharge of ballast waters (from export tankers and other vessels) can impact on water quality and marine fauna. Risk of introduction of invasive species. | **Low –** occasional discharges of ballast water may have a localised effect on water quality. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Segregated ballast tanks.<br>• Compliance with MARPOL requirements.<br>• Ballast water management measures. | **Not significant** |
| Hydrotest waters | Chemically treated hydrotest waters will be discharged and can have a detrimental impact on water quality and marine fauna. | **Low –** hydrotest waters will only be discharged during installation and commissioning. | **Medium –** good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. | **Minor** | • Testing equipment onshore.<br>• Select low toxicity fluids.<br>• Ensure correct dilution. | **Minor** |
| Onshore base - potential leaks and spillages | Potential leaks or accidental releases from tanks, pipes, hoses and pumps, including during loading and unloading from the shore base can impact on soil and groundwater quality. | **Low –** any leaks and accidental releases will have a localised effect, potentially in the long term. | **Medium –** contamination of surface or ground water at onshore facilities could impact on coastal ecosystems and nearby communities. | **Minor** | • Spill prevention measures and procedures.<br>• Secondary containment.<br>• Impervious concrete surfaces.<br>• Stormwater collection channels with oil-water separators. | **Not significant** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| **Air Emissions** | | | | | | |
| Air pollutants | Project activities will emit varying amounts of primary atmospheric pollutants with the potential to impact air quality. | **Medium –** Significant quantities of SOx and VOC will be emitted resulting in a localised and short term impact on air quality due to the highly dispersive nature of the environment of the offshore location. | **Low** - Emissions from the offshore activities are unlikely to have significant direct impacts given the absence of sensitive receptors. | **Minor** | • Compliance with MARPOL 73/78 Annex VI and IFC guidelines for small combustion sources.<br>• Equipment selection, operational procedures and inspection and maintenance of engines, generators, and other equipment to minimise leaks and fugitive emissions.<br>• Routine flaring will be avoided and non routine flaring will be kept to minimum. | **Minor** |
| Greenhouse Gas (GHG) Emissions | Project activities will emit varying amounts of GHGs (eg carbon dioxide and methane) believed to contribute to global climate change. | **Low**- emissions from a single installation are relatively small in the context of the industry but significant in the context of relatively low national emissions in Ghana. | **High** - Emissions that can contribute to climate change are significant at an international scale. | **Minor** | • The mitigation measures aimed at reducing GHG emissions are built into the design of the FPSO through focus on optimisation of overall energy efficiency and reduction in flaring and venting.<br>• Monitor effectiveness of these measures. GHG emission from production and flaring activities will be quantified and reported annually. | **Minor** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| **Waste Management** | | | | | | |
| Storage | Non-hazardous and hazardous wastes will be generated that will require to be transported and disposed of in a manner protective of the natural and human environment. | **Low to Medium –** impact could occur at a regional level and in the long term but volumes of wastes will be small. Limited currently available facilities for waste handling and disposal. | **Medium to High –** depending on the sensitivity/ vulnerability of soils and groundwater resources at disposal sites and the proximity and access of communities to the disposal site. | **Minor** | • Operational controls.<br>• Waste Management Plan.<br>• Proper storage of hazardous waste. | **Minor** |
| Transport | | | | **Minor** | • Safe transport using well maintained, legally compliant and suitable vehicles or vessels and trained operators.<br>• Use of Tullow and EPA approved waste contractors. | **Not Significant** |
| Onshore waste disposal | | | | **Moderate** | • Selection of a suitable disposal facility(s) and upgrade facility standards.<br>• Measures to ensure proper continuous operation and monitoring of the disposal facility. | **Moderate** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| **Oil Spill Risk** | | | | | | |
| Small oil spill | Impacts to water quality and species (seabirds, marine mammals, marine turtles, fish) and economic activities such as fisheries. | **Low -** small oil spills and leaks (ie diesel spillages during bunkering) are likely to occur during the life-time of the project but these are generally localised and impacts are of short duration. | **Medium –** good existing water quality, presence of small groups of sensitive marine species in offshore areas that could be impacted. | **Minor** | • Oil spill prevention equipment, measures and procedures.<br>• Specific procedures for offloading diesel from supply vessels to the FPSO.<br>• Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of a Tier 1 oil spill. | **Minor** |
| Medium to large oil spill | Impacts to marine and coastal habitats and species (seabird, coastal birds, marine mammals, marine turtles, fish), and economic activities such as fisheries and tourism. | **Medium –** this is a precautionary rating as the magnitude of impacts from accidental events takes into account the likelihood of an event occurring. Major spill events, such as ship collision, FPSO hull damage and blowouts are highly unlikely to occur.<br><br>In the event of an incident the extent of impacts would be directly related to the duration and volume of the oil release. | **High –** Marine and coastal habitats and species are of high value and sensitivity both ecologically and commercially. | **Moderate** | • Oil spill prevention equipment, measures and procedures.<br>• Specific procedures for offloading crude from the FPSO onto the shuttle tankers.<br>• Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of a Tier 2 and 3 oil spill. | **Moderate** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| **Socioeconomic and Human** | | | | | | |
| Macro-economic | The revenues generated by the project through oil sales, taxes and royalties will be a valuable source of finance for the government with the potential to facilitate investment in the country's socioeconomic development. | **Medium** - Overall revenues have the potential for significant positive benefits at a national level over at least the long term (20 years). | **High** - high level of expectations and direct benefits to the population at a national level. | **Moderate Positive** | • Establishment and financial support for projects through CSR strategy and sponsoring training programmes/education in oil industry.<br>• CSR framework plan to enhance the positive impacts of activities and transparent spending. | **Moderate Positive** |
| Employment and training | Direct employment by the project and indirect employment through contractors and suppliers will have a positive impact on those people employed, their families and their local communities from wages and other benefits. | **Low** - in general, the oil industry is not a large employer in relation to the revenues it can generate. Employment and training could have a positive direct effect at the local level in the long term. | **Medium** - high level of expectations and direct benefits to the population at a regional level. | **Minor Positive** | • Human Resource Strategy for the recruitment and development of national staff in its operations (known as 'nationalisation'). The strategy will include methods for effective communication of employment opportunities, selection, evaluation and appropriate induction and dedicated staff training programmes. | **Minor Positive** |
| | Skills drawdown from other sectors and unmet expectations due to low numbers of staff required. | **Low** - in general, the oil industry is not a large employer. | **Low –** available skilled resources can meet the anticipated short term demand and training will allow longer term demand to be met. | **Not significant** | | **Not significant** |

| Issue | Impact Summary | Magnitude (L/M/H) | Value/Sensitivity (L/M/H) | Potential Impacts | Key Mitigation Measures | Residual Impacts |
|---|---|---|---|---|---|---|
| Procurement of services and goods | Procurement of goods and services is likely to be positive through stimulating small and medium sized business development, including investment in people (jobs and training) and generation of profits. | **Low -** the project is not reliant on local goods and services but will use those available within existing capacity. | **Medium** - direct benefits to businesses at a regional level. | **Minor Positive** | • A policy of procuring services and equipment locally and assisting local businesses.<br>• Contracting companies to establish longer term commitments to the businesses.<br>• Conduct contractor screening and develop contract conditions to ensure the requirement for local content is met.<br>• Work with suppliers to help them meet the required standards. | **Minor Positive** |
| | Negative impacts due to project demands for goods and services placing pressure on local needs, leading to shortages and price increases. | **Low –** the project is not reliant on local goods and services but will use those available within existing capacity. | **Medium –** local communities and businesses will be sensitive to any shortages or price increases. | **Minor** | | **Not significant** |
| Fishing activities | Potential impacts on fisheries can arise from loss of access to fishing grounds, attraction of fish to the FPSO and disturbance and damage to fishing gear from project support vessels. | **Low –** relatively small area unavailable for fishing. Limited vessel traffic between Jubilee field and Takoradi port. | **Medium –** the Jubilee field is not an important or exclusive fishing ground, however, significant tuna fishing occurs in the project area and coastal fishermen are likely to visit the field attracted by fish around the structures. | **Minor** | • Community Liaison Officers to liaise between fishermen and the project.<br>• Vessel transit route will be agreed with the Ghana Maritime Authority and communicated to fishermen and other marine users.<br>• Notification of mariners of the presence of the FPSO and other marine operations.<br>• FPSO security trained in Voluntary Principles on Security and Human Rights | **Minor** |
| Commercial shipping | Interaction with existing commercial shipping as a result of additional vessel movements associated with the project. | **Low –** limited additional vessel movements are anticipated. | **Low** - larger commercial ships will be able to detect and avoid offshore facilities and vessels. | **Not significant** | • Project vessels to be equipped with radar, navigation equipment and ship-to-ship communications.<br>Location of offshore facilities marked international navigational charts. | **Not significant** |

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|---|---|---|---|---|---|---|
| Onshore operations | Potential strain on capacity of the public utilities and impact on use of shared services by local communities.<br><br>Expansion of the workforce and industrial activities at the bases could result in negative social impacts such as disturbance or damage to the public health of local communities. | **Medium –** local impacts in the short to medium term. | **Low –** shore bases to be located within existing industrial port area and airport. | **Minor** | • EHS policies and procedures to manage environmental and social impacts from onshore activities.<br>• A grievance procedure to be implemented and made known to the surrounding communities and the general public.<br>• Support updating of District Land Use and Development Plans<br>• Corporate Social Responsibility Management Framework and Plan | **Not significant** |
| **Cumulative and Transboundary** | | | | | | |
| Cumulative | Cumulative impacts can result from individually slight but collectively significant activities taking place over a period of time. | **Medium –** cumulative impacts could occur at a regional or even national scale and in the medium to long term. | **Medium –** difficulty of managing cumulative impacts and potential impacts to significant biophysical and socio-economic resources. | **Not significant** | • Government-led Strategic Environmental Assessment (SEA).<br>• Build capacity of local administration to plan effectively for future development in the area.<br>• Collaboration and agreed standards.<br>• Programme of data gathering and monitoring studies led by government.<br>• Collectively applied environmental standards.<br>• Integrated approach to oil spill response. | **Not significant** |
| Transboundary | The project is however located near the border with Cote d'Ivoire and ecological systems are connected so some limited interaction may occur. | **Low –** the magnitude of any transboundary impacts would be low in the offshore environment. No transboundary oil spill impacts are expected. | | **Not significant** | • No specific mitigation proposed, | **Not significant** |