Takoradi LNG Floating Storage Regasification Unit (FSRU)

Environmental and Social Scoping Report

January 2016

Rotan Gas Limited
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1 Introduction

1.1 Overview

This document presents the Environmental and Social Scoping Report (Scoping Report) for the development of a new build Liquefied Natural Gas (LNG) floating storage and re-gasification unit (FSRU) with an approximate storage capacity of 170,000m$^3$, an island jetty berth mooring system, a buried sub-sea natural gas pipeline approximately 5.7km in length, a ~2.5km onshore buried pipeline connecting to the Ghana Gas Takoradi (Ghana Gas) receiving station, and a 500m buried pipeline connecting branch to the West Africa Gas Pipeline (WAGP) onshore header (the Project). The Project is being developed by Rotan Gas Limited (the Project Proponent).

This is a revised and updated Scoping Report from the one submitted to GEPA on September 2015 in order to include the onshore components of the Project, namely: the 2.5km onshore pipeline to Ghana Gas and the 500m connecting branch to the WAGP receiving station.

The Project is associated to a development which involves the construction and operation of a 660MW combined cycle gas turbine (CCGT) power plant, which includes a 2.5km onshore gas pipeline, an accommodation village and a 330 kV overhead transmission grid connection (the Power Project). The Power Project will be one of the consumers of the re-gasified LNG supplied from the Project once the gas comes ashore.

1.2 Purpose and Objectives

This Scoping Report aims to identify the key environmental and social issues associated with the Project. The ESIA will take into consideration the installation (considered as the construction phase), operation and decommissioning phases of the Project and any associated facilities which are identified during the ESIA process. This scoping report identifies the likely impacts and proposes the scope and where appropriate, suitable methodologies for the ESIA in order for the Project to demonstrate compliance with Ghanaian environmental and social standards as well as international requirements.

To inform this Scoping Report, the following activities have been performed:
- Review of information specific to the development of the Project
- Primary data collected from three site visits to the location of the Project by a number of environmental and social professionals, including social scientists, marine ecologists and coastal scientists
- Review of available secondary data
- Consultations with key local stakeholders, including the Ghanaian Environmental Protection Agency (GEPA), the Ghana Ports and Harbours Authority (GPHA), the West African Gas Pipeline (WAGP), the Shama District Assembly, local Chiefs, Aboadze and Abuesi fishermen associations and residents living in the surrounding area of the Project.

The Scoping Report will be disclosed on the Project Proponent’s website and will also be made available for the local communities to further inform them about the Project and provide them with additional information on the proposed assessment approach.
Comments on the Scoping Report are welcome and should be sent to the address below.

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2 Project Description

2.1 Overview

The Project is being developed by Rotan Gas Limited and is to be located offshore in the Western Region of Ghana, in the Shama District close to the town of Aboadze. The FSRU itself will be permanently moored in the Atlantic Ocean and it will connect to an on-shore 660MW CCGT thermal power plant (the Power Project) being developed by Rotan Power Ltd, through a sub-sea gas pipeline of approximately 5.7km in length. Once onshore, an approximately 2.5km onshore buried pipeline will connect the FSRU to the Ghana Gas Takoradi (Ghana Gas) receiving station and a 500m long pipeline will branch off and connect the FSRU to the onshore header of the West African Gas Pipeline (WAGP), located adjacent to the existing Takoradi Thermal Power Station (TTPS).

The Government of Ghana (GoG) has designated the land in the vicinity and surrounding the TTPS as the Aboadze Power Enclave (APE) and is aiming to attract independent power producers (IPPs) to construct and operate further power projects. As a result, it has been identified by the Project Proponent that the Project could eventually be a readily available natural gas supply source for other thermal power projects that will be developed within the APE.

2.2 Need for the Project

The main purpose of the Project is to supply natural gas to the Power Project to be located adjacent to the existing TTPS and to other potential IPPs in the APE. Energy generated by the Power Project will be for the wider distribution throughout Ghana. The current installed power capacity in Ghana is 2,433 MW, yet domestic and export demand is expected to exceed 5,000 MW in the coming years. This rising demand is being fuelled by increasing domestic demand due to improving rates of electrification, a desire by the GoG to become a major exporter into the West Africa Power Pool (WAPP) and high annual economic growth (GDP grew by 14.4% in 2011).

As a result, there is a clear need to increase power production to meet the expected growth in demand and consequently the installation and operation of the FSRU plays a crucial role in supplying natural gas to the Power Project as well as other potential IPPs that may come on-line in the APE in the near future. Gas-fired IPPs remain the most efficient way in developing additional generation capacity. The FSRU will have the capacity to allow other power generators in the area to shift from the widely used liquid fuels, such as light crude oil (LCO), to natural gas for power generation, which will result in substantial cost savings and in a cleaner power sector for the benefit of the people of Ghana. Furthermore the FSRU will enable and streamline the projected efficiency in gas-fired power generation to progress the agenda of establishing a reliable energy network.

2.3 Project Location and Surrounding Area

The proposed FSRU will be moored approximately 5.7km offshore on the southwest coast of Ghana. The towns of Sekondi and Takoradi, in the Essipon District, are approximately 10km to the west of the proposed Project location, which is 6km southwest from the shoreline of the nearest settlement, Aboadze village, located on the south eastern end of the Shama District.
The FSRU will be located in the Sherbro Bank, which is the area off the coast in of the proposed Power Project. The existing WAGP runs offshore and connects to on-shore facilities adjacent to the TTPS. There is another existing subsea pipeline approximately 2.5km long that connects a SPM (Single Point Mooring) that supplies LCO to the TTPS.

The land where the 2.5km onshore pipeline will be laid can be characterised as a shore line, tropical beach environment dominated by sandy beaches and interspersed with near shore rocky bottoms and outcroppings. Inland there are a cluster of trees and long grasses and the land is predominantly flat and low lying, but rises steeply to the north and east of the site.

2.4 Site Selection

The suggested location for the FSRU has been selected for the following reasons:

- The FSRU location is directly offshore and in front of the Power Project
- The FSRU location is to the west of the WAGP that comes onshore adjacent to the TTPS. Therefore the selected location means that the Project’s subsea pipeline will run parallel to the WAGP, negating the need for crossing it
- The FSRU could supply other IPPs within the APE, facilitating a switch from LCO to natural gas, which would streamline operation for the APE as a whole
- The Ghana Gas receiving station is located 2.5km inland to the north of the APE
- There is an existing 330 kV substation located in close proximity, which will facilitate the export of power to the national transmission system by the Power Project, and the other generations assets that could use the FSRU as a fuel supply
- There are no environmentally designated areas in the vicinity of the Project, and
- The APE is designated as a power generation zone

Figure 2.1 below presents the suggested location for the FSRU in relation to the Power Project and the nearby communities and the 5.7km subsea pipeline.
Figure 2.1: Offshore Project components: FSRU location and the 5.7km subsea pipeline

Source: Amec-FW

Figure 2.2 below represents the subsea gas pipeline coming to shore connecting to the Power Project and the 2.5km connection to Ghana Gas and the 500m branch to the WAGP.

Figure 2.2: Onshore Project components: 2.5km and 500m pipelines

Source: Rotan Gas
2.5 Project Components

The Project will consist of a number of components. These are described in the following sub-sections and between them they constitute the technical extent of the Project which is the subject of this Scoping Report and the ESIA process.

2.5.1 Floating Storage and Regasification Unit (FSRU)

The FSRU will receive and store LNG and re-gasify the LNG to supply natural gas to facilities onshore, to power plants in the area and to the Ghana Gas receiving station located 2.5km on-shore. The systems on board the FSRU will include:

- LNG storage tanks
- LNG loading arms
- LNG pumping
- Vapourisation
- Boil-off gas handling
- LNG gas compression
- Power generation
- Connection to off-shore pipeline
- Crew accommodation

The FSRU will draw in seawater and use the heat of the seawater to vaporize the LNG, and discharge cooler seawater to the ocean. Figure 2.3 below presents an indicative FSRU process diagram.
The FSRU will be a ‘new build’ vessel with an LNG capacity of 170,000m$^3$, and be of about 300m in length, 48m width, and with a draft of 11m (minimum sea water depth). It is assumed that the FSRU will be designed to the IMO, ‘International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk’ (IGC Code), 1993 as amended.

### 2.5.2 Island Jetty Berth Mooring System

An island jetty berth type mooring system will be erected on approximately 50 piles in the sea bed. The FSRU will be permanently moored to the jetty berth that will be designed to allow the FSRU to remain on station and in operation in all weather conditions and states of the tide for a continuous period of 20 years. The island berth will be located 5.7km off-shore and to the west of the existing WAGP. Figure 2.4 overleaf shows a generic example of an FSRU and an island jetty berth.
The selection of an island jetty berth is based on the options appraisal carried out by Amec Foster Wheeler\(^1\) who evaluated ten different technical options, five to the east and five to the west of the WAGP. A location to the west of the WAGP has been chosen as crossing underwater the WAGP pipeline was an option to be avoided. The qualitative study used seven criteria to evaluate each technical option and a reserve option was identified, namely, a spread mooring system to be used if for any reason the island jetty berth is not considered feasible.

### 2.5.3 Visiting LNG carriers

The FSRU will be restocked by visits from LNG carriers which will come alongside it and transfer the LNG from ship to ship. The LNG carriers will be of similar dimensions to the FRSU. Restocking visits are expected to be at frequencies of 30 to 40 days, depending on the rate of gas use.

### 2.5.4 Use of tugs

The Project will include the use of three ocean tugs of around 50 tonne average bollard power each, to be located in the nearby port of Takoradi. These tugs will mainly be used to assist in the manoeuvring of the visiting LNG carriers, and for supply trips to the FRSU.

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1 Takoradi Gas to Power Project – Offshore Part 1: Offshore Project Main Study Report
2.5.5 Sub-sea LNG gas pipeline

The sub-sea pipeline will be 5.7km long and 20 inch in diameter with concrete cased carbon steel, and laid in the seabed, with a design pressure of 100 bar and a working pressure of 80 bar. The pipeline will have an external anti-corrosion coating and the density of concrete used will be 3040 kg/m$^3$.

The pipeline will be constructed by tow, which is the most cost effective alternative or by S-Lay, which is the most common method used. For the shore crossing, which is the transitional element from offshore to onshore, a trench shore approach will be used as it will result in limited environmental impact and is the most cost effective option.

2.5.6 Onshore gas pipeline

The onshore gas pipeline is planned to run from the gas receiving station on the Power Project site through undeveloped, low lying land for approximately 2.5km to the Ghana Gas receiving station. The pipeline is expected to be a 20 inch diameter with a 100 bar design pressure. The Project’s onshore gas pipeline will not require the acquisition of new land as it will be laid along a right of way (RoW) and run parallel to the corridor of the Power Project’s onshore pipeline but will transport gas in the opposite direction. It will allow the Project to supply gas for wider distribution throughout Ghana. In addition, a branch is planned to connect with the header at the end of the WAGP, to the north of the existing TTPS, which will not require acquisition of any land other than rights of way during construction.

2.6 Development Schedule

The Project Proponent is currently working to the following schedule for the ESIA process;

- Updated Environmental and Social Scoping Report (herein) January 2016
- Submission of ESIA to the GEPA March 2016 (estimate)

In relation to the wider development of the Project, construction/installation is envisaged to last:

- Commencement of construction activities 2nd Quarter of 2017
- Subsea pipeline construction 7 months
- Onshore pipeline construction 7 months
- Island jetty berth construction 10-12 months
- FSRU arrives (new built and assembled abroad) 2nd Quarter 2018
- Commercial operation 3rd Quarter 2018

In line with the schedule above the Project is expected to achieve commercial operation in the third quarter 2018 which means that re-gasified LNG fuel will be available for the scheduled commercial operation of the Power Project.
3 National Legislation and International Guidelines

3.1 Introduction

This section provides a brief overview of the applicable regulations and standards that will be applied to the Project. This Chapter introduces a number of national and regional requirements that the Project will have to comply with as well as international standards.

3.2 Applicable National Legislation and Requirements

A full review of all applicable requirements can be found in Appendix B. Relevant national requirements are:

- National Environmental Action Plan (NEAP) of 1993
- Environmental Protection Agency (EPA) Act, 1994 (Act 490)
- Fees and Charges (Amendment) Instrument, 2014 (LI 2216)

Other Relevant Existing Policy, Legal Frameworks & Guidelines
- Energy Commission Act (1997), Act 541
- Petroleum Commission Act
- Environmental Assessment Regulations 1999, LI 1652
- Investment Code, PNDCL116, 1985
- Public Utilities Regulatory Commission (PURC) 1997, Act 538
- Water Resources Commission Act (1996), Act 552
- Factories, Offices and Shops Act (1970) Act 328
- National Museums Decree (1969) NLCD 387
- Local Government Act 462 of 1993

Policy Documents
- National Energy Policy

The relevant national Guidelines are:
- Environmental Assessment in Ghana, A Guide (1996) produced by the EPA provides detailed guidance on the procedures to be adhered to when undertaking an EA
- Environmental Impact Assessment Procedures (1995) produced by the EPA details the procedures to be adhered to when undertaking an EA
- Environmental Quality Guidelines for Ambient Air (EPA) provides advice on maximum permissible levels of a variety of air pollutants
- Ghana’s EPA Guidelines for discharges into natural water bodies provide maximum permissible concentrations for a number of parameters

Institutional Framework
- Ministry of Environment, Science, Technology and Innovation
- Ministry of Lands and Natural Resources
- Ministry of Local Government and Rural Development
- Ministry of Petroleum
3.3 International Requirements

The ESIA process is being performed in line with The Equator Principles (EqPs) III, which in turn are based on the IFC Performance Standards 2012. A description of both frameworks is provided in the following sub-sections. The World Bank Operational Policies and Millennium Development Goals applicable to the Project are also outlined in this Section.

3.3.1 Equator Principles III (EqPs)

The EqPs III (adopted on the 4th June 2013), are a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. EqPs signatories use the principles to ensure that the projects they finance are developed in a manner that is socially responsible and reflect sound environmental management practices. To date, these principles have been adopted by 80 financial organisations as a mandatory requirement for project financing. The Project will be assessed against the most appropriate EqPs which comprise ten principles and the ones listed in the latest version are presented below:

1. Review and categorisation
2. Environmental and social assessment
3. Applicable environmental and social standards
4. Environmental and social management system and equator principles action plan
5. Stakeholder engagement
6. Grievance mechanism
7. Independent review
8. Covenants
9. Independent monitoring and reporting
10. Reporting and transparency

The EqPs are based on the International Finance Corporation (IFC) Performance Standards (PS) of social and environmental sustainability and on relevant World Bank/IFC Environmental, Health and Safety Guidelines (EHS Guidelines).

3.3.2 International Finance Corporation Performance Standards (IFC PSs)

The IFC PS are a set of eight standards that set a framework of requirements to be addressed in an international ESIA and the means to address them to international standards. They include:

- IFC PS1 – Social and Environmental Assessment and Management Systems
- IFC PS2 – Labour and Working Conditions
In addition to IFC Performance Standards the following IFC documents are applicable to the Project:

- The General Environmental, Health and Safety (EHS) Guidelines (April, 2007) covering four areas of international good practice, namely:
  - Environmental
  - Occupational Health and Safety (OHS)
  - Community Health and Safety (CHS)
  - Construction and Decommissioning
- World Bank/IFC EHS Guidelines for Liquefied Natural Gas (LNG) Facilities

### 3.3.3 International Guidance for FSRU Operation

The operation of the FSRU should be undertaken in accordance with best international practice. Witherby Seamanship publishes international guidance on the operation of ships (the FSRU would be considered a ship) handling LNG, including:

- Liquefied Gases Marine Transportation and Storage
- LNG Operational Practice
- Liquefied Gas Handling Principles on Ships and in Terminals 3rd Ed.
- Introduction to the Design and Maintenance of cargo system pressure relief valves on-board gas carriers
- Mooring Equipment Guidelines (MEG3)
- Guide to Contingency Planning for the Gas Carrier Alongside and Within Port Limits, 2nd Ed.
- Crew Safety Standards and Training for Large LNG Carriers. Essential best practices for the industry
- The Safe Transfer of Liquefied Gas in an Offshore Environment (STOLGOE). This guide is written for LPG transfers rather than LNG but future issues are expected to cover LNG transfers
4 Terms of Reference and Approach to ESIA

4.1 Introduction

This section presents the proposed approach and briefly summarises the main potential impacts for each environmental and social topic and how they will be assessed within the ESIA.

The ESIA report will contain the following volumes:
- Volume I: Non-Technical Summary
- Volume II: ESIA Main Report
- Volume III: ESIA Technical Appendices and supporting documents
- Volume IV: Environmental and Social Management and Monitoring Plan (ESMMP)

Draft versions of these volumes will be made available at the public consultation event and will also be made available on the Project Proponent’s website as a minimum.

4.2 Technical Scope

The Project upon which the ESIA will be performed consists of the components described in Section 2.5 above. There is a link between the Project presented herein and the development of the Power Project being progressed by Rotan Power Limited as this power plant will be the main customers of the re-gasified LNG which comes ashore. This ESIA will therefore cover all works associated with the FSRU, island jetty berth mooring, the 5.7km subsea pipeline connecting to the Power Project (including where the pipeline runs across the breakwater onto the power site), the 2.5km onshore buried pipeline connecting from the Power Project to Ghana Gas and the 500m branch connecting to the header at WAGP station.

4.3 Spatial Scope

The zone of influence (ZoI) of the ESIA is described by the geographical area. The definition of the spatial scope has taken account of the:
- Nature of the existing baseline environment
- Manner in which impacts are likely to be propagated (e.g. effects on air quality may extend over some distance)
- Area affected (positively and negatively) by impacts; and
- Geographical boundaries of the political and administrative authorities which provide the planning and policy context for the Project.

The effects for each of the disciplines are likely to be confined to different spatial extents. In some cases a wider corridor will be examined to assist with the description of the context within which a significant effect may arise.

4.4 Temporal Scope

The ESIA will address effects arising from the construction, operation and decommissioning of the Project as follows:
Construction and installation is envisaged to last approximately 9-12 months and effects may arise directly from construction activities (e.g. temporary beach excavation for gas pipeline connection, onshore pipeline, island jetty berth mooring to seabed) but also from the temporary use of land (e.g. construction sites and lay down areas) or from associated changes in traffic movements (e.g. diversions in and around the Project site).

Operational effects lasting approximately 20 years that may arise from the operation of the FSRU (e.g. activities of associated facilities); and

Effects associated with decommissioning of Project facilities will be considered (e.g. reuse and or disposal of Project infrastructure).

The significance of the effects (both positive and negative) that will arise in each of these phases is based on any changes compared to the baseline conditions (i.e. those conditions which would exist if the proposals did not go ahead).

4.5 Scoping Site Visit

Three site visits took place during between August and November 2015 and was undertaken by four (4) consultants from Mott MacDonald based in the UK; an environmental consultant, a social scientist, a marine biologist and a coastal and tidal specialist/modeller. The international team was accompanied by counterpart specialist from EEMC who are MM’s local partners in the delivery of the ESIA process.

4.6 Stakeholder Consultation and Public Participation

This section presents the plans for consultation as part of the ESIA studies as well as the communication strategies during the implementation of the Project. It identifies who the key stakeholders are, explains the convened consultation exercises and outlines initial findings of consultation. Further consultations will be held during the ESIA phase to cover pre-construction, construction and operation phases and delineates the grievance redressing mechanisms.

Stakeholder consultation to support the ESIA process specifically aims to achieve the following objectives:

- To provide information about the project and its potential impacts to those interested in or affected by the project, and explore their opinion in this regard
- To provide opportunities to stakeholders to discuss their expectations and concerns
- To manage expectations and misconceptions regarding the project
- To verify significance of environmental, social and health impacts identified
- To inform the process of developing appropriate mitigation measures; and
- To build up a continuous communication with stakeholders to access the efficiency of mitigation measures and improve the implementations during the life of the project.

To adequately appreciate the views and concerns of stakeholders with regard to the proposed Project, field visit and consultation with key stakeholders, Ministries, Departments and Agencies, selected Land Sector Agencies (LSAs), affected persons are being undertaken. The consultations focused on:

- Assessing the views and understandings of the Project;
Identifying and assessing environmental and social impacts of the proposed Project;
Examining the zoning status of the proposed Project sites and compliance and enforcement of environmental regulations.
Environmental and social concerns of the stakeholder institutions for integration into the ESMMP to ensure sustained environmental and social compliance monitoring.

The ongoing consultations are mainly in the form of open interviews with key informants from the Shama District Assembly, VRA Offices in Aboadze and Accra, Ghana Ports and Harbours Authority, GRIDCO, Town Planning Department, Chiefs, Individual Land Owners, The Lands Commission, Regional Land Survey Department, Town and Country Planning, the Environmental Protection Agency, WAGP, Aboadze and Abuesi fishermen associations and other affected persons. Other IPPs have been targeted for further consultation. The consultations revealed key environmental and social concerns of the proposed Project. All consultation activities, discussions and findings will be fully presented in the final ESIA report.

4.7 Potential Impacts

Based on the three site visits undertaken to date and preliminary secondary data review we have identified the following potential impacts that will be assessed during the ESIA process:
- Air Quality
- Coastal Processes
- Water Resources
- Soil and Ground Conditions
- Noise
- Marine Ecology
- Terrestrial Ecology
- Waste, Materials Handling and Storage
- Cultural Heritage
- Socio-economics
- Hazards and Accidents
- Climate Change Adaptation
- Greenhouse Gas Emissions (GHGs)

A description of the baseline data collection techniques that will be used to gather primary information which will inform the ESIA are presented in section 4.8 below. The sections below introduce the likely potential impacts.

4.7.1 Air Quality

The key issues with respect to the installation phase are likely to be:
- Emissions associated with vehicles, equipment and ships during installation;
- On-site dust emissions arising from installation activities on land. Dust can be mechanically transported (either by wind or re-suspension by vehicles). It can also arise from wind erosion on material stock piles, earth moving etc; and
Emissions associated with installation traffic on the local road network

The impacts described above will be temporary and limited to locations close to where the installation work is being undertaken. Therefore in accordance with international best practice for impacts such as these the ESIA will assess the installation phase impacts qualitatively.

The operational phase of the Project will have emissions associated with LNG transport ships mooring alongside the FSRU to transfer LNG and from the auxiliary power requirements of the FSRU. It is estimated that deliveries of LNG via transport ships will be monthly and other emissions from sources meeting auxiliary power requirements will be negligible. Based on the location of the FSRU these emissions will not have the potential to cause significant impacts and on this basis a qualitative description and assessment of the operational phase will be undertaken.

4.7.2 Coastal Processes

Coastal erosion is a serious problem in Ghana (Kumapley, 2001; Anim et al., 2013). Typically coastal erosion at Takoradi and Aboadze is 1.23m/year and 2.33m/year, respectively (Boateng, 2009; 2012). Analysis of coastal erosion using historical maps by Boateng (2009) shows erosion of the order of 1 km in the vicinity of the site between 1895 and 2002 (Figure 4.1 below)

Figure 4.1: Coastal erosion from 1895 to 2002

While it might be argued that the historical data for shoreline position is subject to some degree of error, at some locations, the coastal position has changed very little and this is consistent with more contemporary observations. It must be noted with some concern that if historical trends continue, then the whole enclave
is under a serious erosion threat. If sea level rise is also accounted for, erosion may proceed at an even greater rate than that observed historically. Further evaluation of these data will be discussed in the ESIA.

Coastal processes in the vicinity of the Project have been subject to significant changes attributable to a range of major coastal developments, all of which have impacted to a lesser or greater degree on coastal erosion (Coastal Resources Centre, 2013). To the east of the site, a recently constructed rock revetment extends eastwards approximately 2 km along the coast from the TTPS development and reaches the town of Aboadze. The cooling water intake and discharge facilities for T2 extend seaward beyond the natural shoreline position and recently temporary breakwaters extending a length of 380m at approximately 45° to the coast have been constructed to facilitate deployment of the cooling water infrastructure. Whilst in situ, these structures have provided an effective barrier to alongshore sediment transport.

4.7.3 Water Resources

The assessment of water quality and discharge from the FSRU will be undertaken for issues associated with normal FSRU operations. Intakes to the FSRU are limited to seawater that will be used for the LNG regasification process with potential thermal discharges back to sea. Other water usage, consumption and discharges to the natural environment will be assessed and discussed in the ESIA.

4.7.4 Soil and Ground Conditions

The proposed 2.5 km onshore pipeline will be located on predominantly flat land with long grasses, sparse shrubs and trees and some pools of water due to the low lying nature of the land. Although there are buried pipelines in the vicinity, it is unlikely to be any direct on-site sources of contamination however the site is located adjacent to the existing TTPS and also receives surface water discharges from the local area, including storm water run-off from the TTPS and potentially from the local area.

Potential impacts associated with construction of the Project include:

- Disturbance of potentially contaminated sediments as a result of ground works (excavation/levelling) which could encourage leaching of contaminants into groundwater, or directly into the sea via surface run-off, resulting in impacts on groundwater and seawater quality, and ocean biota.
- Disturbance of potentially contaminated sediments could also lead to impacts on human health (particularly construction workers) via ingestion/inhalation/contact with the soils.
- Vegetation and soil loss associated with construction.
- Soil erosion associated with earthworks and traffic movement.

Most of the above can be mitigated by following good construction and operational environmental practice.

4.7.5 Noise

During the construction and installation phase, temporary noise and vibration impacts are mainly expected to arise during activities such as excavation of the onshore pipeline and due to construction-related road
traffic (heavy vehicle movements). Noise and vibration impacts for the most part will be short in duration and localised whilst varying in location as the Project progresses.

Noise impacts during the operational phase are expected to be associated with the operation of the FSRU. Noise will not be an impact to communities or other sensitive receptors as the FSRU will be moored 5.7km offshore. Therefore the noise assessment during the operation phase will be from an occupational health and safety aspect in regards to the workers on board the FSRU that may be exposed to higher levels of noise emitted from the various components. Most of the above can be mitigated by following good construction and operational health and safety practices.

4.7.6 Marine Ecology

The installation, operation and decommissioning of the Project has the potential to result in adverse impacts on marine ecological resources through the loss, damage or degradation of marine habitats and the direct or indirect mortality, injury or disturbance of protected, threatened or notable marine species. During installation, all elements of the Project have the potential to displace on-site habitats where the FSRU will float and be anchored and species offshore. Habitat loss, degradation, fragmentation and increased disturbances, such as acoustic noise and artificial light (particularly offshore vessels) are likely to result in the greatest impacts. In addition, offshore acoustic noise generated by the Project and the associated increases in movement, vibration and light could cause disturbance to local species both inshore and offshore. This section presents the likely environmental effects associated with the proposed development on the existing ecological receptors.

4.7.6.1 FSRU (Floating Storage and Regasification Unit) and Subsea Infrastructure

The Project will have a physical footprint on the seabed through placement of infrastructure during the installation (the FSRU and the island jetty berth mooring system will be built abroad and only installed in Ghana which will help reduce physical impacts on site, furthermore the entire duration of the construction/installation period may not exceed 12 months) and commissioning of subsea infrastructure and from the long-term presence of this infrastructure. During installation, this will result in temporary habitat loss or disruption to an area of the seabed with direct impacts to benthos (plants and animals living on or closely associated with the bottom of the ocean). The introduction of seabed infrastructure will also provide new substrates for colonization by benthic organisms and provide areas of shelter for demersal (bottom-dwelling) fish that will reside in the area and along the exposed seabed elements of this installed pipeline.

To mitigate potential negative impacts, the layout of the subsea infrastructure will need to be designed to avoid sensitive seabed ecological features (i.e. ahermatypic corals, Lophelia pertusa or other deep water corals or sensitive habitats) and other geo-hazards (geological and environmental conditions that involve long-term or short-term geological processes). This will also protect areas with potentially more diverse habitats and species. Most subsea infrastructure can be installed directly on the seabed or buried within the seabed.
Baseline or secondary surveys will identify any sensitive habitats along the proposed pipeline route. Trenching and jetting use could be reduced to lessen suspended sediments and dispersal of sediments in the water column during installation. This is important as deep-water ecosystems and species are slow growing and have a limited threshold for disturbance with longer recovery times required from anthropogenic impacts. Detailed offshore surveys may be required such as plankton, benthic communities (seabed), marine mammals & marine reptiles, seabirds & commercial fisheries to establish the fauna associated with soft bottoms seabed benthic communities and in water column where the subsea infrastructure will be placed. These offshore pipeline surveys will establish possible impacts and communities and habitats present along the route and operational areas.

4.7.6.2 Water and Sediment Quality Impacts

Site specific water and seabed sediment quality data will need to be identified in the ESIA in relation to sediment and water quality impacts. Offshore impacts will be attributed to the footprint of the FSRU vessel and surrounding operational areas and offshore water quality, water movements and further environmental modelling may be required. Water and sediment quality impacts will be reduced due to plans to use a modern FSRU installation with limited discharges to the marine potentially limited only to cool water. Water quality and temperature may potentially affect the ecology of fisheries and movement of marine mammals and will need further investigation. Following the baseline surveys and detailed desktop review, the ESIA will assess the likely impacts of the project on surrounding water quality/temperature.

4.7.6.3 Underwater Acoustic Noise Impacts

Project generated acoustic noise includes noise from vessel propellers, FSRU power generation units, and subsea valves etc. Localized acoustic noise sources, if sufficiently loud, may be detrimental to certain marine species such as cetaceans, fish and sea turtles, and may result in behavioural changes and injury. Of particular concern are the impacts of underwater sound on marine mammals due to the known reliance on sound for activities such as communication and navigation for some species.

The West African region supports a diverse marine mammal fauna. Six baleen whale species and 22 toothed whale and dolphin species most commonly occur in the region (IUCN red list 2015). Three of these whale species are globally endangered blue (Balaenoptera musculus) and fin whale (Balaenoptera physalus), two are vulnerable i.e. humpback (Megaptera novaeangliae) and sperm whale (Physeter macrocephalus) and several others are in least concern on the IUCN red list categories. Coastal areas offshore West Africa are possible breeding and nursery areas for the humpback whale, which migrates along the coast of southern Africa to mate, calve, and nurse its young during the austral winter.

Following the field surveys and detailed desktop review, the ESIA will assess the likely acoustic impacts of the project on any globally threatened marine mammal species, and on endemic and migratory species.

4.7.6.4 Collisions with Migratory Marine Mammals, Sea Turtles, Seabird Impacts

Collisions with marine mammals, sea turtles and seabirds may occur during the operation of the Project particularly from all vessel and sea-tugs movements, especially on route/return to and from FSRU
infrastructure. Although the potential impacts are considered low at this stage, this will be discussed further during the assessment stage.

There are seven species of sea turtle worldwide; four of which may be found in West Africa; the leatherback (Dermochelys coriacea), olive ridley (Lepidochelys olivacea), green (Chelonia mydas), and hawksbill (Eretmochelys imbricata). All of these are believed to have nested in Ghana and use offshore marine migration corridors in Western African offshore waters.

Seabird species are represented by the major seabird families Diomedeidae Albatrosses, Spheniscidae Penguins, Procellariidae Petrels and shearwaters, Phalacrocoracidae Cormorants, Hydrobatidae Storm-petrels, Alcidae Auks, Laridae Gulls and terns, and Anatidae Ducks, geese and swans. There is a risk to seabirds through collision impacts while positive aspects can be creation of hotspots for food and foraging along with temporary resting platforms for migratory birds. Noise from project activities are generally continuous or near continuous and of lower energy than from other noisy marine activities such as seismic surveys and any marine mammals that frequent the area. The birds may become accustomed to these noise sources and avoid any areas that are detrimental to them. It is recognized that there is a lack of information on marine mammal distribution in Ghanaian waters. Following the detailed desktop review, the ESIA will assess the likely impacts of the project on any globally/nationally threatened marine species, and on endemic and migratory species.

4.7.6.5 Fisheries and Fish Population Impacts

During upwelling seasons in Ghana’s offshore waters, cool, nutrient rich water results in enhanced primary productivity. High nutrient concentrations during these seasons lead to high concentrations of phyto and zooplankton a food source for many species of commercial fish. These conditions are characteristic of a productive offshore ecosystem and conducive to fish production. Egg and larval stages of important fish species such as sardines and sardinellas (both of the herring family of Clupeidae) and tuna (Thunnus albacares) are also represented in zooplankton and key to local and commercial fisheries. Deep water fish species and large pelagic fish species (e.g. tuna (Thunnus albacares) and billfish (family Xiphiidae) may be present in deep water in the project area and could be affected by the presence of subsea infrastructure on the seabed. Fisheries surveys and further desk top studies and third party or primary data collection will identify species that utilise the project area. Pelagic species which inhabit the surface layers of the water column are likely to be attracted to the installation. During the night fish species may also be attracted by artificial light emissions from the installation. The exclusion zone placed around the installation will afford some protection from fishing activity and may act as a defacto marine reserve (with over long term fish biomass or spill over effects) but it will also displace local fishing communities and larger more commercial vessels from frequenting the area possibly causing reduced access to fishing grounds. Following the primary or secondary data surveys and detailed desktop review, it will be possible to assess the likely impacts of the project on fisheries.

4.7.6.6 Pelagic fish

The pelagic offshore fish stocks are exploited commercially in Ghana and comprise the small pelagic and the large pelagic resources. Major small pelagic fish resources account for approximately 80% of the total
catch landed in the country and include sardinella species (*Sardinella aurita* & *Sardinella maderensis*), chub mackerel (*Scomber japonicas*), anchovy (*Engraulis encrasicolus*), horse mackerel (*Trachurus sp.*), African moon fish (*Selene dorsalis*), West African Illisha (*Illisha African*), Atlantic bumper (*Chloroscombrus chrysurus*), barracuda (*Sphyraena sp*) and species of shark such as hammerhead shark (*Sphyrna mokarran*), tiger shark (*Galeocerdo cuvier*) and shortfin mako (*Isurus oxyrinchus*). Initial impacts from pipeline installation will be expected to be short lived and motile species will avoid these disturbances, but some species may use it as a feeding opportunity and temporarily behaviour or migratory routes may be altered due to pipeline deployment. Following the primary and secondary surveys and detailed desktop review, it will be possible to assess the likely impacts of the project on any pelagic fish species.

### 4.7.6.7 Demersal species Impacts

Demersal stocks are also commercially important with widespread distribution on the inshore water and continental shelf of Ghana. The species composition of the demersal assemblage include members of the sparidae family (e.g. blue spotted seabream *Pagrus caeruleostictus*, Angola Dentex *angolensis*, Congo dentex *Dentex congoensis*; Sciaenidae family (croakers), Mullidae (Goatfishes), Lutjanidae (snappers), Serranidae (Groupers). About eighteen (18) commercially fish species are described as globally “threatened” in Ghanaian waters due to heavy exploitation. These include the Blackchin guitarfish, (*Rhinobatos formosensis*) dusky grouper, (*Epinephelus marginatus*) bottle nose skate (*Bathyraja spinosissima*) (endangered), *Thunnus obesus* (vulnerable), Goliath grouper, (*Epinephelus itajara*) Wide sawfish, (*Pristis pectinata*), and Large tooth sawfish (*Pristis microdon*), (critically endangered). After initial installation of offshore pipeline infrastructure any impacts on these migratory mobile species should be negligible. Following the field surveys and detailed desktop study, it will be possible to assess the likely impacts of the project on any demersal species.

### 4.7.6.8 Conservation Impacts

A summary of any protected areas or sites will be investigated and following the details desktop study and secondary data collection and possible field surveys, it will be possible to assess the likely impacts of the project on any habitats or areas that have been identified for designation.

### 4.7.6.9 Operational Discharge Impacts (FSRU)

Discharges will occur throughout the Project lifespan from routine activities and non-routine or one-off discharges associated with commissioning and maintenance activities.

Routine discharges will include cool seawater originated from the use of heat in seawater to vaporise the LNG. Further investigation will be required into the cold water discharges into the marine environment which may require plume or environmental modelling. The potential use of chemicals used during installation, production, and drilling operations may enter the marine environment if not adequately managed. In deep water offshore areas the main environmental receptors are the waters in the vicinity of the discharges and the marine organisms that occupy these waters. These waters would be of good quality being far offshore and the water depth, distance offshore and hydrography should provide a high level of dilution and dispersion for any discharges that will help in the vaporization process of the LNG.
Environmental modelling may be conducted to investigate and mitigate against any operational discharge impacts from the FSRU activities. Following the primary or secondary surveys, environmental modelling and detailed desktop review, it will be possible to assess the routine operational discharges impacts of the project on the marine environment.

4.7.7 Terrestrial Ecology

The Project is not likely to affect any legally protected areas or internationally recognised areas. The nearest designated site for nature conservation is Inchaban Forest Reserve, which is located 6km from the Project and impacts are unlikely.

The onshore pipeline is located within the Guinean Forests of West Africa Biodiversity Hotspot, but there are no tropical rainforest or any type of natural forest in the vicinity. The main habitats on site are scrub, grassland, ephemeral pools, agricultural land and coconut plantation along the sea front. The ephemeral pools are influenced by the water table, which in turn is influenced by rainfall and the tide. These habitats are of low conservation value and therefore the Project impacts are unlikely to be significant. This is to be confirmed by the baseline surveys and in the ESIA. The Anankwari River will not be disturbed by the onshore components of the Project.

The Project area is likely to support a wide range of common species of flora and fauna. However, a small number of globally threatened species (IUCN Red List) are known to occur in the wider area, including the amphibian *Phrynobatrachus ghanensis* (Endangered), the birds *Necrosyrtes monachus* hooded vulture (Endangered), *Ceratogymna elata* yellow-casqued hornbill (Vulnerable) and the mammals *Procolobus badius* West African colobus (Endangered) and *Cercopithecus diana* Diana monkey (Vulnerable).

4.7.8 Waste, Materials Handling and Storage

During installation and operation hazardous materials may be generated on board of the FSRU, these may include: oils and solvents (including empty containers, oily rags, clean up materials, hydraulic fluids, lubricants etc.); paints; coatings; used batteries etc. Adequate waste management practices will need to be in place for the on-board storage and segregation as well as any final off-board treatment or disposal. Domestic wastes from employees and on-board FSRU facilities may also originate such as food waste, paper, plastics, drinks containers and office consumables among others.

The principal potential impacts which can arise from improper use, handling and storage of materials from all phases of the Project are as follows:

- Contamination of receiving environments (marine environment) and on-shore facilities from any waste generated from the installation of the sub-sea pipeline
- Fugitive emissions, such as dust and odour, associated with the handling and storage of waste streams (on-shore for the final disposal of wastes)
Impacts will be assessed by establishing the sensitivity of receptors, the magnitude of impacts and their overall sensitivity. Off-shore waste management resources and receptors will include waste receiving facilities, waste transportation providers and waste disposal facilities.

4.7.9 Cultural Heritage

Cultural heritage, both of intangible and tangible resources, may be threatened mainly during the excavation works for the onshore pipeline. After the three site visits no visible or tangible cultural heritage resource was observed, therefore at this stage the likelihood of this to be an impact is considered low, however we will discuss cultural heritage in the ESIA.

4.7.10 Socio-economics

Construction of the FSRU and the island jetty will take place abroad and will then be transported and connected to the island jetty berth mooring system. The construction of the mooring system and subsea and onshore pipelines are expected to generate a small number of employment opportunities, and there may be limited disruptions to artisanal fishing activities as a result of vessels transporting materials and workers. Specific management measures to minimise disruptions and ensure safety of artisanal fishermen and beach users will need to be developed.

4.7.11 Hazards and Accidents

During all phases of the Project, during installation, workers will be exposed to risk situations and there is the possibility of workplace accidents. Measures to address and protect workers from occupational health and safety risks including marine transport will be considered in the ESIA and identified in the ESMP. This is expected to include the following as a minimum:

- Hazard reporting and continual improvement of on-site safety procedures
- Safety training programmes for workers
- Identification of Personal Protective Equipment (PPE) requirements (working near water)
- An assessment of potentially dangerous working conditions and procedures to handle them
- A risk assessment of materials and handling, equipment and exposure to hazardous substances
- Emergency response plans and procedures to be established and practiced (evacuation vessels)
- Good housekeeping and good industry practice must be adhered to, in line with international standards
- Encouragement of a positive safety culture on-site, in communities and throughout the supply chain

Of particular importance to FRSU works will be the transport and transfer of workers and fuel and the establishment of a positive safety culture to include plans and procedures for evacuation at sea and working in and around the marine environment.

4.7.12 Climate Change Adaptation

A standardised Climate baseline will be developed based on existing literature on climate change for Ghana, for consideration in the technical chapters.
It is understood that the climate of Ghana is tropical, and the location of the Project in the western region of Ghana on the Atlantic Ocean coast (onshore and offshore) experiences its warmest season January to March, and at their lowest in July to September with two rainy seasons in April to July, and September to November. The Project location and key assets likely to be scoped as sensitive to climatic factors mean the relevant climate variables are anticipated to be:

- Temperature
- Precipitation
- Evapotranspiration / Humidity
- Wind

There is likely to be a high degree of uncertainty associated with climate projections for precipitation as the rainfall seasons are controlled by the oscillating movement of the tropical rain belt between the northern and southern tropics. This causes a yearly shift between two opposing prevailing wind directions, of moist air from the Atlantic south-westerly, and hot and dusty air from the Sahara desert in the north east, known as the West African Monsoon. These patterns in part contribute to the considerable seasonal rainfall variations in Ghana on an inter-annual and inter-decadal timescale, as set out in the UNDP Climate Change Profile for Ghana.

The main potential climate risks are anticipated to be:

- Increasing mean temperatures;
- Increased frequency of number of ‘hot’ days and nights;
- Uncertainty associated with precipitation.

It is not possible to provide a definitive scenario for climate change and therefore ranges will be identified highlighting where there is confidence and where there is uncertainty. We will undertake a qualitative risk assessment of the primary elements to identify key risks to allow them to be considered within technical chapters.

**4.7.13 Greenhouse Gas Emissions (GHGs)**

Potential GHG emissions associated with the Project may occur in the installation and operational phase.

In the installation phase, potential sources of GHG may be associated with emissions embodied in the materials and equipment used in the installation of the Project and as a result of fuel use from transport. The potential emissions from the installation phase are likely to be comparatively low to the operational phase and may be considered indirect to the Project and therefore will not be considered in the ESIA.

In the operational phase, the FSRU will have two potential direct emission sources of GHG - combustion of fuel to provide auxiliary power to the FSRU and fugitive emissions:

- **Power:** There will be no combustion emissions associated with the regasification process as the FSRU will utilise seawater to heat the LNG. The amount of GHG emissions produced will depend on the amount of fuel combusted to provide auxiliary power and this will be quantified in the ESIA.
Fugitive emissions: due to the nature of the facility, the transferring and transport of gas in any state leads to the potential for fugitive releases of natural gas. Since the methane in natural gas is a GHG, any fugitive emissions would contribute to the overall impact of the Project.

Smaller sources are unlikely to have a material impact on the assessment and therefore may not be quantified in the assessment.

Emissions associated with the delivery of LNG to the FRSU are considered to be outside of the control of the Project and are not direct sources of emissions and therefore will not be considered in the assessment.

The major sources of emissions will be quantified in line with best practice approaches set out in IFC Guidance including Performance Standard 3 and IFC’s guidance on GHG accounting for energy projects and IFC Guidance for LNG Projects. The quantification will be based on available project data. The total emissions will be compared to the national emissions and typical performance levels for this type of project.

4.8 Baseline data collection methodology

A description of the baseline data collection techniques that will be used to gather primary information which will inform the ESIA are presented in Table 4.1 below.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Baseline data collection methodologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>Existing baseline data will be used to establish existing baseline pollutant concentrations. It should be noted that the baseline that will be used will be obtained from air quality monitoring studies undertaken onshore in and around the Power Project and therefore the results are likely to be elevated compared to the potential baseline concentrations levels at the offshore location where the FSRU will be located (5.7km offshore).</td>
</tr>
<tr>
<td>Coastal Processes</td>
<td>Available data and hindcast model outputs will be used to establish hydrodynamic, wave and meteorological conditions pertaining during normal, moderate and extreme weather and tidal conditions with consideration given to joint probabilities of occurrence. Data will be obtained from published sources, academic and technical documents and Ghanaian institutions. Missing information required for the ESIA identified in a scoping study data gap analysis will be requested from the client if model hindcast data proves to be inadequate. Baseline storm impacts (erosion, overwashing) will be assessed using the XBeach numerical model based on existing measured beach profiles, offshore bathymetry and the hydrodynamic and wave boundary conditions defined by the wide area modelling activities. At a wider spatial scale, the interactions with coastal defence works, comprising a 2 km rock revetment along the Aboadze frontage, will also require assessment as these represent current baseline conditions. These works are nearing completion and will connect with defence to the TTPS cooling water intake structures adjacent to the Project site. These works will have impacts to coastal processes that may affect the infrastructure coming on-shore. The identification of sources for the missing data is currently underway ahead of the ESIA.</td>
</tr>
<tr>
<td>Water Resources</td>
<td>With regards to thermal discharges, there are a number of data requirements related to the type and technology of FSRU to be used and the design and specifications including: associated discharge rates; thermal discharges, dimensions of all Intake / outfall pipes, and discharge characteristics (temperature, salinity of discharge, etc). Identifying sources for the missing data is currently underway ahead of the ESIA.</td>
</tr>
</tbody>
</table>
### Soil and Ground Conditions

A comprehensive desktop review and site walkover will be undertaken to assess the existing soil and groundwater baseline conditions for the site and support the assessment of potential impacts of the Project on ground conditions. The desktop review will include but not be limited to:

- ESIs and ground investigation surveys (where available) for any other projects within the Project area
- Existing groundwater and/or abstraction well monitoring data (where available) within the Project area
- Readily available information on geology, hydrogeology, topography and soil, including published data, maps, site observations as well as discussions with the local community/ regulators (where possible)

A baseline and walkover survey has been undertaken and no signs of visible contamination have been observed. The walkover also provided a visual assessment of the baseline ground conditions and land use. No intrusive surveys will be undertaken.

### Noise

A number of data requirements related to the type and technology of FSRU to be used and the design and specifications including: technology on board, number and type of generators, regasification chambers, working hours (shifts) etc., will be reviewed. Based on this information a baseline study and an assessment will be undertaken from an occupational health and safety aspect.

Identifying sources for the missing data is currently underway ahead of the ESIA.

### Marine Ecology

Baseline environmental conditions will be established by the characterisation of expected ecology of the offshore and inshore environments. Some primary surveys may be negated pending detailed desktop studies and the availability of third party data in adjacent areas of consistent ecology and preliminary investigations in the study area while using best available practices. It is envisaged that any primary surveys could be conducted across one season and further information gathered could be drawn from secondary data sources, such as scientific literature, stakeholders and other published information. Through the scoping exercise consultations will be had with research agencies and scientific organisations to identify any newly published reports or data availability that are obtainable and have been used in recent EIA processes. Environmental data will be collected for a range of survey points within the survey area including the pipeline route and landing sites. Detailed onshore surveys may include full Intertidal studies (inclusive of rocky and sandy shore including, crab and macroinvertibrate surveys), subtidal studies, sea turtle nesting studies, and landing site survey (terrestrial ecology).

The offshore and inshore areas of Ghana have been the subject of recent project EIAs and on-going environmental survey programmes and source of this data should be available as part of this scoping process.

### Terrestrial Ecology

Comprehensive desktop review and field surveys will be undertaken to identify internationally and nationally designated sites, sensitive habitats and protected/threatened species. The desktop review will include (but is not limited to):

- ESIs and ecology studies for any other projects within the APE;  
- Any published research available, as identified by Mott MacDonald, EEMC, the client and by stakeholders;  
- International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species;  
- BirdLife International Data Zone; and  
- Protected Planet

Field surveys for terrestrial ecology along the suggested onshore pipeline route have been undertaken to record key habitats and species that are protected or are of conservation interest. Field surveys will include the following biodiversity features: habitats/flora, mammals, birds, herpetofauna.

The desktop review and field surveys will focus particularly on globally and nationally threatened species, protected species in Ghana, endemic and restricted-range species, migratory and congregatory species, or invasive species.

### Waste, Materials and Handling

Baseline conditions will be established by the characterisation of expected materials usage and waste arising from the Project. Along with the prediction of potential impacts, the baseline will be used to identify specific waste solutions for the waste streams generated.
### Discipline Baseline data collection methodologies

Hazardous and non-hazardous wastes and their segregation will be a key issue. Baseline data collection will involve the review of existing waste management capacity and facilities in the vicinity of the Project area as well as certified waste handlers in the Takoradi area.

#### Cultural Heritage
An initial baseline study will be used in the production of a desk-based assessment of the tangible and intangible cultural heritage assets present within the project ZoI. This assessment will also outline the likely effects upon these assets as a result of the project.

The assessment will include the following, but not limited to:

- A search of Cultural Heritage assets located up to 1km either side of the proposed alignment of the new onshore pipeline, associated roads, a transmission line and a proposed workers village compound (all defined as part of the ZoI for the project);
- Consultation of the Public Records and Archives Administration Department of Ghana database (PRAAD) to locate Heritage Assets (any Tangible, moveable or immovable objects, property, sites, and structures having historical, cultural, artistic, archaeological or religious values (e.g. monuments, temples)) within the ZoI
- Consultation with local communities by use of interviews to identify unique natural features or tangible objects that embody cultural values (Burial mounds etc) located within the ZoI

#### Socio-economics
A comprehensive desktop review of available information will be undertaken to further develop the socio-economic baseline, which will include governmental and non-governmental reports related to coastal use and fishing as well as (available aerial imagery and maps of the area)

Further fieldwork will be undertaken to obtain further data regarding the community’s use of water and the coastline. This is envisaged to be undertaken through observation of beach and ocean use as well as key informant stakeholder interviews and focus group discussions with:

- Neighbouring communities (Aboadze, Abuesi)
- Artisanal fishermen and fishing associations
- Women’s groups and/or representatives
- Youth representatives
- Shama District Assembly
- Volta River Authority
- Beach users

#### Hazards and Accidents
A risk assessment will be undertaken and will account for the type of materials and equipment that workers handle, how they are used and the risk of exposure to certain chemical products. Good housekeeping and industry practice will be in place to reduce risk and an appropriate approach to hazard and accident reporting will be in place prior to installation to ensure worker safety.

#### Climate Change Adaptation
Climate baseline conditions will be identified through a high-level literature review of available regional climate models (UNDP Climate Change Profiles and Ghana’s 3rd National Communication to UNFCCC). The primary climate vulnerabilities identified in the literature will be qualitatively screened as against the primary elements and forecast design. From this, a standardised climate baseline will be summarised identifying the key climate risks for consideration within the relevant technical baselines to the ESIA. This process will broadly follow the role defined as ‘Climate Coordinator’ in the pending IEMA guidelines for integrating Climate Adaptation into ESIA.

#### Greenhouse Gas Emissions (GHGs)
A desk study will be undertaken to establish the baseline GHG emissions for the Project. Emissions associated with the operational phase will be put in context of Ghana’s national emissions and Ghana’s energy sector emissions. This information will be taken from sources including Ghana’s national greenhouse gas inventory report. The relative performance of the assets will also be considered. This will be compared against typical performance levels and benchmarks considering the guidance presented by the IFC in the Thermal Power Guidelines and Liquefied Natural Gas (LNG) Facilities Guidelines, where possible. It is not possible to establish a baseline for the installation phase due to the one-off nature of installation emissions.
4.9 Assessment Methodology for the ESIA

For each aspect presented above, the assessment will identify impacts and report the likely significant environmental or social impacts. The criteria for determining significance are specific for each environmental and social aspect and will be defined in the specialist chapters, but in broad terms it can be characterised as the product of the degree of change or the magnitude of impact and the sensitivity or value of the receptor/resource that is affected. For each impact the likely magnitude of the impact and the sensitivity of the receptor are defined, quantitatively to the extent possible. Generic criteria for the definition of magnitude and sensitivity are summarised below.

4.9.1 Magnitude Criteria

The assessment of impact magnitude is undertaken in two steps. Firstly the key issues associated with the Project are categorised as beneficial or adverse. Secondly, impacts are categorised as major, moderate, minor or negligible based on consideration of parameters such as:

- Duration of the impact – ranging from ‘beyond decommissioning’ to ‘temporary with no detectable impact’
- Spatial extent of the impact – for instance, within the site boundary to district, regionally, nationally, and internationally
- Reversibility – ranging from ‘permanent requiring significant intervention to return to baseline’ to ‘no change’
- Likelihood – ranging from ‘occurring regularly under typical conditions’ to ‘unlikely to occur’
- Compliance with legal standards and established professional criteria – ranging from ‘substantially exceeds national standards or international guidance’ to ‘meets the standards’

Both beneficial and adverse impacts will be identified. Table 4.2 presents generic criteria for determining impact magnitude (for adverse impacts). Each detailed assessment will define impact magnitude in relation to its environmental or social aspect, considering whether impacts are temporary or permanent.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description (adverse impacts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature and requiring significant intervention to return to baseline; exceeds national standards and limits.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.</td>
</tr>
<tr>
<td>Minor</td>
<td>Detectable but minor change to the specific conditions assessed.</td>
</tr>
<tr>
<td>Negligible</td>
<td>No perceptible change to the specific conditions assessed.</td>
</tr>
</tbody>
</table>
4.9.2 Sensitivity Criteria

Sensitivity is specific to each aspect and the environmental resource or population affected, with criteria developed from baseline information. Generic criteria for determining sensitivity of receptors are outlined in Table 4.3. Each detailed assessment will define sensitivity in relation to its environmental or social aspect.

Table 4.3: Criteria for determining sensitivity of a receptor

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Receptor (human, physical or biological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.</td>
</tr>
<tr>
<td>Medium</td>
<td>Receptor with little capacity to absorb proposed changes or limited opportunities for mitigation.</td>
</tr>
<tr>
<td>Low</td>
<td>Receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation.</td>
</tr>
<tr>
<td>Negligible</td>
<td>Receptor with good capacity to absorb proposed changes or and good opportunities for mitigation.</td>
</tr>
</tbody>
</table>

4.9.3 Impact Evaluation

Likely impacts are evaluated taking into account the interaction between the magnitude and sensitivity criteria as presented in the impact evaluation matrix in Table 4.4 below.

Table 4.4: Impact evaluation matrix

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Adverse</th>
<th>Beneficial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Major</td>
<td>Moderate</td>
</tr>
<tr>
<td>High</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Medium</td>
<td>Major</td>
<td>Moderate</td>
</tr>
<tr>
<td>Low</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Negligible</td>
<td>Minor</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

It should be noted that each Chapter of the ESIA develops aspect specific criteria where applicable.

4.9.4 Determining significance

The objective of this ESIA is to identify the likely significant effects on the environment and people of the Project. Impacts that have been evaluated as being ‘Moderate’, or ‘Major’ are significant effects and identified as such in the specialist chapters. Consequently, impacts that are ‘Minor’ or ‘Negligible’ are not significant.
4.10 Cumulative Impacts

The assessment of cumulative impacts considers the combination of multiple impacts that may result when the Project is considered alongside other existing or proposed projects in the same geographic area or similar development timetable. The assessment of cumulative impacts will identify where particular resources or receptors would experience significant adverse or beneficial impacts as a result of a combination of projects.

4.11 Mitigation and Enhancement Measures

Where feasible the following hierarchy of mitigation measures will be applied:

- Avoidance and reduce through design (embedded mitigation)
- Abate impacts at source or at receptor
- Repair, restore or reinstate to address temporary installation effects
- Compensation for loss or damage, such as replacement planting elsewhere

In addition to the above, community engagement and disclosure activities have played a key role in managing the extent of impacts and consideration has also been given to the identification of enhancement measures. Enhancement measures are actions and processes that:

- Create new positive impacts or benefits
- Increase the reach or amount of positive impacts or benefits
- Distribute positive impacts or benefits more equitably

Each technical chapter identifies relevant mitigation and enhancement measures. All the mitigation, management and monitoring measures to address likely Project impacts are reported in Volume IV – ESMP.

4.12 Residual Impacts

Residual impacts are those significant impacts that remain after the application of mitigation and enhancement measures. Impacts considered ‘Major’ or ‘Moderate’ after mitigation and enhancement measures are presented as significant impacts.

4.13 Uncertainties

Any uncertainties associated with impact prediction or the sensitivity of receptors due to the absence of data or other limitations are explicitly stated. Where applicable, the ESIA makes recommendations concerning measures that should be put in place with monitoring or environmental or social management plans to deal with the uncertainty so that they may be addressed.
Appendices

Appendix A.  Brief overview of the Physical Environment .................................................. 32
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Appendix A. Brief overview of the Physical Environment

A.1 Introduction

This Appendix introduces a description of the physical environment in and around the Project site.

A.2 Marine Environment

The oceanography of the West African region is influenced by the meteorological and oceanographic processes of the South and North Atlantic Oceans. Generally, the Tropical Surface Water is characterized by warm, well-mixed water that extends from the surface to the depth of the thermocline (depths from about 30m to 40m). Sea surface temperatures and salinities along the coast of Ghana can vary widely, with the oceanographic regime characterized by a seasonal major upwelling and a minor upwelling.

The Project area as part of the offshore marine environment forms part of the Gulf of Guinea which is characterized by tropical climate as mentioned previously. The main currents affecting the area are the Guinea Current, the North Equatorial Counter-current and the South Equatorial Current. Tidal regime is diurnal and relatively small and ranges average 1.2 m to 0.6 m at Takoradi and decreases the further you go offshore.

The marine environment offshore Ghana is located within the Central West African Upwelling (rising of deeper colder water to shallower depths) System. Oceanic upwelling is an important feature in this area and influences primary productivity and fishery resources. Upwelling off the coasts of Ghana occurs seasonally, with a weak upwelling around January to March, and intense upwelling from July to September and it’s this cold, nutrient rich water of the upwelling system drives the biology of the area.

Ghana’s offshore topography consists of a continental shelf ranging from 13 to 80 km wide. The shelf is generally regular and then drops of sharply and consists of bands of hard substrate formed by remnants of dead ancient coral reef, (fossilized madreporarian corals) and stony, reef building corals of tropical seas. Beyond this soft sediments (mud and sandy mud) predominate and areas of soft to firm clays and silts form a generally smooth and sloping seabed. Previous works done on physicochemical properties of the water column in the Gulf of Guinea Ocean indicate a healthy marine environment where turbidity is generally low in the offshore oceanic waters.

A.3 Physical Environment

The landscape is predominantly flat, with few hilly areas. The shoreline is also dominated by open sandy beaches interspersed with near shore rocky bottoms and outcroppings. The coastline has eroded by an average of 100metres in the last 50 years. Recent surveys concluded that the shoreline was eroding at 2.7m per year.

The APE is bordered to the east by the Anankwari River which opens into a system of wetlands before entering the ocean. During the last decade these wetlands have been gradually reclaimed for energy projects and for housing development. Aboadze is the last eastern coastal town of the Shama District and the Anankwari River separates it from Essipon (Sekondi-Takoradi Metropolitan Area).
A.4 Land Use

The dominant land use patterns on the floodplain shows a mix use. Land use includes agricultural, industrial and sparse residential settlement. Large tracts of lands have been earmarked for Export Processing Zones (EPZ).

A.5 Anankwari River and Wetlands

The Anankwari River and associated wetland is a biologically rich and diverse ecosystem comprising mangrove and swamps that takes it source from a 30 hectare wide reservoir about 7.5 km upstream. The catchment covers an area of 1100 hectares and has a 260 hectare wide delta. The wetland serves as nursery ground for various fish species that during the later stages in their development migrate to the marine environment when the barrier beach is opened temporarily during floods. The wetland also provides other functions such as supporting stabilization of the coastline, reducing erosion and buffering against the impacts of flooding on riparian communities.

A.6 Socio-economic Context and District Profile

To the south of Shama District lies the Gulf of Guinea. On land Shama District is home to 48 major settlements which had a population of 81,966 according to the 2010 census. The population is more urbanised than rural.

The proposed Project site is located approximately six to ten kilometre offshore to the west of the Aboadze community, and approximately five to ten kilometres offshore to the west of the Abuesi community. Both of these communities are urban in nature, and are neighboured by power industry developments from the Volta River Authority. In 2010, Aboadze had a total population of 9,471 and Abuesi a total population of 9,859. Both of these communities are predominantly fishing villages, and therefore most of the livelihood activities are directly or indirectly related to fishing or fish processing activities. The Shama District is fairly accessible from other parts of Ghana, especially the southern portion. The roads linking the District to the major cities in the country (Accra, Takoradi, and Cape Coast) are of good quality. The neighbouring city, Takoradi, is located on a shipping route with the closest ports being Tema (in Ghana) and Abidjan (capital of Cote d’Ivoire).

Fishing activities is the predominant livelihood for most of the coastal communities, who occupy approximately 7km out of the 10km coastline of the District. There are ten landing beaches in the District: Shama – Apo, Shama – Bentsir, Amina – Ano, Abuesi – Abuesi, Abuesi – Compound, Abuesi – Samanadze, Kese wo Kan, Aboadze – Broni-Bema, Aboadze – Ekuro –Bamu.

Fish production in the district over the past five years has averaged 43,488mt over the period (Fisheries Commission 2013) and the main marine fish species landed are the sardinellas, frigate mackerel (Auxis thazard) and long -finned herring (Ilisha africana).
Fishing operations are heavily concentrated in Aboadze, Abuesi and Shama and fishers generally take-off westwards to their traditional fishing ground. Any proposed LNG facility siting offshore Aboadze should take into consideration the fishing routes and activities of nearly 12,000 fishermen from the three towns.

The major season for fish farming is June to September while October to May has been identified as the lean season (Shama District Assembly Medium Term Development Plan 2014 – 2017, 2014).

In communities such as Abuesi and Aboadze, women are also involved in fishing activities, most often as part of the processing of fish (e.g. drying, smoking and salting).

There have been emerging trends of declining fish catches, which has contributed to loss of livelihoods and placed significant pressure on households residing in coastal communities. The recent oil and gas exploration has affected fish harvest in fishing communities in the entire Western Region (De Graft Johnson et al, 2011, as cited in Shama District Assembly Medium Term Development Plan 2014 – 2017, 2014).

According to consultation with the Ghana Ports and Harbour Authority, there are no exclusion zones active in the area but there are safety zones of 500m around offshore infrastructure. The offshore infrastructure for the FSRU will also require establishment of the safety zones of 500m. However, there will be some overlap with the neighbouring existing offshore infrastructure (WAGP, TTPS cooling system, SPM) which will reduce the impact of the exclusion zone to be established.
B.1 Overview

This section provides a brief overview of the applicable regulations and standards that will be applied to the Project. This chapter introduces a number of national and regional requirements that the Project will have to comply with as well as international standards.

B.2 National Environmental Policy Requirements

B.2.1 Ghana’s Environmental Policy

The environmental policy of Ghana formulated in the National Environmental Action Plan (NEAP) of 1993 hinges strongly on ‘prevention’ as the most effective tool for environmental protection. The policy aims at a sound management of resources and environment, and the reconciliation between economic planning and environmental resources utilization for sustainable national development. It also seeks among others, to institute an environmental quality control and sustainable development programs by requiring prior environmental assessment of all developments, and to take appropriate measures to protect critical eco-systems, including the flora and fauna they contain against harmful effects, nuisance or destructive practices. The adoption of the NEAP led to the enactment of the EPA Act 1994 (Act 490); and subsequently the passing of the Ghana ESIA Procedures into the EA Regulations, 1999 (LI 1652).

B.2.2 The Environmental Protection Agency

The Environmental Protection Agency (EPA) Act, 1994 (Act 490) grants the Agency enforcement and standards-setting powers, and the power to ensure compliance with the Ghana environmental assessment requirements/procedures. Additionally, the Agency is required to create environmental awareness and build environmental capacity as it relates to all sectors, among others. The Agency (including its Regional and District Offices) is also vested with the power to determine what constitutes an ‘adverse effect on the environment’ or an activity posing ‘a serious threat to the environment or public health’, to require environmental assessments (EA), environmental management plans (EMP) etc. of an ‘undertaking’, to regulate and serve an enforcement notice for any offending or non-complying undertaking. The Agency is required to conduct monitoring to verify compliance with given approval/permit conditions, required environmental standard and mitigation commitments. Furthermore, a requirement by EPA for an EA precludes any authorising MDA from licensing, permitting, approving or consenting such undertaking, unless notified otherwise.

B.2.2.1 EA Regulations and Procedures

The EA Regulations combine both assessment and environmental management systems. The regulations prohibit commencing an undertaking/activity without prior registration and environmental permit (EP). Undertakings are grouped into schedules for ease of screening and registration and for EP. The schedules include undertakings requiring registration and EP (Schedule 1), ESIA mandatory undertakings (Schedule 2), as well as Schedule 5-relevant undertakings (located in Environmentally Sensitive Areas).
The Regulations also define the relevant stages and actions, including: registration, screening, preliminary environmental assessment (PEA), scoping and terms of reference (ToR), environmental impact assessment (ESIA), review of EA reports, public notices and hearings, environmental permitting and certification, fees payment, EMP, suspension/revocation of permit, complaints/appeals etc.

**B.2.3 Fees and Charges (Amendment) Instrument, 2014 (LI 2216)**

This instrument sets out in the attached schedules the fees and charges for services rendered by the Environmental Protection Agency during the Environmental and Social Impact Assessment process including Environmental Processing Charges and Permit fees, Environmental Approval or Clearance Fees, and Environmental Certification Fee.

**B.2.4 Other Relevant Existing Policy, Legal Frameworks & Guidelines**

B.2.4.1 Water Resources Commission Act (1996), Act 552

Act 553 establishes the Water Resources Commission (WRC) and provides for its composition and functions in the regulation and management of the utilisation of water resources in Ghana, and for related matters. Water Resources Commission is also responsible for issuing water permits for any entity undertaking water extractive activities.

B.2.4.2 Petroleum Commission Act (2011)

The Act established the Petroleum Commission for the regulation and the management of the utilisation of petroleum resources and to provide for related purposes. The purpose of the Commission is to regulate and co-ordinate the policies in relations to petroleum resources.

B.2.4.3 Environmental Assessment Regulations (1999) LI 1652

The Environmental Assessment Regulations 1999, LI 1652 set out all the array of rules and norms in regards environmental and social impacts assessment studies to be undertaken for an array of projects in Ghana.

B.2.4.4 Factories, Offices and Shops Act (1970) Act 328

Act 328 promotes and ensures the health, welfare and safety of persons employed in the country as well as the responsibilities of the employer. Under the Act, employers are required to ensure that a safe and healthy workplace is provided for the safety, health and welfare of all employees.

B.2.4.5 Labour Act No (2003) Act 651

Act 651 which among others provides for occupational health and safety.
Part XV, Section 118 (1) and (2a-h) of the Act enjoins employers to ensure that every worker employed by him or her works under satisfactory, safe and healthy conditions, and is further obliged to provide necessary information, instructions, training and supervision to ensure the health and safety at work of those other workers engaged in a particular work.

B.2.4.6 National Museums Decree (1969) NLCD 387

NLCD 387 provides for the care of any archaeological finds. This is the law governing the activities and operations of the National Museums and Monuments Board. Procedures to be followed on the discovery of any such artefacts are outlined in NLCD 387.

B.2.4.7 The Constitution of the Republic of Ghana, 1992

The 1992 Constitution gives maximum protection to individual property rights. Private properties are only to be taken where there is compelling reasons for the state to interfere with such rights. Article 20 establishes that no property “shall be compulsorily taken possession of or acquired by the State” unless it is, among various purposes, “to promote the public benefit”.

The Constitution also provides that where private lands are surrendered for public good, the affected owners must not be made worse off. It states that “Compulsory acquisition of property by the State shall only be made under a law which makes provision for (a) the prompt payment of fair and adequate compensation; and (b) a right of access to the High Court by any person who has an interest in or right over the property. Further, “where a compulsory acquisition or possession of land affected by the State in accordance with clause (1) of this article involves displacement of any inhabitants, the State shall resettle the displaced inhabitants on suitable alternative land with due regard for their economic well-being and social and cultural values”.

B.2.4.8 Local Government Act 462 of 1993

The Local government Act 462 of 1993 devolves central administrative authority to the district level and fuses governmental agencies in any given region, district or locality into one administrative unit through the process of institutional integration, manpower absorption, composite budgeting and provision of funds for the decentralised services

B.2.5 Policy Documents

B.2.5.1 National Energy Policy

The National Energy Policy outlines the Government of Ghana’s policy direction regarding the current challenges facing the energy sector. The document provides a concise outline of the Government’s policy direction in order to contribute to a better understanding of Ghana’s Energy Policy framework. It is hoped that the document will facilitate the effective management and development of the energy sector as well as provide the public with information about the Government’s policy goals. The energy sector vision is to develop an “Energy Economy” to secure a reliable supply of high quality energy services for all sectors of
the Ghanaian economy and also to become a major exporter of oil and power by 2012 and 2015 respectively.


The National HIV/AIDS STI Policy has been developed to address the very serious health and developmental challenges posed by HIV/AIDS. The policy provides the framework for Ghana’s strategy to reduce the spread of HIV infection. It provides the necessary statement of commitment around which a legislative framework will be built for an Expanded Multi-sectoral Response to reduce further spread of the epidemic, and for the protection and support of people infected with HIV/AIDS in Ghana. Subsequently, a National HIV/AIDS Strategic Framework for Ghana has been formulated in recognition of the developmental relevance of the disease. Ghana, by this document has joined the global community in a united effort to combat the epidemic. The Strategic Framework document is updated periodically and it provides for a “Workplace HIV Policy”.

B.2.6 Guidelines

The relevant national guidelines are:

- Environmental Assessment in Ghana, A Guide (1996) produced by the EPA provides detailed guidance on the procedures to be adhered to when undertaking an EA.
- Environmental Impact Assessment Procedures (1995) produced by the EPA details the procedures to be adhered to when undertaking an EA.
- Environmental Quality Guidelines for Ambient Air (EPA) provides advice on maximum permissible levels of a variety of air pollutants. Guidelines are provided in the Table below.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging Period</th>
<th>World Bank Guidelines for Use at Thermal Power Plants (µg/m3)</th>
<th>WHO Guidelines (µg/m3)</th>
<th>Ghana EPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Dioxide (NO2)</td>
<td>1 hour</td>
<td>-</td>
<td>200</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>150</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>100</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>Sulphur Dioxide (SO2)</td>
<td>10 minutes</td>
<td>-</td>
<td>500</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>150</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>80</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Particulate Matter (PM10)</td>
<td>24 hours</td>
<td>150</td>
<td>-</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>50</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total Suspended Particles (TSP)</td>
<td>24 hours</td>
<td>230</td>
<td>-</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>80</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>15 minutes</td>
<td>-</td>
<td>100 000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 minutes</td>
<td>-</td>
<td>60 000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 hour</td>
<td>-</td>
<td>30 000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 hours</td>
<td>-</td>
<td>10 000</td>
<td></td>
</tr>
</tbody>
</table>


- Environmental Quality Guidelines for Ambient Noise (EPA) provides advice on the maximum permissible noise levels. The permissible ambient noise levels guidelines of the EPA are presented in the table below.

**Table B.2: EPA Guidelines for Ambient Noise**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description Of Area Of Noise Reception</th>
<th>Permissible Noise Level In Db (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAY 0600 – 2200</td>
<td>NIGHT 2200 – 0600</td>
</tr>
<tr>
<td>A</td>
<td>Residential areas with negligible or infrequent transportation</td>
<td>65</td>
</tr>
<tr>
<td>B1</td>
<td>Educational (School) and health (hospital clinic) facilities</td>
<td>55</td>
</tr>
<tr>
<td>B2</td>
<td>Area with some commercial or light industry</td>
<td>60</td>
</tr>
<tr>
<td>C1</td>
<td>Area with some light industry, place of entertainment or public assembly and place of worship such as churches and mosques</td>
<td>65</td>
</tr>
<tr>
<td>C2</td>
<td>Predominantly commercial areas</td>
<td>75</td>
</tr>
<tr>
<td>D</td>
<td>Light industrial areas</td>
<td>70</td>
</tr>
<tr>
<td>E</td>
<td>Predominantly heavy industrial areas</td>
<td>70</td>
</tr>
</tbody>
</table>

- Ghana’s EPA Guidelines for discharges into natural water bodies provide maximum permissible concentrations for a number of parameters. Some guidelines are provided in Table below.

**Table B.3: EPA’s Effluent Quality Guidelines for Discharges into Natural Water Bodies**

<table>
<thead>
<tr>
<th>Impact Parameter</th>
<th>Applicable Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WB/USA/CAN²</td>
</tr>
<tr>
<td>pH</td>
<td>6-9</td>
</tr>
<tr>
<td>BOD₅ (mg/l)</td>
<td>30</td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>100</td>
</tr>
<tr>
<td>Faecal Coliform (No. /100ml)</td>
<td>6-9</td>
</tr>
<tr>
<td>pH</td>
<td>10</td>
</tr>
<tr>
<td>Oil &amp; Grease (mg/l)</td>
<td>0.05</td>
</tr>
<tr>
<td>Phosphorous (mg/l)</td>
<td>0.2</td>
</tr>
<tr>
<td>Lead (mg/l)</td>
<td>0.5</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.5</td>
</tr>
<tr>
<td>Temperature Increase (°C)</td>
<td>&lt;3°C above ambient</td>
</tr>
</tbody>
</table>

2 World Bank/USA/Canada
B.3 Institutional Framework

B.3.1 Ministry of Environment, Science, Technology and Innovation

The Ministry of Environment and Science (MES) was established in 1994. Its creation was in response to a national development need to integrate environmental, scientific and technological considerations into the country’s sectoral, structural and socio-economic planning processes at all levels.

The declared mission of MES is to establish a strong national scientific and technological base for accelerated sustainable development of the country to enhance the quality of life for all. Among other things, this will be done through the development and promotion of cost-effective use of appropriate technologies. Among the main areas of policy thrust for MES, are Sanitation and Waste Management (Technical Options) and Science and Technology promotion, education and acculturation.

B.3.2 Ministry of Petroleum

Within the context of energy sector vision, the Ministry of Petroleum (MoP) goal is to make energy services universally accessible and readily available in an environmentally sustainable manner and to secure long term fuel supplies for the thermal power plants; reduce technical and commercial losses in power supply; information from Energy Commission; support the modernisation and expansion of energy infrastructure to meet growing demands and ensure reliability; increase access to modern forms of energy; improve the overall management, regulatory environment and operation of the energy sector; minimise the environmental impacts of energy supply and consumption through increased production and use of renewable energy and make energy delivery efficient and ensure cost recovery for energy supply and delivery;

B.3.3 Ministry of Power

The Ministry of Power (MoP) regulates the activities of all the players in the power industry including the generators, transmitters and distributors of electricity It therefore oversees the mandates of VRA, GRIDCo, ECG, and NEDCo. IPPs which operate in the country also have recourse to the MoP. It provides the forum for synergy and collaboration between the partners in ensuring the availability of electrical power for both industrial and domestic use.

B.3.4 Volta River Authority (VRA)

The Volta River Authority (VRA) was established on April 26, 1961 under the Volta River Development Act, Act 46 of the Republic of Ghana, with the core business to generate and supply electrical energy for industrial, commercial and domestic use in Ghana. VRA started with the generation of power from the Akosombo dam and later, the Kpong Dam, downstream of Akosombo. In addition, VRA generates power from thermal facilities at Aboadze and Tema to complement hydro generation.
Today, 60% of the country’s power supply comes from hydro sources, while the thermal facilities use, largely, gas from Nigeria through the West African Gas Pipeline, instead of the more expensive crude oil used over the past ten years. VRA is responsible for distribution of electricity in the northern sector of Ghana, through its Northern Electricity Distribution Company (NEDCo).

B.3.5 Ghana Maritime Authority

The functions of the Ghana Maritime Authority (GMA) among others are to implement the provisions of the Ghana Shipping Act, 2003, (Act 645); ensure Safety of navigation; fulfill flag state and port state responsibilities in an effective and efficient manner, having due regard to international maritime conventions, instruments and codes; deal with matters pertaining to maritime search and rescue and coordinate the activities of the Ghana Armed Forces, the Ghana Ports and Harbours Authority and other bodies during search and rescue operations; regulate activities on shipping in the inland waterways including the safety of navigation in inland waterways; cause to be investigated maritime casualties and take appropriate action; oversee matters pertaining to the training, recruitment and welfare of Ghanaian seafarers; plan, monitor and evaluate training programmes of seafarers to ensure conformity with standards laid down by international maritime conventions and ensure in collaboration with such other public agencies and institutions.

B.3.6 Ghana Navy

The Ghana Navy fulfils a broad range of roles. These include among others the monitoring, control and surveillance of fishing activities; maritime presence in the West African Waters and Naval Support in the Region and Crises Areas when requested, to surveillance, patrol and control of Ghana’s Territorial Waters and Economic Zone. Is also in charge of evacuation operations of Ghanaian and other nationals is required.

The Navy also checks criminal activities such as piracy/armed robbery at sea, smuggling of illicit drugs, stowaways and dissident activities and also carries out disaster and humanitarian relief operations, search and rescue, and other mercy missions at sea. Assisting civil authorities such as the Ghana Police, the Volta River Authority, the Electoral Commission, Ghana Ports and Harbours Authority is also within the Navy’s remit.

B.3.7 Ghana Ports and Harbour Authority

The Ghana Ports and Harbours Authority is the statutory public organization mandated to build, operate, maintain and regulate seaports in Ghana. The Authority owns and operates two ports in Tema and Takoradi. The Takoradi Port is being re-positioned through an extensive expansion and modernization programme to better serve the needs of the oil and gas, mining and trading sectors with the aim to make the Seaports of Ghana the leading maritime hub and the beacon of trade and commerce in West Africa. The Authority ensures to improve efficiency and productivity of the entire port service delivery and lower the cost business operations.
The summary profiles of the key environmental and social professionals involved in the production of this Scoping Report are provided in Table D.1 below.

### Table C.1: Summary Profile of Key Environmental and Social Professionals

<table>
<thead>
<tr>
<th>Name and Organisation</th>
<th>Contact Details</th>
<th>Qualifications</th>
<th>Headline experience</th>
</tr>
</thead>
</table>
| Nik Stone Mott MacDonald Ltd | Mott MacDonald Ltd Victory House Trafalgar Place Brighton BN1 4FY United Kingdom +44 (0)1273 365000 nik.stone@mottmac.com | • BSc (Hons) Environmental Science, University of East Anglia, UK  
• MSc Environmental Economics and Environmental Management, University of York, UK | • Project Manager and Project Director at Mott MacDonald.  
• 12 years’ experience in preparing and managing ESIs and ESMPs on behalf of power sector clients.  
• Strong background in water quality, waste management, air quality, noise and social development issues. |
| Andrea Dal Mut Mott MacDonald Ltd | Mott MacDonald Ltd Victory House Trafalgar Place Brighton BN1 4FY United Kingdom +44 (0)1273 365000 andrea.dalmut@mottmac.com | • LLB Law, College of Law, London  
• MSc Environment and Development, London School of Economics and Political Science  
• BA Business Administration, Universidad de las Americas Puebla, Mexico | • Project Manager at Mott MacDonald.  
• 7 years’ experience in the environmental and social development field including ESIA and ESDD projects.  
• Background in law and business providing a robust basis for evaluating environmental and social risks in an investment context. |
| Alistair Halcrow Mott MacDonald Ltd | Mott MacDonald Ltd 1 Atlantic Quay Broomielaw Glasgow G2 8JB United Kingdom +44 (0)141 2224648 alistair.halcrow@mottmac.com | • MSc Environmental Engineering, University of Strathclyde, UK  
• MSc Product Design Engineering, University of Strathclyde, UK | • Experience on ESIA and ESDD projects, working in a multidisciplinary team.  
• Worked on a range of projects in the power sector including wind farms, hydropower plants and thermal plants.  
• Experience in the application of international standards on projects across the globe |
| Dyson Jumpah EEMC | EEMC Limited Environ Engineering & Management Consult 7th Floor, Trust Towers, Farrar Avenue, Accra P. O. Box CO298, Tema, Ghana +233-244649873 Dyson.jumpah@gmail.com | • University of Ghana, 2000-2002, EMBA- Finance  
• CIMA, UK, CIMA Adv. Dip MA  
• KNUST, 1990-1994, B.Sc. (Chemical Engineering) | • Managing Consultant of Environ Engineering and Management Consult (EEMC).  
• An accomplished environmental, engineering and management consultant with a track record of several years of active involvement in the execution of major local and international assignments.  
• Over 16 years working experience in Environmental Assessment and Management.  
• Core areas of professional and technical expertise are in the area of World Bank Safeguard Policies related to Environmental and Social Impact Assessment and |
<table>
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<tr>
<th>Name and Organisation</th>
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<th>Qualifications</th>
<th>Headline experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christian Hetmank</td>
<td>Mott MacDonald Limited 20 Station Road Cambridge CB1 2RN United Kingdom +44 (0)1223 463663 <a href="mailto:christian.hetmank@mottmac.com">christian.hetmank@mottmac.com</a></td>
<td>• MSc Integrated Environmental Studies, University of Southampton • Diploma Environmental Biology, University of Applied Sciences, Germany • Biology Studies, Phillips-University-Marburg, Germany</td>
<td>Management, Environmental and Social Management Framework (ESMF) • Experience in the management of multidisciplinary project teams • Expertise in flood modelling and mapping, strategic flood risk assessment, hydraulic modelling and flood hazard assessment • Has worked on Public Private Partnership projects undertaking geo-spatial data management, analysis and visualisation, technical compliance and quality checks</td>
</tr>
<tr>
<td>Jon Williams</td>
<td>Mott MacDonald Limited 8-10 Sydenham Road Croydon CR0 2EE United Kingdom +44 (0)2087 742564 <a href="mailto:jon.williams@mottmac.com">jon.williams@mottmac.com</a></td>
<td>• PGCert (HE), University of Plymouth, UK • PhD, Queen Mary College, University of London, UK • BSc (Hons) Geography, Portsmouth Polytechnic, UK</td>
<td>Responsible for project and team management and development • Over 25 years’ experience providing expert process and numerical modelling input for large multidisciplinary teams • Expertise and interest in coastal processes with extensive experience in fieldwork and large-scale laboratory experiments</td>
</tr>
<tr>
<td>Dr Philip Gyau-Boakye</td>
<td>EEMC Limited Environ Engineering &amp; Management Consult 7th Floor, Trust Towers, Farrar Avenue, Accra P. O. Box CO298, Tema, Ghana +233-208170581 <a href="mailto:pgboakye@yahoo.com">pgboakye@yahoo.com</a></td>
<td>• Dr. –Ing. Ruhr University Bochum, Germany 1986-1993 • M.Sc. Water and Waste Eng, Loughborough, U.K 1981-1983 • B.Sc. (Hons) Civil Eng, K.N.U.S.T, Kumasi, Ghana 1973-1977</td>
<td>Estimation of catchment runoff based on basin characteristics. • Rainfall and runoff modeling of river catchments for design and operation of water resources management systems. • Water resources survey. • Surface water resources assessment of some river basins of Ghana (i.e. Tano and Ankobra). • Water resources planning of the White Volta and Densu basins and water resources survey in administrative regions and districts of Ghana. • Hydrological studies of some river basins of Ghana and water supply for both urban and rural communities</td>
</tr>
<tr>
<td>Rowan Byrne</td>
<td>Mott MacDonald Limited 20 Station Road Cambridge CB1 2RN United Kingdom +44 (0)1223 463 702 <a href="mailto:rowan.byrne@mottmac.com">rowan.byrne@mottmac.com</a></td>
<td>• MSc Energy, Heriot Watt University, Edinburgh, UK • MSc Managing the Environment, University of Wales, UK • BSc (Hons) Marine &amp; Freshwater Biology, University of Wales, UK</td>
<td>Marine biologist with over 19 years’ experience and proven environmental management and consultancy skills. • Wide ranging experience in marine environmental sciences including ecology, conservation, ESIA, surveys, oil and gas, and stakeholder engagement • Global experience in academic research with many published, peer</td>
</tr>
<tr>
<td>Name and Organisation</td>
<td>Contact Details</td>
<td>Qualifications</td>
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<td><strong>Mihai Coroi</strong>&lt;br&gt;Mott MacDonald Ltd</td>
<td>Mott MacDonald Limited&lt;br&gt;20 Station Road&lt;br&gt;Cambridge&lt;br&gt;CB1 2RN&lt;br&gt;United Kingdom&lt;br&gt;+44 (0)1223 463721&lt;br&gt;<a href="mailto:Mihai.Coroi@mottmac.com">Mihai.Coroi@mottmac.com</a></td>
<td>• PhD Biology (Botany), ‘Alexandru Ioan Cuza’ University, Romania&lt;br&gt;• BSc (Hons) Biology, ‘Alexandru Ioan Cuza’ University, Romania</td>
<td>• Technical leadership capabilities in the coordination of ecological surveys&lt;br&gt;• 21 years’ experience in biodiversity and ecology projects involving terrestrial, freshwater and coastal habitats in the UK and overseas&lt;br&gt;• Coordination and contribution to ESIs, ESDDs, feasibility studies and monitoring programmes on large and small scale projects</td>
</tr>
<tr>
<td><strong>Kweku Amoako Atta Degraft</strong>&lt;br&gt;Johnson&lt;br&gt;EEMC</td>
<td>EEMC Limited&lt;br&gt;Environ Engineering &amp; Management Consult&lt;br&gt;7th Floor, Trust Towers, Farrar Avenue, Accra&lt;br&gt;P. O. Box CO298, Tema, Ghana&lt;br&gt;+233-279827991&lt;br&gt;<a href="mailto:kaadigi@yahoo.co.uk">kaadigi@yahoo.co.uk</a></td>
<td>• 1980 - Post-graduate Diploma, Environmental Management and Protection, Technical University of Dresden, Germany&lt;br&gt;• 1979 - Certificate, Management of Surface Water Resources with special reference to Eutrophication, Technical University of Dresden, Germany.&lt;br&gt;• 1975 - Certificate, Remote Sensing and African Natural Resources and Environment, Accra, Ghana&lt;br&gt;• 1974 - MSc. Botany (Phycology), University of Ghana, Legon, Ghana&lt;br&gt;• 1972 - BSc. Hons. Botany (Marine Biology Option), University of Ghana, Legon, Ghana</td>
<td>• Academic qualifications related to environmental management and surface water resources&lt;br&gt;• Over thirty five years working experience in hydro-botanical, ecological, environmental, waterweeds and watershed management and research; teaching in tertiary institutions and consultancy work including environmental impact assessments.&lt;br&gt;• Worked for EPA on secondment and is familiar with the relevant environmental legislation.&lt;br&gt;• Major areas of interest are environmental and integrated aquatic weeds control and management.&lt;br&gt;• Field skills in aquatic resource identification and especially aquatic weeds and invasive plants</td>
</tr>
<tr>
<td><strong>Christopher Mills</strong>&lt;br&gt;Mott MacDonald Ltd</td>
<td>Mott MacDonald Ltd&lt;br&gt;Victory House&lt;br&gt;Trafalgar Place&lt;br&gt;Brighton BN1 4FY&lt;br&gt;United Kingdom&lt;br&gt;+44 (0)1273 365000&lt;br&gt;<a href="mailto:christopher.mills@mottmac.com">christopher.mills@mottmac.com</a></td>
<td>• MSc Air Pollution Management and Control, University of Birmingham, UK&lt;br&gt;• BSc (Hons) Environmental Science, University of Birmingham, UK</td>
<td>• Technical lead for air quality assessments across a range of sectors which include power, transport and buildings.&lt;br&gt;• Expertise in air quality management including advanced atmospheric dispersion modelling and ESIA input&lt;br&gt;• Over 7 years’ experience in providing consultancy services</td>
</tr>
<tr>
<td><strong>James Peet</strong>&lt;br&gt;Mott MacDonald Ltd</td>
<td>Mott MacDonald Ltd&lt;br&gt;Victory House&lt;br&gt;Trafalgar Place&lt;br&gt;Brighton BN1 4FY&lt;br&gt;United Kingdom&lt;br&gt;+44 (0)1273 365000&lt;br&gt;<a href="mailto:james.peet@mottmac.com">james.peet@mottmac.com</a></td>
<td>• MSc Environmental Science and Society, University College of London, UK&lt;br&gt;• BSc (Hons) Geography, University of Southampton, UK</td>
<td>• Over 3 years’ of environmental consultancy experience specialising in carbon assessments and implementing carbon management strategies for large multinational clients&lt;br&gt;• Has undertaken a range of organisational carbon footprints across a range of sectors, as well as for projects, events, products and services</td>
</tr>
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<td>Name and Organisation</td>
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</tbody>
</table>
| Phil Le Gouais              | Mott MacDonald Limited Demeter House  
                                    Station Road  
                                    Cambridge  
                                    CB1 2RS  
                                    United Kingdom  
                                    +44 (0)1223 465016 philip.legouais@mottmac.com | • Higher National Certificate (HNC) Civil Engineering Studies  
• Ordinary National Certificate (ONC) Civil Engineering Studies | • Experience in project management, environmental permitting, ESIA and environmental management systems |
|                             |                                                                                  |                                                                                | • Experience environmentalist across a range of sectors, primarily in water and sanitation, but also in transportation, power and urban development |
|                             |                                                                                  |                                                                                | • Strong project and programme management skills                                   |
|                             |                                                                                  |                                                                                | • Experience in both public and private sectors in a global context                 |
| Andrew Monk-Steel           | Mott MacDonald Limited Stoneham Place  
                                    Stoneham Lane  
                                    Southampton  
                                    Hampshire  
                                    SO50 9NW  
                                    United Kingdom  
                                    +44 (0)2380 628762 Andrew.Monk-Steel@mottmac.com | • MSc Automotive Dynamics, Noise and Vibration, University of Southampton, UK  
• BEng (Hons) Mechanical Engineering (Design), University of Huddersfield, UK | • Noise and vibration specialist with over 15 years’ experience                     |
|                             |                                                                                  |                                                                                | • Experience in research and development of noise and vibration within the automotive and rail industries |
|                             |                                                                                  |                                                                                | • Expertise in noise and vibration impact assessment, particularly with regards to power, energy and wind energy, transportation, industrial and residential developments |
| Emma Rickard                | Mott MacDonald Limited 2nd Floor, 2 Brewery Wharf  
                                    Kendall Street  
                                    Leeds  
                                    LS10 1JR  
                                    United Kingdom  
                                    +44 (0)1223 463532 Emma.Rickard@mottmac.com | • BSc (Hons) Environmental Geoscience, University of Edinburgh, UK | • Over 11 years’ experience in the field of contaminated land                       |
|                             |                                                                                  |                                                                                | • ESIA and ESDD experience specialising in geology, soils and ground contamination |
|                             |                                                                                  |                                                                                | • Has worked in a number of countries across the globe including the UK, Iraq, Russia and Eastern Europe |
| Emmanuel Amekor             | EEMC  
                                    Environ Engineering & Management Consult  
                                    7th Floor, Trust Towers,  
                                    Farrar Avenue, Accra  
                                    P. O. Box CO298, Tema, Ghana  
                                    +233-244779983 eamekor@gmail.com | • M.Phil (Environmental Chemistry)  
• B.Sc. (Hons.) Chemistry  
• Diploma In Integrated Environment And Water Management  
• Certificate In Environmental Pollution Prevention And Control  
• Certificate In Environmental Management For Sustainable Development  
• Postgraduate Certificate In Environmental Management | • Preparation of Environmental Impact Assessment Report for the proposed Brakfields Generation Limited 1000MW Combined Cycle Thermal Power Plant at Tema (ongoing) |
<p>|                             |                                                                                  |                                                                                | • Preparation of Environmental Impact Assessment Report for the proposed Tricorp Energy 370MW Combined Cycle Thermal Power Plant at Tema (ongoing) |
|                             |                                                                                  |                                                                                | • Preparation of Environmental Impact Assessment Report for the proposed Amandi Energy 240MW Combined Cycle Thermal Power Plant at Abobadze |
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<tr>
<th>Name and Organisation</th>
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<th>Qualifications</th>
<th>Headline experience</th>
</tr>
</thead>
</table>
| Pierre Gouws Mott MacDonald Ltd | Mott MacDonald PDNA  25 Scott Street Waverley Johannesburg 2090 South Africa +27 (0)110 521055 pierre.gouws@mottmac.com | • MA (distinction) Research Psychology, University of Pretoria, South Africa  
• BSc (Hons) Psychology (distinction), University of Pretoria, South Africa  
• BSc Human Physiology, Genetics and Psychology, University of Pretoria, South Africa | • Specialises in the preparation of social impact assessments and resettlement action plans in line with national and international requirements  
• Over 9 years’ experience as a social scientist in Africa including, Tanzania, South Africa, Ghana, Uganda, Ethiopia, Mali, Zambia and Mozambique  
• Has published a number of papers on the subject of resettlement in Africa |
| Kofi Agbogah EEMC            | EEMC Limited Environ Engineering & Management Consult 7th Floor, Trust Towers, Farrar Avenue, Accra P. O. Box CO298, Tema, Ghana +233-266031882 kofi.agbogah@gmail.com | • MSc. Environmental Science and Management, International Institute for Infrastructure, Hydraulic & Environmental Engineering (IHE, Delft), The Netherlands, 1996  
• B.Sc. (Hons) Zoology/Psychology, University Of Ghana, Legon, Ghana,1986 | • University Degree in Zoology, Biodiversity, Conservation Management and Environmental Science  
• Familiar with the relevant environmental legislation.  
• Field skills in plant and animal identification.  
• Familiar with issues associated with invasive species in the terrestrial environment and various control measures used in invasive species management.  
• Project planning and implementation experience. |
| Josh Williams Mott MacDonald Ltd | Mott MacDonald Limited 20 Station Road Cambridge CB1 2RN United Kingdom +44 (0)1223 463739 Josh.Williams@mottmac.com | • PG Diploma in Practical Archaeology, University of Birmingham, UK  
• BSc (Hons) Geography and Archaeology, University of Leicester, UK | • Heritage team leader with over 17 years’ experience in commercial archaeology and heritage  
• Expertise in ESIA, IFC standards and the design of guidance and methodologies for assessing and mitigating historic environmental impacts  
• Experience in producing briefs, specifications, project designs, budget control, assessment of tenders and procurement, management of sub-contractors and consultation between clients, contractors and curators |
| Vincent Sepenu EEMC          | EEMC Limited Environ Engineering & Management Consult 7th Floor, Trust Towers, Farrar Avenue, Accra | • Kwame Nkrumah University of Science & Technology, Kumasi; MSc in Development Policy & Planning  
• University of Science & Technology, Kumasi; BSc | • Over 10 years’ experience in planning.  
• Participated in many significant projects for individuals, institutions (both private and public) and the academia, with particular emphasis |
<table>
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<th>Name and Organisation</th>
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<th>Qualifications</th>
<th>Headline experience</th>
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<tbody>
<tr>
<td>P. O. Box CO298, Tema, Ghana</td>
<td>+233-244896418</td>
<td>(Hons) in Planning</td>
<td>on the active participation of both the client and project beneficiaries.</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:vsepenu@yahoo.com">vsepenu@yahoo.com</a></td>
<td></td>
<td>• Work has been mainly in community and district development planning/policy-related research, capacity building, facilitation, project monitoring and evaluation, and preparation of business / strategic / structure / land-use plans.</td>
</tr>
</tbody>
</table>

Source: Mott MacDonald
Table D.1: Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>APE</td>
<td>Aboadze Energy Enclave</td>
</tr>
<tr>
<td>CCGT</td>
<td>Combined Cycle Gas Turbine</td>
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<tr>
<td>CIA</td>
<td>Cumulative Impact Assessment</td>
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<tr>
<td>CHP</td>
<td>Community Health Programmes</td>
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<tr>
<td>CHS</td>
<td>Community Health and Safety</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>CWSA</td>
<td>Community Water and Sanitation Agency</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental Assessment</td>
</tr>
<tr>
<td>ECG</td>
<td>Electricity Company of Ghana</td>
</tr>
<tr>
<td>EHS</td>
<td>Environmental, Health and Safety</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
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<tr>
<td>EP</td>
<td>Environmental Permit</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>EPZ</td>
<td>Export Processing Zones</td>
</tr>
<tr>
<td>EqPs</td>
<td>Equator Principles</td>
</tr>
<tr>
<td>ESAP</td>
<td>Environmental and Social Action Plan</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>ESMMMP</td>
<td>Environmental and Social Management and Monitoring Plan</td>
</tr>
<tr>
<td>ESMP</td>
<td>Environmental and Social Management Plan</td>
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<tr>
<td>FRA</td>
<td>Flood Risk Assessment</td>
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<tr>
<td>FSRU</td>
<td>Floating Storage and Re-gasification Unit</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GEPA</td>
<td>Ghanaian Environmental Protection Agency</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
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<tr>
<td>GIS</td>
<td>Gas Insulated Switchgear or Geographical Information System</td>
</tr>
<tr>
<td>GNPC</td>
<td>Ghana National Petroleum Corporation</td>
</tr>
<tr>
<td>GoG</td>
<td>Government of Ghana</td>
</tr>
<tr>
<td>GPHA</td>
<td>Ghana Ports and Harbours Authority</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>GRIDCO</td>
<td>Ghana Grid Company</td>
</tr>
<tr>
<td>IEMA</td>
<td>Institute of Environmental Management and Assessment</td>
</tr>
<tr>
<td>IFC (PS)</td>
<td>International Finance Corporation (Performance Standards)</td>
</tr>
<tr>
<td>IPP</td>
<td>Independent Power Project</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature and Natural Resources</td>
</tr>
<tr>
<td>LSA</td>
<td>Land Sector Agencies</td>
</tr>
<tr>
<td>LCO</td>
<td>Light Crude Oil</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
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