

**2x350 MW SUPERCRITICAL COAL-FIRED POWER PLANT:
AFFILIATED COAL HANDLING TERMINAL**



ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

DRAFT REPORT



May 2017

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AFFILIATED COAL HANDLING TERMINAL**

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

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PROJECT NAME	2x350 MW Supercritical Coal-Fired Power Plant: Affiliated Coal Handling Terminal
CLIENT NAME	Shenzhen Energy Group Co., Ltd. (SEC) & Volta River Authority (VRA)
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NON-TECHNICAL EXECUTIVE SUMMARY

➤ The Scope, Purpose and Objectives of the Project

Shenzhen Energy Group Co., Ltd. (SEC) in collaboration with Volta River Authority (VRA) proposes developing a 70,000DWT Coal Handling Terminal and 10,000DWT Material Offloading Facility. The project, which would be affiliated to the development of 2×350MW supercritical coal-fired power generating plant to be situated along the coastline of Aboano in the Ekumfi District of the Central Region of Ghana.

The Shenzhen Energy Group Co., Ltd. was incorporated in 1991 and listed on the Shenzhen Stock Exchange in 1993. SEC has its core business in power generation and has immense interest in environmentally friendly energy sources. It also has interest in gas business and related energy finance. Presently, SEC operates three coal-fired power plants and two additional supercritical power plants are in construction phase.

Volta River Authority (VRA) is solely owned by the Government of Ghana established in 1961 by the Volta River Development Act, Act 46 of the Republic of Ghana to generate and supply electricity for local consumption. Presently, VRA is the largest power generation company in Ghana combining hydro, thermal and solar power plants to generate electricity for supply also to the West Africa Regional markets.

The purpose of the project is to develop a dedicated harbour for handling coal imported for the operation of the coal-fired power plant; which is intended to provide cheaper and reliable alternative power generation source for the needed stability and security in base load power generation capacity of the country especially in the near future.

The project is intended to achieve a 70,000 DWT Coal Handling Terminal and 10,000 DWT Materials Offloading Facility (MOF) specialized and dedicated to meeting the independence and safety of the operation of power plant, ensuring stable and overall effective and efficient operation and management of the proposed 2X350MW Supercritical Coal-fired Power Plant with minimal associated hazards and risks.

On the basis of economic analysis for the transportation of coal requirements planned for both Phases 1 and 2, the 70,000DWT coal handling terminal designed to accommodate 100,000 DWT bulk carriers in future and a 10,000 DWT material offloading facility next to the coal berth was planned.

The first Phase of the Supercritical Coal-fired Power Plant, which would have 700MW installed capacity, would require 1.8 to 2.05 million tons of coal annually. The second phase on completion would increase the total installed

capacity to 2000MW, which would also increase the demand of coal to 5.4 to 6.15 million tons annually.

➤ **Legal and Regulatory Requirement**

In accordance with the Environmental Protection Agency Act 1994, Act 490 (Parts 1&II) and Environmental Assessment Regulations 1999, LI 1652, an Environmental and Social Impact Assessment is required prior to the development of the proposed project.

The Project Development would comply with the National Environmental laws and Quality Standards, and other relevant Ghanaian legislations which are applicable to the project and relevant international agreements and conventions. The Environmental and Social Impact Assessment (ESIA) will further conform to a number of international guidelines and standards including the IFC Performance Standards for Environmental, Health and Safety Guidelines for Thermal Power Plant and requirements of the Equator Principle and the Green Credit Guidelines of the China Banking Regulation Commission.

➤ **Brief Project Description**

The project involves the development of a 70,000 DWT Coal Handling Terminal (CHT) and a 10,000 Material Offloading Terminal (MOF) attached to a proposed 2X350MW supercritical coal-fired power plant.

The 70,000 DWT CHT, which is also structured to accommodate 100,000 DWT coal unloading terminal in phase II, has an overall length of 264m, with a width of 24m and a basin depth of 15.9m initially in Phase I and 16.3m in Phase II of the project.

The coal handling operation is planned to involve the utilization of two sets of bridge type grab vessel unloader for unloading the coal from the vessels onto belt conveyor for transportation to the Coal Storage Yard. The unloader rated capacity is 1500 tons per hour and the conveyor belt is fitted with dust shield, conveyor belt scrapper, coal sampling system and electromagnetic separator at suitable positions of the belt conveyor.

The principal marine structures include the Terminal comprising of Coal Handling Berth and Material Offloading Berth, Approach Trestle, Belt Conveyor Trestle, Turning Basin, Breakwater, Revetment, Approach Channel and Anchorage area.

The affiliated facilities include Coal Handling facilities, Water Supply and Drainage System, Power Supply System, Firefighting System Communication System and Navigational Aids. The other facilities include Apron Office, Tool and Material Room, Sampling Room, Tugboat, and other supporting facilities.

The pre-construction phase of the project involved pre-feasibility study, and feasibility investigations for the development and operation of 2X350MW Supercritical Coal-fired Power plant and affiliated Coal Handling Terminal. The studies involved a number of engineering investigations and analytical reviews including hydrological studies, soil study, marine investigations, geological survey, flood risk assessment, dredging investigations and environmental and social impact assessment and related reports.

The construction phase of the project involved onshore and offshore construction works. The onshore construction includes site preparation and development, removal of any existing vegetation, and grading and excavation of soils for the installation of structural foundations and site utilities. The development would mainly include construction of new infrastructure including water and power supply facilities and drainage network.

The offshore construction would include the berthing facilities and cargo handling facilities (crane tracks and bridges for loading / unloading cargo). Specific offshore construction activities would include preparing the waterside including dredging (and disposal of dredged material); excavation and blasting; and filling and other work related to the construction of quays, piers, harbour basins, access channels and breakwaters.

Similarly, the port operations can be categorized into Onshore (Land-based) operations and Offshore (Water-based) operations. The land based operations would include cargo handling and related shipping support services; fuel and chemical handling and storage; waste and wastewater management; vehicle and equipment maintenance; and buildings and grounds maintenance.

The primary offshore operations involve berthing of ships and related operations and anchoring of ships and related activities. The secondary operational requirements involve maintenance of dredged area involving removal of materials/sediments within the harbour basin and the turning and access channel.

The decommissioning operation would consider dismantling the physical structures of the coal handling terminal, especially the harbour basin, turning basin, access channel and quays where possible. However, these structures have more permanent construction characteristics and therefore alternative uses of the harbour would first be explored based on consultations with GPHA. Alternatively, control measures would be implemented to demarcate the basins

and channel appropriately to caution fishing boats and other users. The civil infrastructure including the quay, pier and also breakwater may also remain where appropriate.

On the other hand, the cargo handling facilities, crane track and ancillary facilities would be dismantled and scrapped, where necessary and depending on the local market for scarp metals, the materials would be sold locally or reshipped to China to recover cost.

Accordingly, the construction works for the coal handling terminal and affiliated facilities is planned to be commenced in April 2018, following the completion of basic preparation work of the power plant. The construction works are expected to be completed by December 2019. The project cost is estimated at 375,950,000.00 US Dollars of which the engineering cost is US\$ 314,500,000.00 US Dollars.

➤ **Project Alternatives**

The design of the project considered three design parameters for alternative options to identify the best solution options given the prevailing conditions and circumstances. These parameters include:

- Alternative coal handling port, which would handle the importation of coal from South Africa. The considerations review the potential of the harbour facilities in Tema and Takoradi which are situated approximately 90 km east and 110 km west respectively of the proposed power plant. The review justified the need for new and dedicated port facilities. Evaluating the status and operating requirements of the two ports and available transportation facilities indicated that neither the tonnage of the berths nor the facilities could meet the transportation requirements for the coal. Consequently, affiliated specialized coal-handling terminal is planned for the project in order to meet the coal demands of the Power Plant project and assure the overall efficient and effective operation of the power.
- Arrangement of the conveyor belt trestle, which reviewed two arrangement plans; assessing whether the conveyor belt trestle should be arranged on the breakwater in the connection area or not. The option of arranging the conveyor belt off the breakwater was considered more suitable alternative.
- Arrangement of the CHT and MOF in linear shape or L shape. The review justified linear shape plan as the preferred option for the project considering the limited dredged volume in the case of linear shaped plan and also less risk of the MOF berth being influenced by traverse wave.

➤ **Brief Explanation of the Methods by which Information and Data were Obtained**

There are two principal sources of information and data, which are identified as primary and secondary sources of information and data. These sources of data also determined the methods by which the information and data were obtained.

The methods of obtaining information and data from the primary sources include consultations and dialogue, which also involved focused group discussions and direct and inter-personal interviews. Additionally, primary information and data were obtained through field studies, technical and engineering investigations and chemical analytical assessment of environmental situation and projections.

Consultations and dialogues commenced from project conception through the inception of project development from Pre-feasibility preparation through feasibility phases. The consultations continued through the scoping phase and subsequently through the preparation of the ESIA.

More than 20 stakeholder groupings including governmental agencies, the communities, the public, media and civil society organisations have been engaged in various consultation and dialogue mechanisms and have been informed appropriately of the potential development impact and implications of the Coal Handling Terminal Project.

The stakeholder groupings include public stakeholders, which can be categorized into three levels namely National, District and Local level consultations. The National Level consultation covered for Power Generation: EPA, Energy Commission, Ministry of Energy, GRIDCo, VRA, Forestry Commission (Wildlife Division), NGOs and Central Regional Coordinating Centre (Minister's Office) and including the chiefs and people of the communities.

The methods of obtaining secondary information and data included desk research involving literature reviews, review of publications and guidelines and review of project studies documentation.

➤ **Brief on the Baseline Data**

The site is located along the coastline of Ekumfi Aboano Village belonging to the open sea area. The site has coordinates: N 5°12'41", W 0°49'51" with the water area of the terminal estimated as 7 km². The project is proposed to cover an area running some 18 kilometers off shore of Ekumfi Aboano.

The area of influence of the project covers Ekumfi Aboano community, Ekumfi Kuntankure Settlement, Ekumfi Estibeedu community, and Ekumfi Otuum community within the Ekumfi District Assembly area.

The area, being a part of the coast of Ghana, belongs to the tropical climate zone, which has two main seasons identified as the rainy season and the dry season. Ghana has high temperature all year round with a monthly average air temperature of 26°C in the coastal region with an annual average relative humidity of 85%. The annual rainfall of Ghana is around 1200~1800mm for the south and southwestern part. The dominating wind direction is SW, the annual average wind speed is 2.5 m/s, the instantaneous maximum wind speed is 35 m/s. The annual average atmospheric pressure is 1012.1hPa.

Tide type along the coast of Ghana is regular semi-diurnal tide. Guinea current is the dominant current for the project sites, of which the flow direction is from west to the east. The current speed for the near shore is less than 0.4m/s. Based on wave model study for the power plant, the dominating wave direction is S - WSW with appearance frequency up to 98.1%. Appearance frequency of significant wave height larger than 1.5m is about 36.9%.

The physical environment depicts water depth of the site changing significantly from 5.3m near the coastline to 18m offshore. The site is also in a state of erosion due to long period wave action. The coast erosion sand is the main sediment source and it is very limited as the coast is in a state of erosion. Sediment concentration within the surf zone seems very high; however, it can be observed that the water is very clear beyond the surf zone. It is estimated that siltation rate within the port is about 0.1m/annum and about 0.3m/annum for the approach channel.

According to the Ghana Geological Survey Department, there are no records of seismic activity in the site.

The biological environment shows that two (2) main intertidal fauna species and nine (9) marcoalgae species were recorded during the study. There are more than 1200 individuals macrobenthos made up of 70 different species belonging to seven major groups identified as Polychaete, Crustasea, Mollusca, Echinodermata, Nematoda, Nemertea and Sipunculidae. The dominant fishery species in the project area are *Chloroscombruschrysurus*, *Brachydeuterusaauritus*, *Ilisshaaficana*, *Sardinellaaurita* and *Selenedorsalis*, whilst *Acanthurusmonroviae*, *Penaeusnotialis*, *Galeoidesdecadactylus* and *Trichiuruslepturus* are in low abundance.

Three main sea turtle species are identified having nesting activities in the Central Region. These include Green, Olive Ridley and Leatherback. However, there are no documented sea turtle activities or threats specifically for the

project area. Generally, most of the beaches within the project area are rocky with high cliffs which may prevent sea turtle from nesting or accessing the back beach.

The stock status within areas demarcated for dredging and dredged material disposal were assessed based on bottom trawl survey carried out off the coast of Ekumfi within these areas. The assessment reviewed fish abundance by species and families. The baseline findings on fish stocks revealed the total number of individual fishes encountered during the trawling period, estimated at 7140 comprising 19 fish species (both shelled and fin fish species). These belong to 15 families (both shelled and non-shelled fishes).

The catch composition included crustaceans, gastropods, cephalopods and elasmobranchs. Carangidae was identified as the dominant fish family and the catch characteristics reflect indications of overfishing.

At the anchorage area, the sediment is silty sand. The physico-chemical parameters are ideal to support marine life. Furthermore, the microbial loads monitored were low. There are several different microbenthic infauna species found at the area.

Generally, it can be concluded that the offshore environment in Ekumfi Aboano is healthy with such a high diversity and abundance of benthos. In terms of heavy metals, there exist variable concentrations of heavy metals in the marine sediment. However, the concentration of Lead (Pb) was below detection limit.

Seascape and Landscape Visual

The seascape visual characteristics generally reflect natural coastline but exploited environment resulting from human activities. Presently, the seascape is represented by coastline with maritime vegetation intersperse with strand and mangrove vegetation occupying the foreshore. The shoreline also portrays high water mark with outcropped rocky beach stretching almost the length of the site.

The visual impressions often characterising the site depict visualization of a distinct relationship between the shoreline with its different spectral colours and shades and pockets of mangrove, weeds and ground cover including thickets of coconut trees.

These impressions are likely to be lost due to the development of the proposed coal handling terminal. The potential visual impact can therefore be described as significantly adverse on the inhabitants. The envisaged development would result in the construction of quays along the shoreline, which would

significantly alter the seascape along the immediate coastline and causing considerable change of the natural environment.

At the moment, erosion is not a major concern along the shoreline. Again, the blasting and removal of the rocks is likely to result in some amount of erosion which must be checked immediately. The engineering aspect of the project has considered cutting and filling, which these rocks would be removed.

Presently, the sea line depicts identifiable straight line that can easily be placed in the subconscious. This identity would likely be lost and completely replaced with the development of the breakwater embankment connecting the plant site and the port terminal.

Also, the topography is hilly with sparse vegetation and scattered pockets of thickets, which represent the general surrounding environment and though disturbed appears very natural landscape visuals.

The overall aesthetic quality therefore depicts natural environment which given the village setting has friendly and positive impact on the people. The vegetation continues to change through the seasonal variations also influences the visual impressions and consequent impact implications.

It can therefore be concluded that presently, the baseline visual aspect of the seascape is considerably friendly and hardly has adverse impact implications on the people.

Socio-economic Baseline

Ekumfi Aboano falls within the jurisdiction of the Ekumfi District Assembly. There are approximately 52,000 people inhabiting the Ekumfi District out of which 1900 of the District's population reside in Ekumfi Aboano (GSS, 2014). The population of Ekumfi Aboano is considered youthful because approximately 55.9 % of the population is children. There two hundred and sixty (260) homes in Ekumfi Aboano with an average of 13 – 15 people per home (Ghana Statistical Service, 2014; Global Brigades, n.d.).

The primary livelihood activity of the five communities is fishing and farming. However, other livelihood activities include petty trading, charcoal production, food vending, operation of drinking spot, hair dressing and dress making are complementary economic activities, which the population engage in.

Historical, Cultural and Traditional Heritage

The Fantes constitute the dominant ethnic group in the Ekumfi District. There are notably varieties of historical resources, cultural and traditional heritage

forming the conceptions, beliefs, reverence, obedience and faith of the people and contributing to their socio-cultural and economic well-being.

The project would cover significant area of the sea and shoreline of the Aboano community, the seafront is significantly used for rituals by the fisher folks. The folks consider that there would be the need to relocate the commonly used ritual grounds along the seafront and the associated activities, which presently situate within the project area.

There would also be loss of territorial control and economic benefits to the Chief Fisherman and his subjects would lose considerable fish landing grounds. This is likely to cause relocation of some of the fishermen to other fishing territory.

Therefore, the project would have considerable impact on the traditional practices of the fisher folks and their activities. This means that new location(s) will have to be found and transfer of deities and their subjects will be required.

Green House Gas Emission

The principal sources of greenhouse gases emission in Ghana are identified to include agriculture, forestry, energy (fuel combustion, mobile combustion & fugitive emission), Industrial Processes and waste. Globally, Greenhouse gas emission in Ghana is relatively insignificant compared to global emissions. The Total GHG Emissions Excluding Land-Use Change and Forestry in 2012 was estimated as 27.34 MtCO_{2e} and the Total GHG Emissions Including Land-Use Change and Forestry in the same period was 58.84 MtCO_{2e}.

➤ **Impacts Identified and their Mitigation**

The project would involve the development, operation and decommissioning of 70,000 DWT Coal Handling Terminal and 10,000DWT Material Off-loading Facility. The development is expected to result in a number of potential impacts arising from activities related to the pre-construction, construction, operational and decommissioning phases of the project.

The potential impact identification process involved comprehensive assessment of the identified potential sources of impact of the project development and associated activities and predicting and evaluating the potential effects on the physical, biological, social and cultural environment within the project area of influence.

Dredging and dredged material disposal would make significant changes to the marine ecology and may have consequent impacts on the marine habitats. It is

envisaged that the total dredged volume of the dredged areas would be 4.62 million cubic metres.

The operation would adopt appropriate techniques to control suspension of sediments to minimize adverse impacts on marine life; routine inspection and monitoring of dredged areas would be instituted to evaluate the effectiveness of impact prevention strategies, and where necessary re-adjust the prevention strategies.

The blasting and dredging operations and the disposal of the dredged material would be carefully conducted in a fashion so as to avoid fish migration or interruption of sensitive areas for marine life such as feeding, breeding, calving, and spawning.

During the construction phase the residual impact on air quality from the earthworks along the shore and exhaust emissions is expected to be minimal and therefore the construction operation is considered as minor and severity would be minor however occurrence is likely.

The principal likely receptors are the operatives of the fishing sector within the immediate vicinity, residents of adjoining communities and the construction workers.

Given the scale of construction works, the ambient noise level is expected to increase considerably beyond the baseline value resulting from the massive construction activities including blasting, machinery operation and vehicular movement to and from the project site. However, the duration and extent would be limited especially to the initial stages of construction operation.

Liquid and solid waste would be generated during the construction of the project. The principal sources of waste water generation include concrete works, cleaning of construction equipment and domestic applications. Additionally, source is from possible dewatering of sediment, which may be insignificant, if well managed and monitored. However, domestic sewage would be a key source of waste water generation.

The principal receptor would be the sea, nearby surface water and underground water as the sewage may drain or sip in to these water bodies. The potential impact may be rated as moderate and the severity also as low.

Considering the shoreline and wharf construction works, it is expected that debris from construction works would be mainly grass vegetation and smaller rock boulders. Additionally, waste from packaging materials and domestic waste including food leftovers could be significant.

The main receptor of solid waste is the physical environment which would receive the waste materials. Indiscriminate dumping of waste would be avoided to ensure proper management and disposal of the waste generated using the municipal authorities and waste management system. The impact on the identified receptors could be rate as minor and the severity could also be rate as low. The likelihood is considered unlikely.

The main receptor of traffic impact could be the general public and other road users. In general, the residual impact would be minor as transportation requirements and therefore traffic incidence would be rather limited and can be managed and controlled effectively. Consequently, the severity would also be minor and unlikely.

Construction activities would include blasting, dredging, earthworks, constructions work, operation of the construction machinery and movement of vehicles and machinery. These activities would generate dust, fumes and noise that could lead to possible respiratory problems, hearing loss and other health related problems to humans. Accidental tipping of construction materials and tools, use of power tools and accessories, falling gadgets, cuts from sharp objects as well as the inhalation of exhaust fumes from vehicles and equipment could cause potential injuries and harm to health of especially construction workers and neighbouring residents.

The main receptors of health and safety impact include construction workers, the residents of the adjoining communities and visitors calling at the port. Construction workers and visitors would be provided with appropriate and adequate personal protection equipment (PPEs), while ensuring effective use of the PPEs. Given the various mitigation interventions relating to dust generation, noise nuisance and exhaust gas emission and the limited duration of the impacts, the residual impact could be rated as moderate and since the impact is considerably localized its severity could be rated as low.

Generally, the ecosystem offshore Ekumfi showed rich diversity and abundance of macro benthic infauna with as much as 70 different species identified. The organisms, which are also central elements of intertidal and near shore ecosystems, provide good indicators of environmental health. Based on bottom trawl survey conducted within areas of identified dredged material disposal site, the fish species caught in the area designated as disposal site, the anchorage site as well as for the dredging basin and channel are common species found in Ghanaian waters. Also, the sizes of the fishes caught were much smaller as compared to the maximum attainable sizes, indicating that the species are currently overfished.

No endemic/vulnerable/threatened fish species was captured and no infaunal species were found, thus no conservational concerns can be attributed to the

use of the area as disposal site. Therefore, the construction activities are not likely to alter the ecological structure, especially the sedimentary characteristics of the intertidal and near-shore ecosystem within the Ekumfi shore area; and therefore unlikely to have any significant adverse impact on the marine fauna.

The terrestrial ecosystem of the proposed project site is noted to have very low fauna diversity and abundance. No species of international conservation interest was encountered in the project area. Three species of birds encountered in the area were completely protected by the Wildlife Conservation Regulation of Ghana. The proposed project is therefore unlikely to have any significant adverse impact on the fauna of the area due to the very low faunal population and poor species diversity currently in the project area. Also the impact zone (foot print) of the project is limited and therefore not expected to have any significant impact on wildlife within the area of influence and beyond.

In relation to greenhouse gases, according to the baseline data, the vegetation and forest cover have already been cleared for farming activities, consequently the vegetation and forest cover clearing for the predevelopment of project structure would be rather limited. Therefore, the significance of the potential impact would be minor.

The Project is envisaged to cover a sea area of 7 Km², this area would be much restricted to local fishing operation and therefore related loss of fishing opportunities and associated loss of income, and probable relocation of fishermen. Nonetheless, the sea area is vast and the fishes identified in the project area are the common species found in the sea areas of the Central Region. The residual impact is expected to be minor, however the occurrence is likely.

The seascape visual characteristics generally reflect natural coastline but exploited environment resulting from human activities. Presently, the seascape is represented by coastline with maritime vegetation intersperse with strand and mangrove vegetation occupying the foreshore. The shoreline also portrays high water mark with outcropped rocky beach stretching almost the length of the site.

The site, which is located along the coastal beaches of Ekumfi, also coincides with the Southern Marginal Forest in the Central Region. Generally, the site depicts maritime and coastal scrub and grassland vegetation with hilly and rocky outcrops lying along the coastline. These impressions often characterize the visuals of the site. However, same is likely to be lost due to the development of the proposed coal handling terminal. The potential visual impact can therefore be described as significantly adverse on the inhabitants. The envisaged development would result in the construction of wharf along the

shoreline, which would significantly alter the seascape along the immediate coastline and causing considerable change of the natural environment.

The overall aesthetic quality therefore depicts natural environment which given the village setting has friendly and positive impact on the people. It can therefore be concluded that presently, the baseline visual aspect of the seascape is considerably friendly and hardly has adverse impact implications on the people.

Community health and safety issues during the construction of the Terminal relate to noise nuisance, vibration, traffic accidents and communicable diseases associated with the high influx of temporary construction labour. Resulting increased community population and the consequent demand on community health and educational facilities are likely. Similarly, demographic changes may also have cultural and moral implications.

The operations of the Terminal may be categorized into land-based operations and water-based operations. The land-based operations include cargo handling; fuel and chemical storage and handling and ship support services; waste and wastewater management; vehicle and equipment maintenance; and buildings and grounds maintenance. The water-based operations include berthing of ship and maintenance dredging of the harbour basin and access channel.

Both the land-based operations and water-based operations are likely to impact considerably on sensitive environmental resources/receptors. The likely impacts include ambient air quality, water quality, marine ecology and human health.

The principal mitigation measure involved enclosure of the coal unloading and handling facilities (including the conveyor system). The residual impact is expected to be low and therefore considered as minor and severity rated minor and occurrence is unlikely.

Waste water would include facility cleaning water, storm water and sewage from domestic effluent from the operation of the terminal, bilge water, ballast water and vessel cleaning wastewater from ships calling at the port. Measures to minimize or eliminate pollution from effluent would include filtering mechanisms, containment basins and run-off collection points. The residual impact is expected to be low and therefore considered as minor and severity rated low and occurrence is unlikely.

The solid and liquid wastes relating to the operation of the terminal would include solid waste from packaging materials, maintenance operations and administrative offices. In addition, the solid and liquid waste would also include the waste from vessels operating from or calling at the Terminal. The

wastes originating from the vessels may include oily sludge and other materials such as food packaging, and food waste. The Terminal would provide reception facilities meeting both the internal requirements of the terminal operations and the requirements of the ships calling at the Terminal and in accordance with international regulations of MARPOL Convention 73/78.

Hazardous materials at terminal would include oil, fuels, lubricants, solvents and other chemicals used in maintenance operations. Spillage could be a major source of pollution. Hazardous materials and oil management processes would be developed to ensure control, minimization and prevention of pollution and contamination.

Noise sources within the operational areas of the Terminal would include coal unloaders and handling facilities, particularly the conveyor system and ships calling at the Terminal.

The potential impact of the operation of the Terminal may result from the mooring and anchorage of ships calling at the Terminal. Moored ships may cause disturbance through noise and movements of ships and therefore cause disturbance to marine fauna and possibly birds feeding within the intertidal area.

Additionally, discharge of ballast water from ships calling at the Terminal during port operations may result in the introduction of invasive/non-native marine species into the marine ecosystem. Also dredging during maintenance of the Terminal and disposal of dredged spoils may lead to short and long-term impacts on the immediate marine ecology and habitat as well as the shoreline.

During operation of the Terminal, occupational health and safety concerns may arise in relation to exposure to dust and hazardous materials that may be present in cargo and maintenance materials, and physical hazards associated with the use of heavy equipment and tools.

Chemical hazards may involve handling bulk coal, solvents and other chemical materials. The workers may be presented with risk of exposure to volatile organic compounds (VOC) during normal use or in the case of spills. Coal dust and fuels are flammable and may also present risk of fire and explosions.

Confined space at the Terminal, including cargo holds, silos, sewage tanks, water tanks, and others may present considerable hazards. The potential for accidents can result from inadequate preparation to enter confined space or attempting a rescue from a confined space. The Management of the Terminal would develop and integrate confined space entry procedures.

The Terminal facilities would cause significant changes to the landscape and seascape visuals, especially in relation to illumination at night at the Terminal.

Furthermore, ships calling at the port would also cause visual changes to the seascape.

Decommissioning of the Coal Handling Terminal would involve dismantling of the coal unloading and transport facilities and possibly demolition of the wharf and breakwaters. However, the specific action would be dependent on the outcome of discussions with GPHA to find alternative uses of the facility.

➤ **Monitoring and any other Critical Matters**

An Environmental Monitoring and Evaluation Programme would be instituted to incorporate the intertidal and near-shore ecosystem monitoring to prevent, reduce or mitigate the release of harmful elements/chemicals such heavy metals into the sedimentary environment from constructional as well as operational activities.

Environmental Performance Monitoring during the project construction phase would include:

- a) Air quality (Particulate Matter, Sulphur dioxide, oxides of Nitrogen, and Carbon Monoxide)
- b) Noise
- c) Resource use efficiency

The monitoring during the project operational phase would include Air quality, Effluent from the cleaning the facility, Seawater quality analysis, Marine environment in general would be monitored half yearly, Noise level, Availability and use of personal protective equipment and the overall environmental performance and resource use efficiency would be monitored monthly.

The Project would establish monthly reporting scheme and submit the reports, including quarterly and annual reports accordingly as required by EPA to meet national compliance requirements

➤ **Provisional Environmental Management Plan**

A Provisional EMP outlining the necessary environmental management planning is prepared to facilitate commitment to prevention and minimization of any potential residual impacts to acceptable levels of environmental quality, health and safety standards. The Environmental Management Plan (EMP) is also seeking to establish an Environmental Management System (EMS) that ensures mitigation measures are implemented effectively and efficiently to minimize the impacts of the CHT and affiliated facilities.

The EMS has been developed including the organizational structure and planned resources requirements for implementation of the corporate environmental protection policy.

Decommissioning becomes necessary due to disuse of the Coal Handling Terminal and the consequent low effectiveness making the economic operation expensive. The Coal Handling Terminal would have outlived its useful economic life.

The principal considerations in decommissioning the CHT would include realizing alternative uses of the terminal and environmental concerns.

It is considered that the CHT decommissioning would involve dismantling of unloading facilities and demolition of physical structures. The specific activities would include permitting, environmental and ecology assessment including ground investigation, noise mitigation and pollution control, structural demolition, site dismantlement and scrap recovery, waste disposal, environmental clean-up, site remediation and restoration and costing.

The Project would engage the services of professional demolition contractors to carry out the work and ensure appropriate measures would be taken to prevent unnecessary or undue degradation.

➤ **Conclusion**

In conclusion, VRA and SEC have conducted the Environmental and Social Impact Assessment of the proposed Coal Handling Terminal affiliated to the 2X350 Supercritical Coal-fired Power Generating Plant to be situated along the coast of Aboano in the Ekumfi District of the Central Region.

After carefully evaluating the project design and the environmental pollution controls; and having identified and assessed the likely residual impacts and recommended appropriate mitigation measures to eliminate, minimize or compensate where necessary; it is concluded that the development and operation of the CHT is unlikely to have significant adverse effect on the environmental resource, however may contribute marginally to climate change.

Furthermore, it is unlikely that the project would affect the health and safety situation of the workers and the community any significantly following the implementation of the project development. However, the project, in general is likely to provide immense social and economic benefits to the surrounding communities and the nation as a whole; providing decent jobs and consistent income flow to stakeholders directly and indirectly, and boosting the commercial activities of the people. In addition, the project would contribute to

power generation capacity indirectly, providing efficient, cheaper and convenient transportation and handling of coal fuel for power generation.

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LIST OF ABBREVIATIONS

EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
VRA	Volta River Authority
SEC	Shenzhen Energy Group Co., Ltd.
CHT	Coal Handling Terminal
MOF	Material Offloading Facility
DWT	Dead Weight Tons
M	Meter
MM	Millimeter
HP	Horse Power
NO _x	Nitrogen Oxides
SO _x	Sulphur Oxides
CO _x	Carbon Oxides
PM	Particulate Matter
NEQG	National Environmental Quality Guideline
Tpd	Tons per Day

1 INTRODUCTION

1.1 Background

Shenzhen Energy Group Co., Ltd. (SEC) and Volta River Authority (VRA) are collaborating to develop a 70,000 DWT Coal Handling Terminal (CHT) and 10,000 DWT Materials Offloading Facility (MOF) to support the development and operation of the proposed 2×350MW supercritical coal-fired power generating plant which would be situated at Aboano Ekumfi along the coastline of Ghana facing the Atlantic sea.

The Power Plant is planned to have a total installed capacity of 2000MW comprising of 2x350MW Supercritical Coal-fired Units under Phase 1, which would then be expanded with either 4x350MW or 2x600MW units in Phase 2. The installed capacity of Phase 1 project would therefore be 700MW requiring 1.8 - 2.05 million tons of coal annually. The coal requirements would increase to 5.4 - 6.15 million tons annually following the completion of the Phase 2 component of the project.

The affiliated Coal Handling Terminal is to be developed and dedicated to ensure efficient and consistent delivery of coal to the power plant. The project includes a 70,000 dead weight ton (DWT) Coal Handling Terminal (CHT) which is designed to provide 70,000 DWT bulk carriers with a 38m-long-segment next to the coal berth and to accommodate 100,000 DWT bulk carriers and a 10,000 Material Offloading Facility (MOF) in phase 2.

1.1.1 Profile of Shenzhen Energy Group Co., Ltd

The Shenzhen Energy Group Co., Ltd. was incorporated in 1991 in China and became listed on the Shenzhen Stock Exchange in 1993. The current structure of the general share capital of Shenzhen Energy is 3,964,491,597 shares, configured as 1,896,000,775 shares held by Shenzhen Municipal People's Government State-owned Assets Supervision and Administration Commission, accounting for 47.82% of the general capital; 991,741,659 shares are held by Huaneng Power International Inc., accounting for 25.02% of the general capital; and 1,076,749,163 shares are held by other shareholders, accounting for 27.16% of the general capital.

SEC is the first large joint-stock company in the national power industry and also the first utility stock company to be listed on Shenzhen Stock Exchange. SEC is therefore largely publicly owned and has remained seriously committed to its social responsibility and public accountability, consequently its aspirations of generating green power for the future.

Through the years SEC has developed its core business in power generation with environmentally friendly energy, gas business and related energy finance as subsidiary business both on the Domestic and International markets. Currently SEC has more than twenty subsidiaries, creating strategic pattern with energy generation as the core business and dominating the operations. These enterprises include two public-listed companies, three coal-fired power plants, five gas power plants, six waste-to-power plants, a number of solar power stations and an ocean fleet with six Panama bulk carriers.

At the end of 2014, the total installed capacity controlled by SEC was 9060 MW including the waste-to-power plants demonstrating the comprehensive development policy of the group. SEC ranks among the top 500 enterprises in the China, which have created the good image of "integrity, merit, standard and environmental protection".

One of SEC's primary strategic positions is being an innovative and competitive low-carbon power provider, an innovative and competitive technology solution provider and an investor in municipal solid waste treatment.

Since inception, Shenzhen Energy has pursued scientific orientation as the strategic direction combining the business philosophy of "safety first, cost primary, benefit oriented and environment friendly" to strengthen the work style of doing good job, optimized management and controlled risk in the full realization of "responsible energy, powerful energy, environmental energy and harmonious energy".

By the end of 2014, SEC had attained energy generation mix, which had increased the proportion of clean energy to 59.10% from less than 3% ten year ago. The renewable energy projects have been important strategic pillar of the group's energy development, which include 418MW wind power projects for grid-connected power generation, 163MW photovoltaic power generation projects for grid-connected power generation and 147MW hydroelectric projects for grid-connected power generation out of the more than 500MW exploitable hydroelectric resource obtained.

Shenzhen Energy has insisted on the highest environmental protection standard while significantly expanding its power generation industrial set-up. SEC has also relied on the garbage treatment industry to actively develop waste to energy as an energy environmental protection industry. Shenzhen Energy presently treats over 7,050 tons of garbage daily and emission index of the plants has been up to or superior to EU standards; presently, Baoan Garbage Power Plant processing 4,200 tonnes per day is the largest garbage incineration power plant with the highest standard in China.

Presently, SEC operates three coal-fired power plants, which are identified to include Shenzhen Energy Mawan Power Plant (1,910 MW), Shenzhen Energy Heyuan Power Plant (1,200MW) and Shenzhen Energy Guangshen Shajiao B Power plant (700MW). Meanwhile, two additional supercritical power plants are in the construction phase, namely Shenzhen Energy Korla Power Generation Corporation (2x350MW) and Shenzhen Energy Baoding Power Generation Corporation (2x350MW).



1.1.2 Profile of Volta River Authority

Volta River Authority (VRA) is solely owned by the Government of Ghana and was established in 1961 by the Volta River Development Act, Act 46 of the Republic of Ghana to generate and supply electricity for the country. Presently, VRA is the largest power generation company in Ghana combining hydro, thermal and solar plants to generate electricity for supply to the local and West Africa Regional markets.

The local market for power comprise of Electricity Company of Ghana, demand and supply for the mining operations and industrial operations, whiles the export market is constituted by demand and supply to Communauté Electrique du Benin (CEB) (for the Republics of Togo and Benin) and Société Nationale d'électricité du Burkina (SONABEL) (Burkina Faso).

In the past, electricity generation and supply in Ghana has been dominated by hydro power, which accounted for all the generation capacities until the late 1990s. However, presently the situation has changed and since the end of 2010 and Ghana's total installed thermal generating capacity has almost equalled the existing hydro generation capacity.

VRA hydroelectric power generation plants are situated at Akosombo and Kpong; also the thermal plants are situated mainly in Tema (Tema Thermal 1 & 2, Mines Reserve Plant and Kpone Thermal), and Aboadze in Takoradi (Takoradi Thermal Power Station T1, TICO/T2 and T3). At close of 2016, the

total installed generation capacity was 2,340 MW with a dependable capacity of 2,107 MW. Currently, the thermal power generation plants using crude oil and gas as the fuel source play significant role in the power generation mix of VRA. VRA also operates a solar plant with installed capacity of 2.5 MW situated in the Northern Region of Ghana.

VRA has subsidiaries, which also create relevant strategic pattern supporting its leading operations, including Northern Electricity Distribution Company (NEDCo), Akosombo Hotels Limited, Volta Lake Transport Company and Kpong Farms Limited. Furthermore, VRA runs Health Services, Schools and Real Estate Departments, which are also developed as part of the Strategic Business Units.

VRA has also supported the socio-economic development of the Volta Basin; operating as a local authority for the Akosombo Township and exercising administrative responsibility over the Akuse and Aboadze Estates. The Authority implements Environmental Management Programmes to mitigate the adverse impacts of its operations.

1.2 Purpose of the Project

The first Phase of the Supercritical Coal-fired Power Plant would have 700MW installed capacity, which would require 1.8 to 2.05 million tons of coal annually. The second phase on completion would increase the total install capacity to 2000MW, which would also increase the demand of coal to 5.4 to 6.15 million tons annually.

The quotas of coal handling in Phase 1 and Phase 2, which are 2.05 and 6.15 million tons annually respectively, are significantly large and require specialized coal handling system dedicated to the power plant to ensure efficient and effective delivery of coal; and further assure the independence, safety and stable operation and maintenance of the power plant.

The 70,000 DWT Coal Handling Terminal and 10,000 DWT Materials Offloading Facility (MOF) would be developed and dedicated to meeting the independence and safety of the 2x350MW Supercritical Coal-fired Power Plant, ensuring stable and overall effective and efficient operation and management of the proposed power plant with minimal associated hazards and risks.

The coal would be transported from South Africa directly to the power plant, which is also a long transportation distance for such volume of coal; economic review of transportation of the coal indicates the demand for a 50,000 DWT bulk cargo terminal. The water depth of the anchorage area is up to 18 metres.

The handling facilities at the port include quay cranes, movable crane, high-speed belt conveyor and grain elevator.

1.3 Rationale of ESIA

In accordance with the Environmental Protection Agency Act 1994, Act 490 (parts I&II) and Environmental Assessment Regulations 1999, LI 1652, the National Environmental Policy institutes and implements an environmental quality control programme requiring prior Environmental Impact Assessment of all new investments that would be deemed to affect the quality of the environment.

As part of the Environmental and Social Impact Assessment Process, a scoping report was prepared on the project and submitted to EPA for review. Following review of the Scoping Report, EPA advised that the ESIA process should consider separate reports on the power plant and the port facility to ensure that issues related to port development are given appropriate attention. This ESIA report is therefore on the Coal Handling Terminal and it is separate from the ESIA on the 2x350MW Supercritical Coal-fired Power Plant.

The rationale for the environmental and social impact assessment on the Coal Handling Terminal is therefore to:

- a) Compile all relevant information relating to the proposed affiliated 70,000 DWT CHT and 10,000 DWT MOF for the 2X350MW supercritical coal fired power plant to inform the permitting process of the project for appropriate consideration.
- b) Identify all important receptors and disclosing identified potential environmental impacts of project prior to project being started.
- c) Determining the significance of impacts and identifying mitigation measures to alleviate any significant adverse impacts.
- d) Ensuring appropriate precautionary control alternatives are well considered and incorporated into design, operation and maintenance of the facility.
- e) Developing sustainable related environmental practices.

The Environmental Assessment Procedure has involved:

- a) Registration
- b) Screening

- c) Scoping
- d) ESIA Study
- e) ESIS Review
- f) Decision Making

Methods by which information and data were obtained include:

1. Desk research, involving review of available documentations of relevant project information and data including project feasibility study and various related design studies.
2. Consultations with various stakeholders in various forms to discuss varied issues of interest and concerns to identify potential impacts and implications and the possible mitigation measures that need to be considered and addressed; these included:
 - a. interview with community leadership, residents and identified groupings;
 - b. public hearing,
 - c. direct dialogue and
 - d. focused group discussions with government agencies, regulatory agencies, Civil Society Groups, affected communities, local authorities and other interest groups identified;
3. Conducting field inspections, surveys and interviews to gather primary data and information on the various aspects of the projects;
4. Conducting physical measurement, observation, sampling and analytical investigation of environmental parameters and resources to establish existing/current situation or baseline conditions.

1.3.1 Linkage with the 2X350MW Supercritical Coal-fired Power Plant

The Affiliated Coal Handling Terminal would be purposefully developed to meet the specific development and operational requirements of the 2X350 MW Supercritical Coal-fired Power Plant. Consequently, the development and operation of the CHT would be directly linked to the development and operation of the Power Plant. The two projects would be situated within the same location and therefore co-exist within the same environment with coinciding area of influence. Similarly, the environmental and social impact and implications would be significantly linked cumulatively; hence mitigation measures and environmental management initiatives may be common to the two projects.

1.3.2 Structure of ESIA Report

The ESIA Report is structured as follows:

Chapter 2: Policy, Legal & Administrative Framework: outlines the combination of relevant policies, legislative and administrative framework within the context for ESIA. It also covers the international protocols, conventions and legal requirements for the projects; specifically, those of IFC, World Bank Group, and China Banking Regulation Commission. Furthermore, the chapter illustrates the corporate standards, programmes and best practices applicable to the project.

Chapter 3: Description of the Undertaking: provides a reasonably detailed description of the project including the background to the development of the project, project location, scale and scope of the project design, construction and operation, manpower and materials requirements for the various stages of the project and their sources and project schedule as well as financial requirements.

Chapter 4: Consideration of Alternatives: describes all alternative and subsequent designs options and site considerations reviewed and also in relation to cost benefit analysis and environmental concerns and implications. Also the issues would cover consideration of the alternative situation where the undertaking is not proceeded with.

Chapter 5: Baseline Information: provides detailed description of the resources and environmental situation of the proposed site including the immediate adjoining land uses and zoning status. Further provides detailed description of the existing environment (including the physical, biological, socio-cultural and economic) of the project area.

Chapter 6: Consultations: presents the catalogue of the consultations and engagements with stakeholders and findings of all the consultations and engagements in relation to informing all stakeholders to be affected by the project, including the state agencies, District Assemblies and local communities and individuals etc. The dialogue covered the various issues of concern in relation to the potential impact of the project and the mitigation proposals to alleviate potential impact.

Chapter 7: Identification, Analysis and Evaluation of Impacts: provides detailed description of the potential impacts of the proposed the development including the methodology used for the impacts identification. Information on potential, positive and negative impacts of the proposed undertaking from the environmental, social, economic and cultural aspect in relation to the different phases of the development of the undertaking is provided. The identified

impacts are described in terms of their nature, duration, magnitude, areal extent and frequency and categorized into all the phases of the project, particularly Pre-constructional, Constructional, Operational and Decommissioning Phases of the project.

Chapter 8: Mitigation Measures: presents the description of the proposed mitigation measures from the pre-construction, construction, operational and decommissioning activities; and outlines the details of the specific mitigation options and considerations against the identified significant impacts, defined in terms of costs, manpower, equipment and technology needs.

Chapter 9: Monitoring Plan: presents the periodic measures put in place to observe any significant deviations from the baseline conditions of the environment and particularly the identified receptors; described to cover constructional activities, operational and decommissioning activities of the project.

Chapter 10: Environmental Management Plan: describes the provisional Environmental Management Plan (EMP) developed to minimize the potential environmental impacts due to proposed project. It also presents the commitment of the proponent to ensure adequate safeguard of the environment as well as the surrounding population.

Chapter 11: Decommissioning: describes the activities to remove the installed facilities and equipment and return the site to a condition as close to a pre-construction state as feasible to ensure public health and safety, environmental protection, and compliance with applicable regulations. It further outlines the procedures and activities for reclamation during and after completion of project operation as well as measures to be taken to prevent unnecessary or undue degradation.

Chapter 12: Conclusions & Recommendations: outlines the general overview of all conclusions arrived at during the study and recommendations made in order to justify the issuance of an Environmental permit.

Chapter 13: References: outlines the list of references used for the analytical review and in the preparation of the report.

Appendices

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The chapter outlines the national and international institutional legislations, administration, standards and guidelines relevant to the development of coal fired power plant and meeting the environmental performance of the project, including international treaties, conventions and relevant corporate policies.

Specifically, the chapter provides the relevant information in relation to the following:

- a) Ghana's Government and Administrative Framework;
- b) Ghana's environmental and social laws and regulations deemed applicable to the Project;
- c) International conventions, standards and guidelines, which the Project will comply with and;
- d) The corporate policies of the financing institution China Africa Development Fund (CAD) and the proponents both the SEC and VRA.

2.1 Government and Administrative Framework

2.1.1 The Ghanaian Constitution

The Constitution of Ghana in Article 41(k) demands that all citizens protect the natural environment of the Republic of Ghana. As such SEC and VRA have the responsibility to safeguard the natural environment of Ghana while pursuing the project objectives.

2.1.2 Ministries and Administrative Bodies

Ghana issues legislations at the national level through Acts, Regulations, Policies and Guidelines. A number of Ministries and their administrative agencies of the Ministries enforce these regulations. The key Ministries and administrative agencies relevant to the project include:

- a) Ministry of Energy; the Ministry is responsible for providing and enacting policies for the power, energy and petroleum sectors of the economy. The Ministry formulates, implements, monitors and evaluates the sector policies. The Ministry works with other stakeholders to enact policies and regulations, which provide support to stakeholders in the sectors. The relevant agencies, which work under the Ministry to promote energy generation, include the VRA, Electricity Company of Ghana and Energy Commission.
- b) Ministry of Lands and Natural Resources; the Ministry is responsible for

formulation, implementation, monitoring and evaluation of land policies and with other leading agencies; the Ministry implements land related policies of the country. The various agencies under this Ministry include Lands Commission and Forestry Commission amongst others.

- c) Ministry of Sanitation and Water Resources; the Ministry is responsible for ensuring efficiency of the sector in the initiation, formulation, implementation and co-ordination of policies and programmes for the systematic development of the country's infrastructure requirements in respect of Water Supply and Sanitation, Hydrology and Flood Control Systems. The relevant agencies under this Ministry include Water Resource Commission, Ghana Water Company Limited and Community Water and Sanitation Agencies.
- d) Ministry of Defence; this Ministry is responsible for the security of the country against external attacks. The Ministry is also engaged in other humanitarian activities for the nation.
- e) Ministry of Environment, Science, Technology and Innovation; the Ministry has responsibilities for the environment, settlement planning, science research and innovation. Its relevant agency is Environmental Protection Agency (EPA).
- f) Ministry of Local Government & Rural Development; under this Ministry, local governance relating to the Metropolitan, Municipal and District Assemblies are regulated. Government enacts legislations and administrative policies through this Ministry.
- g) Ministry of Food and Agriculture; Regulates and enacts policies under the food sector which includes fishing.
- h) Environmental Protection Agency; the Agency has been established to co-manage, protect and enhance the country's environment in particular, as well as seek common solutions to global environmental problems.
- i) Energy Commission; the Commission mandated by the Energy Commission Act, 1997 (Act 541) is responsible for regulation, management, development and utilization of energy resources in Ghana. The Commission further provides technical regulation of electricity, natural gas and renewable energy industries in Ghana. The Commission advises Government on Energy Matters
- j) Lands Commission; the Commission is mandated to ensuring lands in

the country are properly registered and protected through the land registration system. The commission also makes recommendation to Government to enact various policies responsible for the protection of the country.

- k) Forestry Commission; is responsible for the regulation and utilization of forest and wildlife resources, conservation and management of the resources. It also has the responsibilities for the coordination of policies related to the protection, management and regulation of the forest and wildlife resources.
- l) Fisheries Commission; is mandated to regulate and manage utilization of the fishery resources of Ghana and coordinate the related policies for promoting and enforcing policies related to fishing and fishery resources management.
- m) Water Resources Commission; this is a Commission under the Ministry of Sanitation and Water Resources with the mandate to regulate and manage the water resources in Ghana. The Commission is further to promote and coordinate Government policies related to the country's water resources.
- n) Minerals Commission; The Commission is the main promotional and regulatory body of the mineral sector in Ghana and is responsible for the regulation and management of the utilization of the mineral resources of Ghana and the coordination and implementation of policies relating to mining. It also has the responsibility of monitoring effectively to ensuring compliance with the Mining and Mineral laws and regulation in Ghana.
- o) Ghana Ports and Harbours Authority (GPHA); the Authority is mandated to build, operate, maintain and regulate seaports in Ghana. The Authority has strengthened collaboration with the private sector in ensuring improved efficiency and productivity of the entire port service delivery.
- p) Ghana Maritime Authority (GMA); The Authority is charged with the responsibility of monitoring, regulating and coordinating activities in the maritime industry.
- q) The Ghana Investment Promotion Centre (GIPC); the Centre is mandated with responsibility of promoting, encouraging, coordinating and monitoring all investment activities and facilitating investments. The Centre further provides for the creation of attractive incentive framework

and transparent environment for investments in Ghana.

- r) Ghana Grid Company Limited (GRIDCo); The Company is responsible for the establishment and exclusive operation of the national interconnected transmission system. The company functions to undertake economic dispatch and transmission of electricity from wholesale suppliers to bulk customers; GRIDCo also carries out planning of transmission system including implementation of necessary investments to provide the capacity to transmit power and manage the wholesale power market reliably.

2.1.3 Environmental Protection Legislation

In 1991, the National Environmental Policy (NEP) was adopted by the Ghanaian Government as a means of ensuring economic development without disservices to social and environmental development. The NEP provided a framework for the implementation of the National Environmental Action Plan (NEAP) as well as a number of other policies relating to conservation and environmental management.

The Environmental Protection Agency Act

The Environmental Protection Agency Act 1994 (Act 490), is an Act of the Parliament of Ghana giving the Agency the responsibilities to formulate environmental policies, issue environmental permits and pollution abatement notices and prescribing standards and guidelines related to the pollution of air, water, land and any other environmental receptor. The Act further mandates the Agency to prescribe standards and guidelines related to discharge of waste, control of toxic substances and act to coordinate in collaboration with governmental bodies to control pollution and generally protect the environment.

The Act is in four parts; the first part establishes the Agency and its mandates, prescribing the functions and structure of the agency, including ministerial responsibilities and the governing board. The second part describes the enforcement and control mandate, defining the power of the Agency to require an environmental impact assessment for undertakings likely to impact on the environmental standards. The Agency is also mandated to require mitigation measures in respect of adverse environmental impacts of any undertaking or halt the development. Infringement of enforcement notices of the Agency is an offense liable to fine or imprisonment. The Act also mandates the Agency to appoint and authorize Environment Protection Inspectors to enter premises and ensure compliance with the laws pertaining to protection of environment.

The third part relates to funding of the Agency while the last part prescribes the administrative functions and the general provisions.

EPA is therefore mandated to prescribe standards and guidelines and require an environmental impact assessment for undertaking the development and operation of 2X350MW Supercritical Coal-fired Power Plant at Ekumfi in the Central Region.

Environmental Impact Assessment Regulations

The ESIA process is legislated through the Environmental Assessment Regulations (LI 1652, 1999). The ESIA Regulations require that all activities likely to have an adverse effect on the environment must be subjected to environmental assessment and issuance of a permit before commencement of the activity.

The Regulations are structured in three parts. The first part defines the requirements and steps for EIA process for an environmental permit in relation to the activities of existing undertakings and new undertakings. The process starts with screening, evaluating applications in relation to location, size, land use, technology and possible output as well as the concerns of the general public.

The second part of the Regulations describes the requirements of preliminary environmental report and environmental impact statement. A scoping report outlining the scope of the proposed undertaking and the terms of reference shall be submitted prior to environmental impact statement. Public hearing and submission of the environmental impact statement shall follow and an environmental permit valid for 18 months is issued. The environmental permit shall be renewed within 24 months of the commencement of the activity following submission of environmental management plan to the Agency and revision in every three years. The format of the environmental management plan shall be determined by the Agency.

The Regulations require the persons to submit annual environmental reports in respect of the undertaking to the Agency starting from the end of the first year of the commencement of the activity.

The ESIA Regulations has set out the requirements for Preliminary Environmental Assessments (PEAs), Environmental Impact Assessments (EIAs), Environmental Impact Statement (EIS) (also termed the ESIA Report), Environmental Management Plans (EMPs) and Environmental Permitting. Schedules 1 and 2 of the Regulations provide lists of activities for which an environmental permit is required and ESIA is mandatory, respectively.

The project would be expected to follow prescribed EIA process and permitting conditions as set by the EIA Regulations and schedules 1 and 2 of the regulation, which provides list of activities for which an environmental permit is required and EIA (also termed ESIA) is mandatory.

The construction of the 70,000DWT Coal Handling Terminal and 10,000 DWT Material Offloading Facility affiliated to 2x350MW Supercritical Coal-fired Power Plant is an undertaking which requires a full ESIA before a permit could be issued.

Fees and Charges

Fees and Charges (Amendment) Instrument 2015, LI 2228 provides revision of the Fees and Charges applied for granting Environmental Permit by EPA. The relevant two principal fees and charges are the Processing Fee and the Permit Fee. Both are structured on the basis of the sector and scale of potential impact of the project. Other Fees and Charges include penalties levied for non-compliance with the regulations.

The Project would be required to pay for the Processing and Permit Fees to obtain the environmental permit.

Environmental Guidelines

The EPA has issued formal guidance on regulatory requirements and the ESIA process. The following are relevant to the ESIA process and the Project for compliance requirements:

- a) Environmental Quality Guidelines for Ambient Air (EPA);
- b) Sector Specific Effluent Quality Guidelines for Discharges into Natural Water Bodies (EPA);
- c) General Environmental Quality Standards for Industrial or Facility Effluents, Air Quality and Noise Levels (EPA);
- d) Waste Discharge Standards (Emission Guidelines) for Solid Fuel and Biomass.

2.1.4 Resource Management Legislation

Water Resources Legislations

Water resources in Ghana are governed by two legislations, namely the Water Resources Commission Act (Act 52 of 1996) and the Water and Sewerage Corporation Act (Act 310 of 1965).

For the purpose of the proposed project, the Water Resources Commission Act (Act 52 of 1996) is relevant here. The Act establishes the Water Resources Commission to regulate and manage the use of water resources of Ghana. The Act defines the composition of the Board of the Commission as well as its functions. According to the Act, water resources cannot be used without authority except for fire-fighting; however, water resources may be used for domestic purposes. The Act prohibits the construction for the purpose of water abstraction without authorization. Water use right may be obtained by application made to the Commission. The Commission publishes gazette notice of applications. Any person claiming could be affected from the grant for water use may object to the Commission within three months of the gazette notice. The failure of the user to comply with conditions of the grant of water use and to remedy the default within the period specified by a written notice, the water use grant is terminated.

The Commission is tasked with establishing comprehensive plans for the use, conservation, protection, development and improvement of Ghana's water resources and is able to grant water rights for the exploitation of water resources.

In recognition of the water resource legislation, the project has the obligation to protect water resources within the project area.

Biodiversity and Wildlife Legislations

The legislations which regulate biodiversity and wildlife in Ghana are:

- a) Wild Animals Preservation Act, Act 235 1964
- b) Wildlife Conservation Regulations 1971 (LI 685)
- c) Wild Reserves Regulations 1971 (LI 740)
- d) The Wetland Management Regulation, 1999
- e) Forest Protection (Amendment) Act 2002, Act 624
- f) Fisheries Act 2002, Act 625

Wild Animals Preservation Act, 1961 (Act 43) provides to consolidate and amend the law relating to wild animals, birds and fish and to continue the observance of the convention signed at London on the nineteenth day of May 1900. The Minister may appoint honorary game officers to carry out all or any of the purposes of this Act or do anything required or allowed by this Act to be done by a game officer. The Act mandates the Minister to permit the collection of specimens of animals for scientific purposes; and restricts export and import of trophies. A person shall not export any trophy from Ghana unless granted a certificate by a Superior Police Officer not below the rank of Assistant

Superintendent. Section 5 relates the marking and identification of trophies consisting of ivory. Section 6 relates to prohibition of hunting by motor-vehicle or aircraft. Section 7 relates to prohibition of surrounding animals by fires. Section 8 describes the powers of Game Officers to arrest persons without a warrant. Trophies of animals shot by a Game Officer in the execution of his/her duty shall be the property of the Government. Section 11 defines regulation making powers of the President for purposes of administration (Food and Agriculture Organization of the United Nations). Annexes I and II list those species protected by law.

The Wetlands Management Regulations, 1999 establishes wetlands ("Ramsar sites") for purposes of the Convention of Wetlands of International Importance especially as Waterfowl Habitat and assigns specified powers to the Minister responsible for lands and forestry, the Director of the Wildlife Division of the Forestry Commission, and District Assemblies in respect of such sites. The Regulations describe activities that are prohibited or restricted in the sites. The Minister may also declare closed seasons during which certain activities including fishing are prohibited. A District Assembly where a Ramsar Site is located may, in consultation with the Minister and by Bye-law, prescribe custody and traditional conservation practices which are compatible with the Ramsar Convention and permitted under these Regulations (FAO, IUCN and UNEP, no date).

Fisheries Act, 2002 (Act 625) mandates the establishment and administration of the fisheries commission as well as financial provisions. The Act regulates fisheries management and development and includes provisions related to fishing vessels, aquaculture and recreational fishing, licensing of fishing vessels. The Act also contains provisions for establishment of fishing zones, methods, seasons for fishing, and conservation measures. It stipulates provisions for monitoring, control, and surveillance. Section 93 of the Fisheries Act requires that the Fisheries Commission is informed of any activity with potential impacts on fishery resources and provided with mitigation strategies by proponents of the project. This is particularly important due to the services (food, income and employment) provided by the resource.

The project would utilize forest, riverine and marine environmental resources; legislations that govern these environments will be strictly adhered to by the SEC and VRA.

2.1.5 Energy Legislation

The Ministry of Energy is the highest executive body responsible for formulating, monitoring and evaluating policies, programmes and projects in Ghana's energy sector. There are other public Agencies working to support the activities of the Ministry of Energy. These public Agencies regulating the energy sector include:

- a) The Energy Commission, established by the Energy Commission Act (Act 541), is responsible for making policy recommendations to the Government to regulate the development and utilization of energy resources in Ghana. The Commission institutes rules, standards and procedures as well as grants licenses for generation, transmission, wholesale supply and distribution of electricity. The Commission has an Inspectorate Division to inspect premises to ensure that the provisions of the act are complied with.
- b) There are two subsidiary regulations established to provide proper management of the energy sector in Ghana. The first is the Electricity Transmission (Technical, Operational and Standards of Performance), 2008. Its objective is to establish the requirements, procedures, practices and standards that govern the development, operation, maintenance, and use of the high voltage national interconnected transmission system. The second regulation is the Electricity Regulation, 2008 which provides the planning, reliability, general safety, and overall regulation of the electricity market.
- c) The National Electricity Grid Code, 2009 is designed to guide and regulate the activities of electricity transmission utilities and independent system operators in order to facilitate competition in power generation. It was established by the Commission and describes the requirements, procedures, practices and standards of the National Interconnected Transmission System (NITS) in Ghana. Furthermore, the Code ensures that the distribution network provides fair, transparent, non-discriminatory, safe, reliable, secure, and cost efficient delivery of electrical energy.
- d) The Public Utility Regulatory Commission (PURC) is responsible for regulating utility tariffs in the country; Public Utility and Regulatory Commission Act (Act 538), 1997.

The Commission is the body with oversight responsibilities for the provision of the highest quality of electricity and water services to consumers.

The objectives of PURC include:

- Providing guidelines for rates to be charged for the provision of utility services;
- Examining and approving electricity and water rates;
- Protecting the interest of consumers
- Monitoring and enforcing standards of performance for the provision of utilities services;
- Promotion of fair competition among public utilities
- Receiving and investigating complaints and settling disputes between consumers and public utility;
- Advising any person or authority in respect of any public utility

Regulations governing the supply and transmission of electricity include:

- a) The Public Utilities Regulatory Commission (PURC), Act 538 (1997)
- b) Electricity Transmission (Technical, Operation and Standards of Performance) Rules. 2008 L.I. 1934 and
- c) L.I. 1937: Electricity Regulations, 2008

The project would generate, transmit and supply electricity to Ghana at an agreed tariff in accordance to the energy legislative and regulatory requirements of Ghana.

2.1.6 Maritime Legislation

The Ghana Maritime Authority (GMA) superintends over the Ghana Maritime Authority Security Act 2004 (Act 675), which gives effect to Chapter XI-2 of the International Convention for the Safety of Life at Sea 1974 (SOLAS) as amended to enhance maritime safety and security.

The Act seeks to implement the International Ship and Port Facility Security (ISPS) Code to enhance the safety and security of ships and port facilities. The ISPS code was developed by the international maritime community to provide a system for securing maritime terminal. Consequently, the ports of Tema and Takoradi are issued documents of compliance and thereby created positive environment for ships to call at the ports.

The Act provides for Ghana Maritime Authority additional mandate and role of recognized security organizations in relation to security levels for ships and port facilities; furthermore, providing for security level and security level information for ships and port facilities.

Again, the Act provides for ship security plan and international security certification for Ghanaian ships as well as requirements in relation to International Ship Security Certificate and Security Level for all ships intending to enter Ghanaian ports.

Ghana Shipping Act, 2003 (Act 645) (as amended) provides rules for shipping and related matters such as survey, registration, licensing and marking of ships, mortgages on ships, maritime liens and claims, ship records, prevention from collisions and maritime security, construction and importation of ships, carriage of dangerous goods, (limitation of) liability and divisions of liability and protection of the marine environment. The GMA shall be the principal administrative authority of purpose of this Act. Extensive regulation-making powers are granted to the Minister. The Act contains provisions on the marking of fishing vessels and exempts fishing vessels from various provisions regarding, among other things, maritime security and load lines. The Act defines powers of the Authority for purposes of protecting the marine environment.

The project would develop its dedicated port facilities, which would be required to operation in compliance with the international and national maritime regulations to ensure maritime security and safety for the ships and port facilities.

2.1.7 Other Relevant Ghanaian Regulations

There are other relevant legislations which are applicable to the project and include the following;

a) *Factories, Offices and Shops (Amendment) Law, 1983 (PNDCL 66);*

Section 3 part 1 of the Factories, Offices and Shops Law states that not less than one month before someone begins to occupy or use the premises as a factory, must apply for the registration of the premises by sending to the Chief Inspector a notice containing the particulars set out in the First Schedule.

The project would operate production facilities and would be required to register the premises in compliance with the Factories, Offices and Shop (Amendment) Law.

b) *Ghana National Fire Service Act, 1997 (Act 537), s.33(b)*

The Ghana National Fire Service is established in accordance with article 190 of the constitution and with the objective to prevent and manage undesired fire.

The functions of the service for the purpose of achieving its objectives include:

1. Organize public fire education programmes to create and sustain awareness of the hazards of fire, and heighten the role of the individual in the prevention of fire;
2. Provide technical advice for building plans in respect of machinery and structural layouts to facilitate escape from fire, rescue operations and fire management;
3. Inspect and offer technical advice on fire extinguishers;
4. Co-ordinate and advise on the training of personnel in firefighting departments of institutions in the country;
5. Train and organize fire volunteer squads at community level;
6. Offer rescue and evacuation services to those trapped by fire or in any other emergency situations, and
7. Undertake any other function incidental to the objective of the Service.

The Minister of Interior on the advice of the Council and in consultation with the Minister responsible for Works and Housing may, by legislative instrument, make Regulations (a) requiring premises to have fire-fighting facilities, and (b) on fire protection facilities to be provided by occupiers of premises.

The Minister on the advice of the Council may, by legislative instrument, make Regulations:

- a. on the issue of fire certificates;
- b. on the code of discipline for members of the Service;
- c. on any matter that falls within the scope of the functions of the Service; and
- d. generally for carrying this Act into effect.

The Production Facilities would be required to comply with the registration and regulatory requirements of the Ghana National Fire Service Act of 1997.

c) Labour Act 2009 Act 651;

The Act 651 provides protection of employment for employees, fair and unfair termination of employment, protection of remuneration, special provision for both temporary and casual workers among others.

d) Local Government Act 462 1993;

Under the planning functions of the district assemblies for the development charges, the District Assembly may levy development charge in respect of a planning permit granted for the carrying out of a physical development.

e) *National Building Regulation, 1996 (LI 1630)*

The National Building Regulation (NBR) (L.I. 1630) was enacted in 1996 in Ghana to regulate the erection of buildings, alteration of building structures and execute works or install fittings in connection with any building.

The buildings of the project would comply with the Act.

f) *Town and Country Planning Ordinance, 1945 (Cap 84):*

The Town and Country Planning Department (TCPD) was established in pursuant to the Town and Country Planning Ordinance (Cap 84) and charged with the responsibility of planning and managing the growth and development of cities, towns and villages in the country.

It therefore seeks to promote sustainable human settlements development based on principles of efficiency, orderliness, safety and healthy growth of communities. It also coordinates the diverse/various types of uses and development of land undertaken by various departments and agencies of government as well as private developers.

Other legislative instrument which backs the establishment of the department includes:

- Local Government Act, 1993 (Act 462)
- National Development Planning Commission (NDPC) Act, 1994 (Act 479)
- National Development Planning (System) Act, 1994 (Act 480)
- National Building Regulations, 1996 (LI 1630)

The development of the power plant would be required to comply with the land use zoning requirements of the Ordinance.

g) *The Children's Act (Act 560) of 1998*

An ACT to provide for the rights of the child, maintenance and adoption, regulate child labour and apprenticeship, for ancillary matters concerning children generally and to provide for related matters.

For purposes of this Act, a child is a person below the age of eighteen years. Part V. of the Act relates to the employment of children and child labour. The act stipulates that:

- No person shall engage a child in exploitative labour.

- No person shall engage a child in night work.
- The minimum age for admission of a child to employment shall be fifteen years.
- The minimum age for the engagement of a child in light work shall be thirteen years.
- The minimum age for the engagement of a person in hazardous work is eighteen years.
- An employer in an industrial undertaking shall keep a register of the children and young persons employed by him and of the dates of their births if known or of their apparent ages if their dates of birth are not known.

The Project would be complying with the employment regulatory requirements of the country and would be required to meet the provisions of the children's Act.

2.1.8 Relevance of Legal and Regulatory Framework

The relevance of the legal and regulatory requirements to the Project has been summarized in **Table 2-1**.

Table 2-1 The Relevance of the Legal and Regulatory Framework to the Project

No.	Legal and Regulatory Framework	Summary of Core Requirements	Relevance to the Project
1	The Ghanaian Constitution	Requires the proponents to protect the natural environment and resources of the country	Demand on the Project to demonstrate good stewardship in relation to national environmental resources.
2	Environmental Protection Agency Act, 1994	<ul style="list-style-type: none"> • Requires an environmental impact assessment for undertakings likely to impact on the environmental standards. • Requires mitigation measures in respect of adverse environmental impacts of any undertaking or halt the development 	Relates to the requirements of Project to comply with the regulatory and permitting requirement, abatement notices and prescribed standards and guideline on pollution of air, water, land and any other environmental receptor by EPA.
3	Environmental Impact Assessment Regulations (LI 1652), 1999	<ul style="list-style-type: none"> • Conduct environmental impact assessment and securing environmental permit before commencement of the activity • Procedural framework for environmental impact assessment and permitting • Submission of EMP and renewal of permit within 24 months of commencement of activity and revision every 3 years • Submission of annual environmental report after the first year of activities. • Processing and Permit Fees are charged and Penalties levied for non-compliance with the regulation. 	Relates to the requirements of the project to conform to environmental assessment processes, reporting and issuance of permit before commencement of project development activities. Further, the regulation demands the Project to submit annual environmental reports to the EPA.
4	Water Resources Commission Act (ACT 52), 1996	Water use right should be obtained as authorization for construction for abstraction of water.	Requires that the Project apply for authorization for water abstraction and use right from the commission.
5	Wild Animals Preservation Act,	<ul style="list-style-type: none"> • Adherence to biodiversity and wildlife 	Relates to the requirements of the

No.	Legal and Regulatory Framework	Summary of Core Requirements	Relevance to the Project
	(ACT43) 1961	conservation regulation in Ghana; Conservation of protected species.	project to comply with protection of animal species identified in Annexes I and II of the ACT.
6	Wetland Management Regulation, 1999	Restriction/prohibition of activities in wetlands	Requires the project to comply with prohibition of activities within Wetland
7	Fisheries Act (ACT 625) 2002	<ul style="list-style-type: none"> • Protection of fishing zones; Inform the Fisheries Commission of activities of the project with the potential impact on fisheries resources.	Relates to the requirements of the project to duly notify the Fisheries Commission of any activities, which may have potential impact on fisheries resources and further provide mitigation strategies by the Project.
8	Energy Commission Act (ACT 541)	<ul style="list-style-type: none"> • Conformity with the rules, standards and procedures for development and utilization of energy resources; • Secure licence for generation, transmission and wholesale supply of electricity; 	Relates to the requirements of the project to conform to the rules, standards and procedures; and meeting the Technical Operational and Standards of performance stipulated by the commission. Furthermore obtain licenses for generation, transmission and wholesale supply of electricity.
9	Public Utility Regulatory Commission Act (ACT 538), 1997	<ul style="list-style-type: none"> • Conform to electricity tariff guidelines; • Conform to quality standards for provision of electricity. 	Provision of guideline for rates to be charged for the provision of utility services
10	Ghana Maritime Authority Security Act, (ACT 675) 2004	<ul style="list-style-type: none"> • Conform to international ship and port facility security; • Secure documents of compliance with port facility security for the terminal; • Conform to security level procedures and security level information for ships and port 	Requires the Project to comply with International Ship and Port Security (ISPS) Code to enhance the safety and security of ships and port facilities. The Project is to be issued with document of compliance, which ensures creation

No.	Legal and Regulatory Framework	Summary of Core Requirements	Relevance to the Project
		facilities	and maintenance of positive environment for ships to call at the ports.
11	Factories, Offices and Shops (Amendment) Law, 1983 (PNDCL 66)	<ul style="list-style-type: none"> • Provide required particulars to Factories Inspectorate Directorate • Registration of premises as factory 	Requires the Project to secure registration of the premises not less than one month before commencement of occupation or use the premises as a factory.
12	Ghana National Fire Service Act, 1997 (Act 537); S 33b	<ul style="list-style-type: none"> • Provide fire-fighting facilities at the premises; • Obtain fire certificate for the premises • Undertake periodic fire education and awareness campaign 	<p>Relates to sections 31, 32 and 33 of the Factories, Offices and Shops Act, 1970 (Act 328) regarding fire prevention and safety in a factory, office or shop and provision technical advice for building plans and issuance of fire clearance certificate.</p> <p>Furthermore, relating to building and sustaining awareness and competences in management of hazards of fire, and heighten the role of the individual in the prevention of fire;</p>
13	Labour Act 2009 Act 651	Comply with labour regulations	Relates to compliance with protection of employment for employees, fair and unfair termination of employment, protection of remuneration, special provision for both temporary and casual workers among others.
14	Local Government Act 462 1993	<ul style="list-style-type: none"> • Acquire development permit Payment of development charges 	Relates to the acquisition of development permit and payment of

No.	Legal and Regulatory Framework	Summary of Core Requirements	Relevance to the Project
			development charges under the planning functions of the district assemblies.
15	National Building Regulation, 1996 (LI 1630)	Comply with National Building Regulations	Relates to the requirements regulating the erection of buildings, alteration of building structures and execute works or install fittings in connection with any building.
16	Town and Country Planning Ordinance, 1945 (Cap 84)	Conformity to land use zoning and development planning	Relates to the requirements to conform to the development planning and land use zoning of the village.
17	The Children’s Act (Act 560) of 1998	Compliance with child labour regulation; prohibiting exploitative child labour.	Relates to employment of children and child labour; prohibiting exploitative child labour and child labour at night, and stipulates the minimum age for child labour, light work and hazardous employment and also registration of children and young persons in industrial undertaking.

2.2 Relevant International Agreements and Conventions

Ghana is signatory to a number of international conventions and agreements and also regional treaties seeking to conserve key ecosystems and natural resources and in relation to energy development, and environmental management (See **Table 2-2**).

In certain case conventions and agreements have influenced policy, guidelines and regulations and must be considered in the impact assessment and complied with during the planning, construction and operation of this project. Also these agreements are cited in the World Bank’s key international agreements on the environment.

Table 2-2 Relevant International Agreements and Conventions

Name	Year Ratified
The International Labour Organisation (ILO) Fundamental Conventions related to forced labour, freedom of association, discrimination and child labour.	2011
International Covenant on Economic, Social and Cultural Rights	2000
Gulf of Guinea Large Marine Ecosystem Project	1999
Memorandum of Understanding Concerning Conservation Measures for Marine Turtles of Atlantic Coast of Africa	1999
United Nations (UN) Convention on Biological Diversity	1994
Framework Convention on Climate Change	1992
Convention of Fisheries Cooperation among African States Bordering the Atlantic Ocean	1991
African Charter on Human and Peoples' Rights	1989
Montreal Protocol on Substances that Deplete the Ozone Layer	1989
Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of West and Central African Region (Abidjan Convention)	1981, ratified in 1989
Convention on Wetland of International Importance (Ramsar)	1988
Convention on the Conservation of Migratory Species of Wild Animals	1988
Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air	1987

Name	Year Ratified
Pollution, Noise and Vibration (ILO No. 148)	
United Nations Convention Law of the Sea	1982
Convention on the Conservation of Migratory Species of Wild Animals	1979
Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) , Paris	1975
Convention on International Trade on Endangered Species of Wild Fauna and Flora	1973
Convention on Wetlands of International Importance, Especially as Waterfowl Habitats	1971
African Convention on Conservation of Nature and Natural Resources.	1968
International Convention for the Conservation of Atlantic Tunas	1966

2.3 International Standards, Guidelines and Best Practice

2.3.1 International Standards and Best Practices

The relevant International Finance Corporation Performance Standards on Environmental and Social Sustainability document; the Environmental, Health, and Safety (EHS) Guidelines for Ports, Harbours, and Terminals, which are applicable to commercial ports, harbours, and terminals for cargo and passengers transfer would be considered as the technical reference documents for the project. These standards would also be considered as international requirements for Good International Industry Practice (GIIP) ¹. The IFC requires the Project Company to carry out an environmental and social impact assessment of the Project-related impacts according to the Performance Standards (PS) on Environmental and Social Sustainability. The IFC's PSs are listed as follows:

- PS1: Assessment and Management of Environmental and Social Risks and Impacts;
- PS2: Labour and Working Conditions;
- PS3: Resource Efficiency and Pollution Prevention;
- PS4: Community, Health Safety and Security;
- PS5: Land Acquisition and Involuntary Resettlement;

¹IFC, Environmental, Health, and Safety Guidelines, Thermal Power Plants.

- PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- PS7: Indigenous Peoples; and
- PS8: Cultural Heritage.

The following guidelines of the IFC, which are deemed relevant to the Project and considered during the design of the Project and the Environmental and Social Assessment study are:

- The IFC General EHS Guidelines, dated April 30th, 2007;
- The IFC EHS Guidelines for Ports, Harbour and Terminal, dated April 30, 2007;
- The IFC EHS Guidelines for Shipping, dated April 30, 2007;
- The IFC Workers" accommodation: processes and standards, dated August 2009.

To aid decision making on provision of financing, qualification for financing, financial advisory and loans the ESIA must conform to a number of international standards. These include the IFC Performance Standards as follows:

- a) Assessment and Management of Environmental and Social Risks and Impacts
- b) Labour and Working Conditions
- c) Resource Efficiency and Pollution Prevention
- d) Community Health, Safety, and Security
- e) Land Acquisition and Involuntary Resettlement
- f) Biodiversity Conservation and Sustainable Management of Living Natural Resources
- g) Indigenous Peoples
- h) Cultural Heritage

Furthermore, the proposed project has been developed in compliance with the Equator Principles of Equator Principles Financial Institutions; consisting of the following:

- a) Review and Categorisation
- b) Environmental and Social Assessment
- c) Applicable Environmental and Social Standards
- d) Environmental and Social Management System and Equator Principles Action Plan
- e) Stakeholder Engagement
- f) Grievance Mechanism
- g) Independent Review

- h) Covenants
- i) Independent Monitoring and Reporting
- j) Reporting and Transparency

Compatibility with the IFC performance Standards necessitates compliance with the World Bank Group's Environmental, Health and Safety Guidelines (EHS Guidelines) under the following broad headings:

- a) Environmental and Social Assessment
- b) Occupational Health and Safety
- c) Community Health and Safety
- d) Construction and Decommissioning

2.3.2 International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes (International Maritime Organization, 2014).

The MARPOL Convention was adopted on 2 November 1973 at International Maritime Organization (IMO). The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention, and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years (International Maritime Organization, 2014).

The Convention includes regulations aimed at preventing and minimizing pollution from ships – both accidental pollution and that from routine operations – and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.

Annex I: Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983): covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.

Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983) : details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention; the discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.

Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992): contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications. For the purpose of this Annex, “harmful substances” are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Annex of Annex III.

Annex IV: Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003) : contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminute or disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminute or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land. In July 2011, the IMO adopted further amendments to MARPOL Annex IV which introduce further limitations to ships operating in the Baltic Sea.

Annex V: Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988): deals with different types of solid waste and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics. In the last revision of Annex V in March 2012, the discharge of all garbage into the sea, except as provided otherwise in regulations 4, 5, and 6 of the Annex, which are related to food waste, cargo residues, cleaning agents and additives and animal carcasses, are prohibited.

Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005) : sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOX, NOX and particulate matter. In 2011, after extensive work and debate, the IMO adopted

ground breaking mandatory technical and operational energy efficiency measures which it is hoped will significantly reduce the amount of greenhouse gas emissions from ships; these measures were included in Annex VI.

2.3.3 Green Credit Guidelines of the China Banking Regulation Commission

The proposed project must be developed in compliance with the China Banking Regulation Commission Green Credit Guidelines to ensure complying with the Chinese Financing requirements.

The China Banking Regulation Commission issued the Green Credit Guidelines, which regulate the Banking and financial sector in China.

The Guidelines, which is in line with the implementation of policies provided for Energy Conservations and Emission reduction is based on the Banking Industry Regulation and Administration Law of the People's Republic of China and Commercial Banking Law of the People's Republic of China. The purpose of the guidelines serves to promote green credit growth among banking financial institutions.

The guideline enjoins Banks to promote green credit as a strategy, support economy to grow in a green, low-carbon and recycled model through business innovation, manage environmental and social (E&S) risks, improve banks' own E&S performances, and in doing so optimize credit structure, improve services and contribute to the transformation of economic growth pattern.

Furthermore, the guideline demands Banks to effectively identify, assess, monitor, control or mitigate E&S risks in business operations, develop E&S risk management systems, strengthen credit policies and processes that are related.

The Bank is required to put in place Lending Process Management including determined scope of E&S risk due diligence based on sectors and geographic features of the client; stringent compliance review on clients; credit approval management based on nature and severity of E&S risk faced by clients.

2.4 Project Environmental Standards

The environmental standards considered for the project include the EPA Guidelines (National Environmental Quality Guideline), IFC Environmental Health and Safety Guidelines, MARPOL Standards, EIA Guideline for Coal Power, China Banking Regulation; Green Credit Guideline.

The selection of standards for environmental parameters has given preference to more stringent standards and considered as the “Limit Value”.

2.4.1 Ambient Air Quality

The standards for ambient air quality considered for the project have been selected from EPA guidelines and IFC EHS guideline (See **Table 2-3**).

Table 2-3 Environmental Standard for Ambient Air Quality

Parameter	Period (Averaging Time)	NEQG for Ambient Air Quality ($\mu\text{g}/\text{m}^3$)		IFC EHS Guideline Ambient Air Quality ($\mu\text{g}/\text{m}^3$)
		Industrial	Residential	Guideline Value
SO ₂	1 hr	900	700	
	24 hr	150	100	150
	1 year	80	50	80
NO ₂	1 hr	400	200	
	24 hr	150	60	150
	1 year	-	-	100
TSP	1 hr	-	-	
	24 hr	230	150	230
	1 year	75	60	80
PM ₁₀	1 hr			
	24 hr	70	70	150
	1 year			50
Smoke	1 hr			
	24 hr	150	100	
	1 year	50	30	
CO	15 min	100 mg/m ³		
	30 min		60 mg/m ³	
	1 hr	30 mg/m ³		
			10mg/m ³	
Ozone		10 ppb		
Hydrogen Sulphide	24 hr	150		
Mercury	1 year	1		
Lead	1 year	2.5		
Fluorine	24 hr	100 mg/m ³		

Source: EPA National Environmental Quality Guideline and IFC EHS Guideline

2.4.2 Waste Discharges

The waste discharge guidelines are given by EPA guidelines for maximum limits for any trade, industry process, industrial plant or fuel-burning equipment (See **Table 2-4**).

Table 2-4 EPA Guideline for Waste Discharge

Parameter	NEQG for Emission Standards (mg/m ³)
Solid Particles	200
SO ₃	120
Fluorine Compounds	100 (as HF)
Hydrogen Chloride	200 (as HCl) 100 (as Chloride)
Hydrogen Sulphide	5 (as Hydrogen Sulphide)
NO _x	1000 (as NO ₂)
CO	1000

Source: Agreed EPA Ghana Standards and Environmental Health and Safety Guidelines

2.4.3 Noise

Table 2-5 Environmental Standard for Ambient Noise

Description of Area of Noise Reception	Permissible Noise Level in dB(A)		IFC EHS Guideline Ambient Air Quality (µg/m ³)	Selected Standard Value
	Day	Night	Guideline Value	
Residential Areas	55	48		55
Light Industrial Area	70	60		-
Heavy Industrial Areas	70	70		70

Source: EPA National Environmental Quality Guideline and IFC EHS Guideline

2.4.4 Water Quality

Table 2-6 Environmental Standard for Water Quality

Parameter	EPA Effluent Quality Guideline for Discharges into Natural Water Bodies
pH	6 – 9
BOD (mg/l)	50
Oil & Grease (mg/l)	5
Total Dissolved Solids (mg/l)	
Total Suspended Solids (mg/l)	50
Cadmium (mg/l)	
Total Phosphorus (mg/l)	2.0
Temperature	<3°C above ambient
Colour (TCU)	200
COD mg/l	250
Chromium (+6) (mg/l)	-
Sulphide (mg/l)	1.5
Turbidity (N.T.U)	75

Lead (mg/l)	0.1
Nitrate (mg/l)	50
Conductivity (µS/cm)	
Mercury	
Zinc	
Iron	

Source: EPA National Environmental Quality Guideline

2.5 Corporate Environmental Policy Statements

2.5.1 VRA Environmental Policy Statement

The Volta River Authority is committed to ensuring continuous improvement of environmental performance that minimizes potential impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations.

In respect of the above, VRA will:

1. Make environmental considerations a priority in all business planning and decision-making and comply with relevant national and international environmental protection regulations.
2. Take reasonable steps to mitigate the impact of its actions with regard to the development, operation and management of its assets.

VRA will thus pursue the following specific objectives:

1. Develop and implement Environmental Management System for all its business units to:
 - I. Assess environmental impact of processes, operations and products;
 - II. Focus on pollution prevention and waste reduction;
 - III. Ensure compliance with national/ international environmental protection regulations;
 - IV. Set annual environmental targets to ensure continuous improvements;
 - V. Monitor and report on environmental performance as required the appropriate stakeholders.
2. Ensure minimum environmental impact of VRA’s projects and take adequate steps to mitigate any such anticipated adverse impact as far as is practicable
3. Promote environmental awareness and individual sense of responsibilities among its employees through print material for

- distribution, safety meetings and corporate website which will continue to be updated, and provided adequate empowerment and training for personnel to perform environmental jobs satisfactorily;
4. Support research efforts on materials, products, processes and pollution reduction techniques that are directly related to its operations;
 5. Contribute to the development of public policy and programmes that enhance environmental awareness and protection;
 6. Promote open communication on environmental issues
 7. Undertake projects and programmes in collaboration with relevant agencies to preserve the Volta Lake resource, and reasonably restore/mitigate ecological imbalance caused by the creation of the lake;
 8. Undertake projects and programmes to mitigate the impact on the livelihood of individuals and communities displaced or affected by VRA's development projects.

VRA shall design evaluation procedures for all processes for that fall under this policy to ensure that these processes comply. Deficiencies in the policy or in the evaluation procedure shall be addressed as required.

Each employee of VRA is charged to exercise his or her responsibility on behalf of VRA to ensure that the intentions of this Policy Statement are diligently carried out.

2.5.2 SEC Environmental Policy Statement

Shenzhen Energy Group Co., Ltd is committed to conducting its operations in the manner that safeguards the integrity and sustainability of the environment in conformity with the national and international environmental quality standards for sustainable development.

The policy further enjoins the company taking the necessary measures to ensure and maintain compliance with all relevant legislation on environmental protection and health and safety of all employees.

SEC commits to ensuring harmony between increased power generation and natural ecosystem conservation. At Shenzhen Energy Group Co., Ltd. all our operational activities in promoting sustainable growth in power generation are foremost guided by sustainable environmental practices and ensuring full protection of the fragile ecology.

It is our vision to use best technology in power generation while lowering Green House Gas emission intensity. Our key guiding principle is hinged on efficient and sustainable use of natural resources and conservation.

Management of Shenzhen Energy Group Co., Ltd. is vitally interested and committed to improving the environment and quality of life of mankind for the present and the future.

3 PROJECT DESCRIPTION

The project involves the development of a 70,000 DWT Coal Handling Terminal (CHT) and a 10,000 Material Offloading Terminal (MOF) next to the coal berth affiliated to a proposed 2X350MW supercritical coal-fired power plant. The power plant is planned in two phases comprising 2X350MW generating units in Phase I and two units of 2X350MW or 2X600MW generating units in Phase II (See **Figure 3-1**).

The quantity of coal demanded to operate the power plant in Phase I is 2,050,000 tons annually. This quantity would require a 70,000 DWT Coal Handling Terminal for efficient delivery. However, the phase II of the development would increase the demand for coal to 6,150,000 tons annually, which would require a 100,000 DWT Coal Handling Terminal. Consequently, the structure of the 70,000 DWT terminal is designed to accommodate 100,000 DWT bulk carrier handling 6,150,000 tons of coal annually in future.



Figure 3-1 An Artist Illustration of the Affiliated Coal Handling Terminal of the Power Plant

The coal handling operation is planned to involve the use of two sets bridge type grab vessel unloader installed at the Terminal for unloading coal from vessels calling at the Terminal onto belt conveyor for horizontal transportation. The belt conveyor is fitted with dust shield, conveyor belt scrapper, coal sampling system and electromagnetic separator at suitable positions of the belt conveyor. The outstretch of the grab type unloader is 38m and the rated capacity is 1500 tons per hour.

A detailed feasibility studies have been conducted responding to specific external conditions and environmental demands for building the affiliated coal handling terminal and ensuring effective and efficient technological development with optimum environmental performance.

3.1 Sea Usage Plan

The terminal, which is arranged parallel to the shore with berth length of 435m, is protected by breakwaters and connected to the land area through the trestle.

The total area of the sea utilized is estimated to be 204.8 hectares. The detailed usage area is listed in **Table 3-1**.

Table 3-1 The Detailed Usage Area of the Sea

No.	Marine Structure	Sea Area (hectares)	Usage	Property
1	Breakwater and Revetment	24.8	Non-permeable structure	Structure Area
2	Terminal	1.6	Permeable structure	
3	Berthing area and Turning Basin	37.8	Basin usage	Sheltered Area
4	Channel and Anchorage area	140.6	Dedicated Channel	Open Area
	Total	204.8		

3.2 Project Components

Table 3-2 Main Construction Components of the Affiliated Terminal Project

No.	Item	Unit	Quantity	Remark
1	Terminals	m	435	The width is 24m
	CHT Berth	m	264	The marine structure is designed for 100,000DWT bulk carriers, the channel and basin is designed for 70,000DWT bulk carriers.
	MOF Berth	m	171	The southern part (38m) of marine structure is designed for 100,000DWT bulk carriers.
2	Trestle	m	60	
3	Breakwater	m	1384	The crest elevation is +5.8~6.9m
4	Revetment	m	1013	
5	Approach Channel	m	2869	
6	Belt Conveyor Trestle	m	568	
7	Apron Office		1	
8	Substation		1	
9	Tool & Material Room		1	
10	Sampling Room		1	

The main construction components of the affiliated terminal are listed in **Table 3-2**.

3.2.1 Coal Handling Terminal (CHT) Structure

The 70,000 DWT CHT, which is also structured to accommodate 100,000 DWT coal unloading terminal, has an overall length of 264m, with a width of 24m, a cope level of 5.0m and a basin bottom elevation is -15.9m initially (for Phase I) and -16.3m eventually (for Phase II).



Figure 3-2 Artist illustration of the Layout of the Affiliated Coal Handling Terminal

The pile foundation is cast-in-situ piles, and the space between bents is 9.0m. There are two cast-in-situ piles with the outer diameter of 1600mm and two cast-in-situ piles with the outer diameter of 1300mm for each bent, the cast-in-situ piles with the outer diameter of 1600mm are below the rail beam. The superstructure is the intercross beam and slab system, transverse beams are cast-in-situ on the piles; rail beam, longitudinal beam and slab are composite structure. SC1600H, standard reaction rubber fender (one drum one board) and 1000kN bollards are set on the terminal. For vessel unloader operation, QU100 rail is adopted.

3.2.2 MOF Structure

The overall length of MOF is 171m, the width is 24m, the cope level is 5.0m and the basin bottom elevation is -9.8m. The structure of terminal with length 38m connecting the CHT is designed to accommodate 100,000 DWT bulk carrier as well, and the left which is 133m long is designed to accommodate 10,000 DWT cargo vessel.

The structure of MOF terminal with length 38m connecting the CHT is the same as CHT, and the space between bents is 7.0m. SC800H, standard reaction rubber fender (two drums one board) and 1000kN bollards are set on the terminal, and the SC1600H, standard reaction rubber fenders, one drum one board, are reserved for phase II operation. For vessel unloader operation, QU100 rail is adopted.

The left side has pile-wharf structure with length 133m. The pile foundation is cast-in-situ piles. There are four cast-in-situ piles with the outer diameter of 1300mm for each bent, and the space between bents is 7.0m. The superstructure is intercross beam and slab system, and the transverse beams are cast-in-situ on the piles. SC800H, standard reaction rubber fender (two drums one board) and 750kN bollards are set on the terminal.

3.2.3 Approach Trestle Structure

The terminals are connected to the land area by the trestle. The overall length of the approach trestle is 60m, and the width is 12m. The cope level is from 5.0m to 6.0m.

The approach trestle also has a pile-wharf structure with a foundation of cast-in-situ piles. There are three cast-in-situ piles with the outer diameter of 1100mm for each bent, and the space between bents is 6.0m. The superstructure is intercross beam and slab system and the transverse beams are cast-in-situ on the piles.

3.2.4 Breakwater Structure

The overall length of breakwater is 1384m including breakwater revetment for prevention of wave with length of 294m. The top elevation is 6.0m. The design is a rubble mound breakwater structure type with quarry rock core.



Figure 3-3 Shape of Chinese-pode

The outside and inside slope of the breakwater are both 8-ton Chinese-pode (**Figure 3-3**) forming the armour block of outside and inside. The under-layer rock is 600~800kg rocks.

3.2.5 Revetment Structure

For general layout the overall length of revetment is 1013m, including power plant revetment with length of 172m, eastern revetment with length 232m and southern revetment with length 609m. The top elevation of the revetment is 6.0m. The top elevation of wave wall is 8.0m.

The revetment is a rubble mound structure type with quarry rock core. The slope of the revetment is 1:1.5. 4t Chinese-pode is used as the armour block outside. The underlayer rock is 200~400kg quarry rocks.

3.2.6 Basin

The CHT berth is considered to have a bottom depth 15.9m with berth box of 65m in phase 1 for 70,000DWT coal carriers, which would be deepened to 16.3m in phase 2 for 100,000DWT coal carriers. The diameter of the turning circle of CHT berth is taken as 456m with bottom depth of 15.9m in phase 1 for 70,000DWT coal carriers, which would be expanded to 500m and 16.3m depth in phase 2 for 100,000DWT coal carriers.

The bottom of MOF berth is taken as 9.8m depth with berth box of 44m in Phase I for 10,000DWT heavy duty cargo carriers.

3.2.7 Approach Channel

The approach channel is aligned by 330°~150° with overall length of approximately 2,869m with a width of 166m and bottom depth of 17.0m in

Phase I for 70,000DWT bulk carriers; the channel would be expanded to 210m and 17.4m depth in Phase II for 100,000DWT bulk carriers.

3.2.8 Handling Facility

The amount of coal required for firing the power plant in Phase 1 is 2,050,000 tons per year and would require a 70,000 DWT coal handling terminal. However, the structure of the terminal is designed to accommodate 100,000 DWT bulk carrier handling 6,150,000 tons per year of coal. A 10,000 material offloading terminal is laid next to the coal berth.

The coal handling operation is arranged to involve the use of two sets of bridge type grab vessel unloader, which would unload coal from the vessels onto belt conveyor and transported horizontally (See **Figure 3-4**). The belt conveyor is fitted with dust shield, conveyor belt scrapper, coal sampling system and electromagnetic separator at suitable positions of the belt conveyor. The grab type unloader has an outstretch of 38 meters and the rated capacity is 1500 tons per hour.



Figure 3-4 An Artist illustration of the Bridge Type Grab Unloader and Belt Conveyor Arrangement

A single route belt conveyor is adopted for the operation. The belt has width $B=1.8\text{m}$, velocity $V=3.15\text{m/s}$, rated capacity $Q=3000\text{t/h}$ and the max capacity is 3600t/h . In addition, the operation would also involve 4 sets of about 180HP trimming bulldozer for cleaning the cabin.

The provided handling facilities could meet the transportation demands of both Phase 1 and 2, satisfying the handling requirements of 100,000 DWT general cargo berth and the 6,150,000 tons' annual quota of coal of the power plant in phase 2.

3.2.9 Affiliated Facilities

Water Supply and Drainage

Water supply services to the vessel, cleaning purposes, firefighting and environmental protection of the terminal have been arranged as part of the power plant facilities. These facilities are integrally connected and the detailed parameters of pipe connection points are determined as follow:

- a) Water supply pipe for supply services to the vessel (potable water system) would have diameter DN 150, with required water pressure $\geq 0.35\text{Mpa}$;
- b) Water supply pipe for production and environmental protection (reclaimed water system) would have diameter DN 150, with required water pressure $\geq 0.30\text{Mpa}$;
- c) Fire protection water supply pipe is connected from the designed pipe connection point with diameter DN150 and water pressure $\geq 0.40\text{Mpa}$. Water consumption of the hydrant system is considered for 20 Litre/s, and fire duration of 3 hours; the pipe of sprinkler system is DN200, water pressure $\geq 0.50\text{Mpa}$. The water consumption of the sprinkler system is considered for 67 Litre/s, and fire duration is 1 hour.

Power Supply

In this project, there will be one substation set under the belt conveyor trestle of the jetty platform. Two units of 6kV feeders will be provided for this substation.

The main electrical loads of the terminal include the vessel-unloader, belt conveyor, material & tools storage, office, sample building, iron-remover, shore distribution board, submersible sewage pump, maintenance distribution board, jetty PLC control system, road lighting and so on. Among them, vessel-unloader, belt conveyor, iron-remover, jetty PLC control system are second order load; shore distribution board, maintenance distribution board, production and living auxiliary building, road lightings are third order load.

Firefighting System

The wharf and auxiliary buildings have a safe distance, which is required for fire protection in accordance with “Code of design for building fire protection and prevention”.

The different levels of voltage for power distribution system have been selected according to the rated voltage of electrical facility of this project. Also power cables have been selected according to the capacity of electrical facility and distance. The relay protections have been set up for major, large-scale electrical facilities. Power cables would be laid in channel, cable-bridge or buried with protective pipe according to the specific situation to avoid damages. The lightning protection and grounding system would be set up in the wharf and production area.

According to the “Technical Code for fire protection and water supply and hydrant systems”, a fire at a time is considered for this project. Water consumption of the hydrant system is based on 20 liters per second flow rate and fire duration is 3 hours. Water consumption of the sprinkler system is considered for 67 liters per second, and fire duration is 1h. The fire-fighting water consumption for each time is 458 m³.

The hydrant would be set up on the trestle and wharf with obvious identification. SN65 type vessel water supply hydrant is set at the front of the wharf, which can be used for fire-fighting in fire. Portable fire extinguishers would be arranged in the transfer station and enclosed corridors.

Communication System

The communication facilities of the project include conventional telephone communication system, wired dispatch communication system, wireless dispatch communication system, ship to shore communication system and CCTV system.

According to the overall design, the communication systems of the wharf operation area would be interlinked with the communication systems of the power plant. However, the ship to shore communication system would be set up independently.

Navigation Aid

Light buoy shall be arranged according to the buoy standard of IALA (International Association of Lighthouse Authorities) in the A zone. In this project, according to the new waters area arrangement, eight new buoys shall be set.

Others

The building structures of the project include the main front office, substation, front tool and material room, sampling rooms, trestle, closed corridors and 10-meter foundation for road lighter.

The building covers floor area of 640m². The design life for these buildings is 50 years, the buildings are graded as Grade III, with fire resistant rating of Grade II.

3.3 Pre-Constructional Phase

The pre-construction activities of the project involved pre-feasibility study, and feasibility investigations for the development and operation of 2X350MW Supercritical Coal-fired Power plant and the affiliated Coal Handling Terminal. A number of engineering investigations and analytical studies have been carried out to contribute to the project design and developing the basis for the feasibility evaluation of the project. These studies included Hydrological studies, Soil study, Marine Investigations, Geological Survey, Flood Risk Assessment, Dredging Assessment and Environmental and Social Impact Assessment and related independent reports.

The process also involved consultations with various stakeholders, both the affected and interested groups, on the development of the proposed 2X350MW Supercritical Coal-fired Power Plant and the affiliated Coal Handling Terminal and Material Off-loading Facility.

The consultation process involved presentation of the project features to various stakeholder interest groups to discuss issues of regulatory requirements and concern to the stakeholders. The details of the consultations are provided under Chapter 6 of this report.

Additional processes involved registration of the project in accordance with meeting the legal and regulatory compliance requirements for project development and securing permits for the project development activities. The relevant agencies include:

- a) EPA, which would provide Environmental Permit following the submission of the Environmental and Social Impact Statement for the Project; presently the draft Environmental and Social Impact Statement is prepared.
- b) Ghana Ports and Harbour Authority, which would grant approval for the construction and operation of the port. Currently, consultation is on-going.

- c) Ekumfi District Assembly, which shall provide Building Permit.

3.4 Constructional Phase

The port construction works can be categorized into two parts, identified as Onshore Construction and Offshore Construction.

Onshore construction would include site preparation works encompassing removal of existing vegetation, blasting and excavation of rocks, excavation and grading of soils for the installation of structural foundations and site utilities. The activities would further include the development and construction of civil structures and new infrastructure including water and power supply facilities as well as access and drainage network, which would also be largely a part of the power plant infrastructure.

Offshore Construction forms the main construction works of the CHT. The works principally include developing vessel approach channel and berthing facilities and also the cargo handling facilities comprising crane tracks and bridges for loading / unloading cargo. The specific offshore construction activities would include preparing the waterside including dredging (and disposal of dredged material); excavation and blasting of rocks under water; and filling and other work related to the construction of quays, piers, harbour basins, access channels, anchorage and breakwater structures.

The construction of cast-in-situ piles would involve drilling rig directly fixed on the construction platform and drill stem with guiding device is used and when the bit had reached bedrock surface, the reverse circulation drilling rock method would be used.

The pre-cast part would be formed at the temporary pre-cast yard and subsequently installed on site. The concrete for casting the piles would be supplied by mixing plant on land. Also the rubber fenders, ladders and other equipment would be supplied and installed by crane.

The breakwater and revetment would be rubble mound structure type and the armour block would be chinesepode. The construction works would involve excavation and removal of soft soil layer, pushing and filling quarry rocks to form the core, and using long arm backhoe excavator to tidy the slope. The outside cushion and armour rock would transported by trucks and filled directly, and again long arm backhoe excavator would be used to tidy the slope. Bottom protection rocks are thrown and cleaned by the machine on a barge. The concrete wave wall would be cast on site after the core rock has been filled to the design elevation. The gravel cushion would be set according to the design

requirements. An estimated 90% of the breakwater core stones would be obtained from excavation of stones on site, however, another 10% core stones is considered to be procured from a local quarry. However, there is still some uncertainty about the strength of the stone and amount available.

3.4.1 Dredging and Disposal

The dredging operation for the basin would consist of berthing basin, turning basin and approach channel. Grab dredger having bucket volume of over 8 cubic meters and 5000 cubic meters trailing suction hopper would be used for dredging of the project basin. The total dredged volume of the dredging areas is estimated at 4.47 million cubic metres, composed of 40 thousand cubic metres of reef explosion, 2.44 million cubic metres of sand clamp silt and 1.96 million cubic metres of mucky soil.

The turning basin and channel of the Phase I coal-handling terminal would be dredged for the navigation of 70,000 DWT coal vessel; the connecting water area for the material offloading terminal would also be dredged to accommodate the navigation of 20,000 DWT general cargo vessel.

The key coordinates of dredging area are shown in **Table 3-3**.

Table 3-3 Coordinates of the Dredging Area

NO.	INDEPENDENT COORDINATES		GHANA NATIONAL GRID	
	Y(m)	X(m)	Y(m)	X(m)
A	40185.5737	76196.2272	292864.2816	59852.18362
B	40406.2885	75433.9866	293082.5817	59089.40787
C	40833.4357	75171.3788	293508.8273	58825.52365
D	40946.6067	75237.1015	293622.1803	58890.8813
E	42381.1768	72752.3533	295048.7372	56402.16449
F	42524.937	72835.3533	295192.727	56484.70087
G	40830.1887	75770.7434	293507.4452	59424.77934
H	40445.974	75882.6949	293123.655	59537.90364
I	40330.7515	75862.378	293008.3922	59517.94916
J	40406.2885	75433.9866	293082.5817	59089.40787

The dredged materials would be disposed at an identified and recommended disposal about 18 km from the project site offshore with a 25-metre water depth and following approval from EPA. The blast reef debris would be cleaned and thrown away to the mud-dumping area after blasting.

The location and coordinates of the proposed Disposal Area is shown in **Appendix 2: Location of the Anchorage Area and Dredged Material Disposal Area**.

3.4.2 External Auxiliary Facilities Conditions

Water supply, Power supply, Communication

Power supply to the site for construction works would be provided by the local electricity grid. There is municipal water supply system, which would provide water to meet the water requirements of the project.

Sources of sand and stones

The project would involve considerable cutting and filling of rocks and sand. After the power plant area excavation and filling works have reached appropriate balance, the remaining part of the stones could be utilized in filling the breakwater core. On the other hand, the sand, gravel, cement and steel could be procured within the region and transported to the site. There are considerable materials within the region to meet the project construction requirements.

Traffic condition

The site can be accessed by the Accra – Cape Coast highway, branching off at the Ekumfi Essuehyia intersection southwards towards the sea through Otuum to the project site at Ekumfi Aboano. The road off Otuum is untarred feeder road.

Traffic condition of the project would largely be influence by the supply of construction materials.

Construction force

There are a number of construction teams from China with immense technical expertise and abundant construction facilities, who could work on the port engineering construction. They would form the core construction team and local construction team would also be established to compliment the operations. So the construction works could be undertaken by combined Chinese and local construction workers.

3.4.3 Demobilization Strategy

On completion of construction works for the project, complete shutdown of the construction operation is anticipated. Preparation and shut down operation would include the following activities:

1. All equipment would be decontaminated and cleaned either at the primary support/utilization area or other designated area and demobilized/disassembled as needed when the project work ceases.
2. All equipment would be transported appropriately using appropriate facilities and guard.
3. Debris generated will be disposed of and the entire area cleaned to meet the relevant environmental standards and to the satisfaction of the District Assembly.
4. The storage areas both on-site and off-site would be appropriately secured and provided security to ensure limited access to unauthorised persons and the general public.
5. Remediation activities involving areas that were disturbed during construction activities will be restored to the degree practicable given the stage of the project. Any temporary fencing, temporary barriers and sediment control measures in the work areas will be taken down as required.
6. A reduced office staff may continue working on site performing necessary post-construction and administrative activities for the commissioning phase of work and any remediation activities necessary to ensure minimal impact to any residents or stakeholders.

3.5 Operational & Maintenance Phase

Similarly, the port operations can be categorized into Onshore (land-based) operations and Offshore (water-based) operations. The Environmental Flow Chart is shown in **Figure 3-5**.

3.5.1 Onshore Operation

The land based operations would include cargo handling; fuel and chemical storage and handling and ship support services; waste and wastewater management; vehicle and equipment maintenance; and buildings and grounds maintenance.

Cargo Handling

Cargo handling includes unloading coal and unloading materials including machines and equipment.

Waste and Wastewater

The Port operations would generate and manage its waste. Solid waste may be generated from maintenance and administrative operations while wastewater may originate from storm drainage and domestic wastewater and sewage. Furthermore, there would be significant stream of wastes and wastewater from the ships calling at the port. The management of the would be responsible for providing receiving facilities for wastes.

The following sections summarize the types of ship-generated wastes that must be managed in these shore-based facilities.

Solid and Liquid Waste

Waste materials generated on vessels and at the port include plastic, paper, glass, metal, and food wastes. Hazardous wastes generated on vessels as a result of maintenance activities would include waste lubricating oils, waste from the sludge tank, disused batteries, paints, solvents, and pesticides. The Port Management would manage the collection and temporal storage of hazardous and non-hazardous wastes. However, transportation, treatment, and disposal of the waste would be assigned to third parties licensed to handle such waste material. The reception facilities provided for waste collection would include containers, general-use skips, and bins.

Effluents

Effluents generated by ships include sewage, tank cleaning water, bilge water, and ballast water. The effluents would be collected and transported using trucks or pipes within the port area. Port services would cover collection and treatment the wastewater before discharging to surface water, or transported to municipal sewage treatment plants.

3.5.2 Offshore Operations

Ship Berthing

Ships may enter and leave the port assisted by tugboats. While berthed in the harbour, the ships may be supplied power for operational activities including cargo handling, climate control, communications, and other daily operations. It is envisaged that the ships are mostly powered by diesel engines, consequently

emissions from stacks of the ships would comprise of particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides. These ships would also be additional source of noise generation.

Anchorage Site

The Terminal would provide shelter and safe anchorage for ships calling at the Terminal and awaiting unloading of coal. The anchorage is sited offshore. Again, the operations of ships at anchorage would primarily involve running the auxiliary engines, which are mostly diesel powered and consequently cause stack emissions.

Maintenance Dredging

Maintenance dredging involves the routine removal of material / sediment in the harbour basins, turning basin and access channels. This activity is important to maintain or improve depths and widths and ensure safe access for the ships as well as efficient navigation depth in the neighborhoods. Maintenance dredging would take place once in one or two years, depending on the output of the monitoring programme.

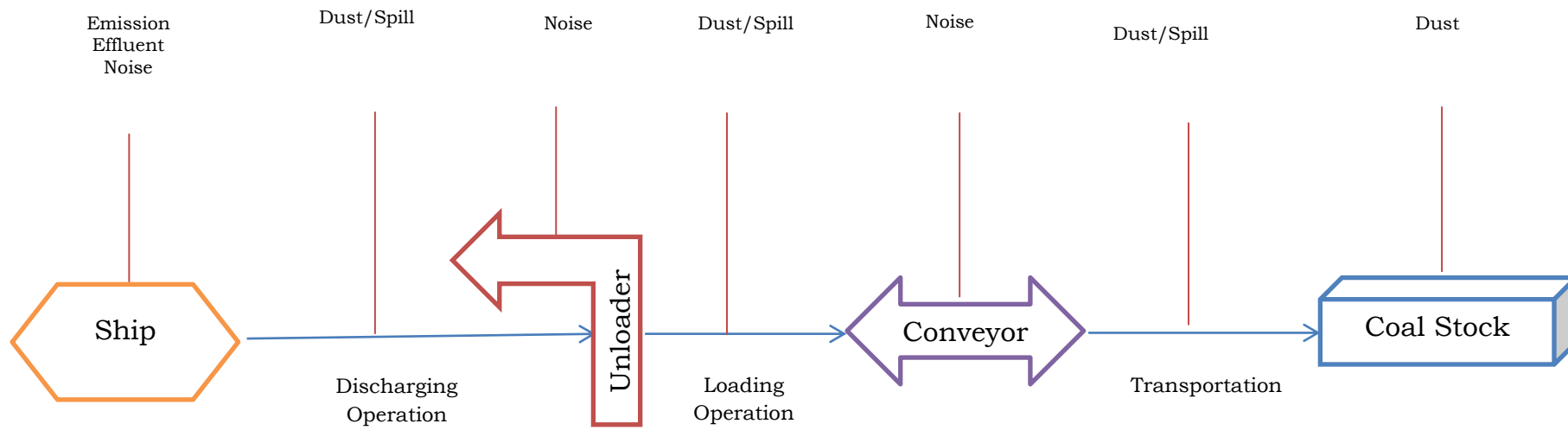


Figure 3-5 Environmental Flow Chart of the Affiliated Coal Handling Terminal

3.6 Work Schedule

The phase I of the power plant is planned to be commenced in December 2017 with all related preparation works accomplished. The two units will be completed and put into commercial operation in December 2020 and July 2021 respectively.

As for the affiliated coal handling terminal, the construction is planned to be commenced in April 2018, following the completion of basic preparation work of the power plant. The detailed construction schedule is shown in **Table 3-4**.

3.7 Decommissioning

The physical structures of the coal handling terminal, especially the harbour basin, turning basin, access channel and quays have more permanent construction characteristics.

Alternative uses of the harbour would first be explored based on consultations with GPHA. Where alternative use of the harbour is not found, precautionary measures would be put in place by installing warnings to demarcate the basins and channel appropriately to caution fishing boats and other users. The civil infrastructure including the quay, pier and also breakwater may remain where desirable.

On the other hand, the cargo handling facilities, crane track and ancillary facilities would be dismantled and scrapped, where necessary and depending on the local market for scrap metals, the materials would be sold locally or reshipped to China to recover cost. Detailed decommissioning operation for the power plant is provided under **Chapter 11 DECOMMISSIONING**.

3.8 Estimated Costs

The investment of the affiliated coal handling terminal is estimated to be US\$ 375,950,000.00 in which the engineering cost is US\$ 314,500,000.00.

Table 3-4 Construction Schedule of the Affiliated Coal Handling Terminal

No	Item	Year 2018				Year 2019						Year 2020				
		4~ 5	6~ 7	8~ 9	11 ~ 12	1~ 2	3~ 4	5~ 6	7~ 8	9~ 10	11 ~ 12	1~ 2	3~ 4	5~ 6	7~ 8	9~ 10
1	Construction preparation	█														
2	Breakwater construction		█	█	█	█	█	█	█	█						
3	Revetment construction			█	█	█										
4	Approach trestle construction				█	█										
5	MOF construction						█	█	█	█	█					
6	CHT construction								█	█	█	█	█	█		
7	Auxiliary project												█	█	█	
8	Water, electric and other matching project												█	█	█	
9	Large facilities installation														█	
10	Structure & Basin dredging	█	█	█	█	█	█	█	█		█	█	█	█		
11	Completion acceptance															█

4 PROJECT ALTERNATIVES

This chapter describes the alternative situation where the project is not proceeded with and also in circumstances of alternative technology options and site considerations; evaluating the other technology options, engineering alternatives, environmental implications and cost-benefit.

4.1 No Development Scenerio

A no development scenario would depict a situation reflecting the project area remaining unchanged; particularly the sea front and the shoreline. The coastal savannah grassland and rocky beach would remain.

The traditional use of the beach front and the ocean would also continue. The fishing operation and fish landing practice would be expected to continue similarly alongside the traditional spiritual and cultural practices.

Consequently, the instance of no development situation would not result in any significant change if the traditional livelihood pattern of the inhabitants of the communities. The economic and social attributes of adjoining communities are likely to remain unchanged any significantly. However, the dwindling fishery resources and operation, the absence of feasible alternative livelihood and the rapidly growing youth unemployment may more likely aggravate the social and economic situation of the areas.

Principally, in a no development situation, the communities of Ekumfi would not experience the considerable infrastructural development and economic transformation the project is likely to bring in.

4.2 Alternative Coal Handling Port (Necessity of Construction)

The conditions for port development facilities, production and operation considered the two ports in Ghana, namely Tema and Takoradi Ports, which are located 90 kilometres east and 110 kilometres west respectively from the project site.

The Tema Port is located along the coast of southern Ghana and to the north of Gulf of Guinea, situated about 26km away from Accra. It is the biggest port in Ghana.



Figure 4-1 Status of Tema Port

The shoreline of the port of is 3600m and has 14 major berths in the port area, with 12 multipurpose berths, average berth length is 183 metres and total length of about 2013 metres. In general, the water depth of the berths is around 7.6 meters whiles the water depth of Number 1 and 2 berths is 11.5m. The water depth of the anchorage area is up to 18m.

Handling facilities of the port include quay cranes, movable crane, high-speed belt conveyor and grain elevator in the port. The capacity of the warehouse in the port area is around 100 thousand tons; the storage capacity of the freight shed for cocoa is 60 thousand tons. Cocoa, wood, peanut kernel, coffee, alumina and manganese ore are the main exported goods, while crude oil, cement, car, construction materials, tractor and general cargos are the main imported goods.

Transportation from Tema to Ekumfi Aboano is principally by road transport. An existing old railway line running from Accra to Takoradi has remained disused for long time.

Takoradi Port is located inside the Takoradi Gulf in southern Ghana and it is one of the major ports in Ghana. Takoradi Accra Highway is the main transportation mode. There is defunct existing railway to Accra.

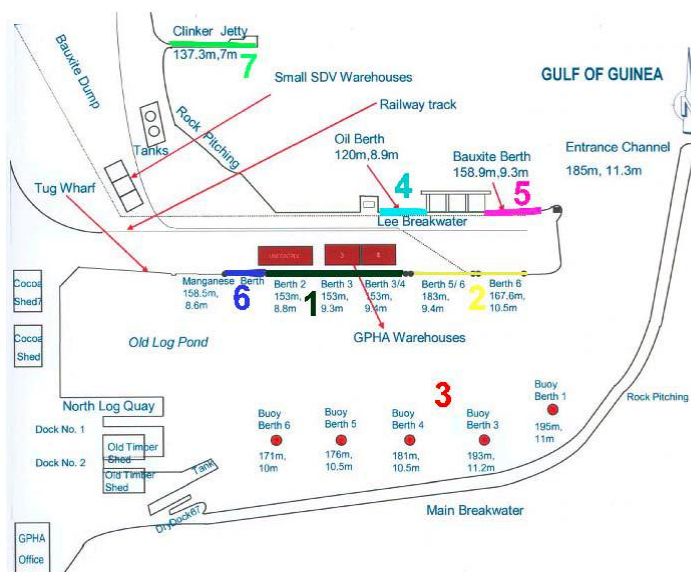


Figure 4-2 Status of Takoradi Port

Takoradi Port has 9 main berths in the port area. The length of the shoreline is 1569 meters and the water depth is 10 meters. Handling facilities include quay crane, gantry crane, movable crane, multipurpose crane, lorry-mounted crane, belt conveyor, barge, tug boat and roll-roll facilities, which the maximum capacity of the multipurpose crane is 35 tons. There are many warehouses, freight sheds and storage yards for sawmilling. The wharf could mostly accommodate 20,000 DWT vessels. There are 8 mooring buoys and could mostly accommodate 173-meter vessel.

Manganese ore, cocoa, wood, alumina, palm oil, rubber, gold, copra and banana are the main exported goods. Textile, machine, coal, appliance, oil, tobacco, artificial silk, steel, food and drugs are the main imported goods.

Transportation from Takoradi Port to Ekumfi Aboano is principally by road transport. An existing old railway line running from Takoradi to Accra has remained disused for long time.

Evaluation of the status of the ports indicates that neither of the berth tonnage and capacity could meet the coal transportation demands.

Taking the site location and coal transportation requirements and demands into account, specialized coal-handling terminal would be necessary in order to meet the coal demands of the Power Plant project and assure an overall efficient and effective operation of the power. Furthermore, the transportation requirements and the consequent environmental implications and controls could be of major concerns.

4.3 Alternative Terminal Layout Arrangement

Two key aspects of the general layout have been considered and are identified as:

- a) Whether the belt conveyor trestle could be arranged on the breakwater or not in the connection area of the terminal and the trestle;
- b) The two terminals could be arranged in linear shape or ‘L’ shape.

4.3.1 Arrangement of the Belt Conveyor Trestle

Two arrangement plans were considered. For Plan I, the belt-conveyor trestle is arranged on the breakwater in the connection area (See **Figure 4-3**); while for Plan II, the belt conveyor trestle is not arranged on the breakwater in the connection area (See **Figure 4-4**).

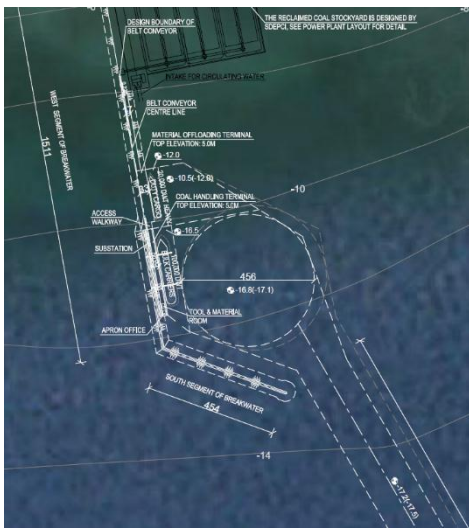


Figure 4-3 Plan I of Belt Conveyor Trestle



Figure 4-4 Plan II of Belt Conveyor Trestle

Considering these arrangements:

- a) Plan I has a longer trestle length;
- b) In Plan I the geological condition, particularly sand and silty soil layer, may lead to significant settlement during the operational phase, which influences the safety and stability of the belt conveyor system;
- c) The no-overtopping design of the breakwater in Plan I, involving a lot more engineering work.

Plan II has been considered more suitable option for the Project.

4.3.2 Arrangement of the CHT and MOF

Again, two terminal arrangements in linear shape or ‘L’ shape were considered.

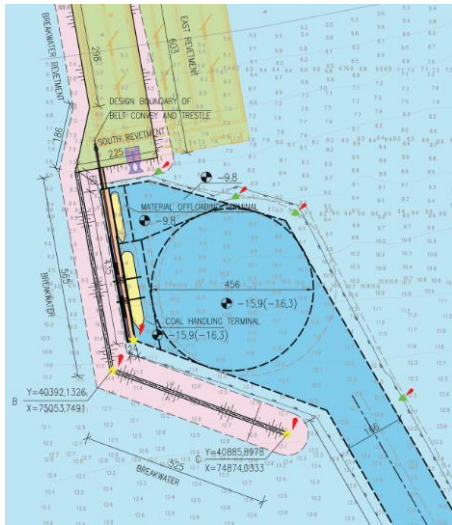


Figure 4-5 The Linear Shape Plan



Figure 4-6 The ‘L’ Shape Plan

In the linear shape plan (See **Figure 4-5**), the breakwater is plotted as approximately 1752m including breakwater revetment. The total length of the berths is taken as 435m and the terminals width is taken as 24m. The 70,000DWT CHT berth length is taken as 264m (marine structure designed for vessel; 100,000DWT bulk carrier) and the 10,000DWT MOF berth length is taken as 171m. The terminals width is taken as 24m and the trestle is plotted as 60m long, 24m wide.

In the ‘L’ shaped plan (See **Figure 4-6**), the breakwater is plotted as approximately 1633m including breakwater revetment. The total length of the berths is taken as 478m. The 70,000DWT CHT berth length is taken as 302m and the terminal width is taken as 24m (marine structure designed for vessel; 100,000DWT bulk carrier). The 10,000DWT MOF berth length is taken as 176m. The depth of the berth box is taken as 10.3 meters. The terminal width is taken as 17m and the trestle is plotted as 60m long and 9.5m wide.

Considering the dredging works, the volume would be $4.62 \times 10^6 \text{m}^3$ in the linear shape plan while $5.64 \times 10^6 \text{m}^3$ in the ‘L’ shape plan.

A comparison between these two shape plans is presented in **Table 4-1**.

Table 4-1 Comparison between Linear Shape Plan and ‘L’ Shape Plan

Item	Linear Shape	‘L’ Shape
Length of Breakwater	1752m	1633m
Length of Terminals	435m (CHT: 264m, MOF: 171M)	478m (CHT: 302M, MOF: 176M)
Trestle	60m long, 24m wide	60m long, 9.5m wide
Dredging Volume	4.62x 10 ⁶ m ³	5.64 x 10 ⁶ m ³

The engineering costs of these two plans are equal and the investment difference is 0.8%. However, considering the less dredged volume of linear shape plan and the risk that the MOF berth will be influenced by traverse wave in the ‘L’ shape plan, the linear shape plan is preferred for the Project.

5 DESCRIPTION OF THE EXISTING ENVIRONMENT

5.1 Geographic Location of the Project

The project would be located along the coastline of Ekumfi Aboano, which is situated at the southern coast of Ghana and to the western coast of Tema Port (See **Figure 5-1**).

The site is situated mid-way between Saltpond and Winneba and has coordinates: N 5°12'41", W 0°49'51". The site is about 90 km away from Tema and 110 km away from Takoradi Port. This site location belongs to open sea area.



Figure 5-1 Geographic Location of the Project

5.2 Climatic

The coast of Ghana belongs to the tropical climate zone, which has two main seasons: the rainy season and the dry season. The rainy season begins in April and lasts until September, and the dry season lasts from November to the next early April. Being close to the equator, Ghana has high temperature all the year round and the monthly averaged air temperature is 26°C in the coastal region.

Months of February and March are relatively hot with highest air temperature rising up to 34°C. The relatively cool months are August and September with the lowest air temperature recorded as 15°C. The annual rainfall of Ghana is around 1200~1800mm for the south and southwest part, while for the northern is around 600~1200mm. The coastal areas of Ghana are dominated by the relatively stable southwest monsoon, for which the wind speed varies between 1.5~2.0m/s. While in the dry season the dry northeast wind occurs.

5.2.1 Temperature

According to the observation statistics from year 2010 to 2014, the monthly averaged air temperature ranged from 24.4 to 28.65. The highest temperature was 30.65 °C which occurred in April 2014 and the lowest temperature was 21.65°C occurring in July 2012. The monthly average temperature statistics are listed in **Table 5-1**.

Table 5-1 Monthly Mean Air Temperature Statistics (Unit: °C)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2010	26.81	27.99	28.16	28.65	28.6	27.5	25.97	25.48	25.78	26.87	27.07	27.29
2011	26.86	27.41	27.56	28.17	28.16	28.16	25.88	24.69	25.33	25.19	25.67	26.87
2012	27.2	26.64	27.34	27.76	27.75	26.82	25.47	24.5	25.12	26.15	26.91	27.9
2013	27.46	27.45	27.78	28.21	28.24	26.94	25.48	24.41	25.04	25.69	26.63	26.67
2014	27	26.74	26.9	27.99	28.26	28.4	26.05	24.77	25.19	25.82	26.67	26.85
Monthly highest	29.05	28.75	29.95	30.65	30.05	30.25	28.65	24.75	25.65	27.85	29.5	28.65
Monthly lowest	22.75	23.65	24.65	24.75	26.65	25.95	23.34	21.75	22.85	25.35	24.75	23.34

Source: Lake Environmental Resource Centre, Canada

5.2.2 Wind

The Monthly Mean Wind Speed statistics for the period 2010 to 2014 reveals that the highest monthly mean wind speed was 3.81m/s occurring in July 2010 and August 2014 and the lowest monthly mean wind speed was 2.46m/s occurring in November 2010. The wind speed statistics are provided as following in **Table 5-2**.

Table 5-2 Monthly Mean Wind Speed Statistics (Unit: m/s)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2010	3.28	3.61	3.01	2.97	3.26	3.35	3.81	3.79	3.39	3.18	2.46	2.60
2011	2.60	3.28	3.32	3.19	3.17	3.59	3.49	3.79	3.77	3.31	2.69	2.71
2012	2.94	3.57	3.51	3.26	3.38	3.42	3.57	3.63	3.59	3.40	2.87	2.67
2013	2.94	3.29	3.37	3.06	3.03	3.46	3.61	3.68	3.73	3.43	2.87	2.97
2014	3.34	3.30	3.53	3.15	3.02	3.49	3.68	3.81	3.72	3.45	2.88	2.59

Source: Lake Environmental Resource Centre, Canada

Based on a special wind and wave study conducted by Hohai University of China(HHU) in November 2015 and reported in “Ghana 2x350MW Supercritical Coal-fired Power Plant Terminal-Numerical Wave Model Study”; the wind climate established from the CCMP and CFSR wind time series from year 1979 to 2014 at the power plant offshore location (Coordinate: 0.75°W, 4.5°N) are quoted as follows:

At this offshore location, the dominating wind direction is S~WSW with appearance frequency up to 90.3%, the most frequent wind direction is SW with appearance frequency up to 36.7%. WNW ~ ESE direction wind can hardly happen with appearance frequency only about 2.6%. The strong wind direction is SSW~WSW with annual average wind speed around 4.7 ~5.0m/s as well as annual maximum wind speed around 10.3~11.0m/s within this SSW~WSW direction. Appearance frequency of Beaufort wind scale 2 to scale 4 is up to 96.1%. Appearance frequency of wind speed larger than Beaufort wind scale 5 is around 1.21% and that happens within wind direction of S ~SSW. Appearance frequency of wind speed larger than Beaufort wind scale 6 is only 0.01%.

5.2.3 Rainfall

According to the observed rainfall statistics, the highest monthly average precipitation rate from 2010-2014 is 3.819mm/hr which occurred in July 2010 while the lowest monthly average precipitation rate was 0.001 which occurred in March 2013. The highest precipitation rate was recorded as 13.21mm/hr in August and a lowest precipitation rate was 0.25mm/hr recorded each month. Monthly precipitation statistics are presented below.

Table 5-3 Monthly Mean Rainfall Statistics (Unit: mm/hr)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2010	0.0085	0.019	0.010	0.055	0.149	0.366	3.819	0.184	0.359	0.172	0.107	0.057
2011	0.019	0.046	0.012	0.024	0.063	0.38	0.197	0.091	0.19	0.199	0.043	0.195
2012	0.114	0.031	0.003	0.060	0.095	0.528	0.201	0.103	0.226	0.102	0.155	0.223
2013	0.098	0.047	0.001	0.062	0.164	0.217	0.409	0.062	0.079	0.056	0.126	0.064
2014	0.025	0.007	0.005	0.035	0.128	0.332	0.374	0.583	0.199	0.086	0.278	0.048
Monthly Highest	1.02	0.76	0.76	1.178	2.79	5.33	4.83	13.21	6.35	5.08	4.06	2.34
Monthly Lowest		0	0.25	0	0	0	0	0	0	0	0	0

Source: Lake Environmental Resource Centre, Canada

5.2.4 Relative Humidity

According to the statistics, the highest relative humidity was recorded in November 2014 at 88.73% and the lowest was recorded as 80.69% which occurred in May, 2011. The average relative humidity statistics of each month are presented in **Table 5-4**.

Table 5-4 Monthly Mean Relative Humidity (Unit: %)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2010	82.54	81.89	82.05	81.99	81.36	83.18	85.03	87.16	86.95	86.14	84.91	81.52
2011	82.21	84.08	83.21	81.03	80.69	82.72	85.80	87.51	88.14	86.76	85.34	82.97
2012	82.93	85.43	83.57	82.59	81.43	83.09	84.20	87.62	88.29	87.42	86.49	84.02
2013	81.47	82.97	83.18	82.29	81.53	82.60	84.98	87.40	87.36	87.53	86.43	82.06
2014	83.90	84.64	83.80	82.67	81.29	81.96	84.1	88.31	88.40	86.86	88.73	81.12

Source: Lake Environmental Resource Centre, Canada

5.2.5 Atmospheric Pressure

According to the observation statistics, 2014 recorded the highest surface pressure of 1011mb in July and the lowest of 1000 mb in the months of February, March, April and November. The monthly mean surface pressure is presented below in **Table 5-5**.

Table 5-5 Monthly Mean Surface Pressure (mb)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2010	1004.2	1005	1005.3	1004.7	1005.9	1008	1008.3	1008.4	1007.1	1005.9	1004.6	1003.9
2011	1004	1004.6	1004.7	1004.6	1005.8	1007.5	1007.7	1008.5	1008.1	1005.5	1005.3	1005.3
2012	1005.3	1004.8	1005.3	1005.3	1006.7	1008.1	1008.3	1009.2	1008.6	1006.5	1005.2	1005.1
2013	1005.6	1004.8	1005.3	1005.6	1006.6	1007.9	1008.9	1008.6	1008.3	1007	1004.9	1008.7
2014	1005.5	1005.3	1005.4	1005.6	1005.9	1007.8	1009.7	1008.8	1008.2	1007.1	1005.9	1006
Monthly Highest	1008	1008	1007	1006	1007	1009	1011	1009	1009	1008	1007	1006
Monthly Lowest	1002	1000	1000	1000	1002	1004	1004	1006	1002	1001	1000	999

Source: Lake Environmental Resource Centre, Canada

5.3 Hydrology

5.3.1 Tide

The Tide characteristic along the coast of Ghana is of the regular semi-diurnal tide type. The characteristic tide levels at Tema tide station (Geographical coordinates: 5°38'N, 0°01'E), are presented as follows (With respect to CD Datum, the same below):

- Mean High Water Spring : 1.5m
- Mean High Water Neap : 1.2m
- Mean Low Water Neap : 0.6m
- Mean Low Water Spring : 0.2m
- Mean Sea Level : 0.85m

5.3.2 Current

Sea currents are dominated by the Guinea Current. The dominant currents are in the west to east direction, with the strongest current occurring between May and July (Gyory et al 2005) . Tidal range along the coast of Ghana is small, and current dynamic is estimated to be weak.

5.3.3 Wave

Wave Climate

Hohai University in China (HHU) performed a special wind and wave study in November 2015 and reports in “Ghana 2x350MW Supercritical Coal fired Power Plant Terminal-Numerical Wave Model Study”.

The report applied the HHU South Atlantic hind cast wave time series from year 1979 to 2014 at offshore location as data base to establish the comprehensive wave modeling study; the wave climates are summarily cited as follows:

At the offshore location, the dominating wave direction is S - WSW with appearance frequency up to 98.1%. Appearance frequency of significant wave height larger than 1.5m is about 36.9% and that is about 1.8% for the significant wave height larger than 2.5m. The annual maximum significant wave height is 3.74m, which appeared in the S direction with related mean wave period T_m equals to 13.5s. The annual maximum mean wave height is 2.91 m.

Additionally, HHU established wave transformation simulation from offshore to the near shore start point of the approach channel and the wave climate indications are summarized as follows:

At the start point of the approach channel, the primary dominant wave direction is South with appearance frequency up to 75.3%, the secondly dominant wave direction is SSW with appearance frequency up to 23.4%.

Compared with the offshore location, due to wave refraction, appearance frequency of the South wave direction has increased from 55.3% offshore to 75.3% near shore and appearance frequency of the SSW wave direction has decreased from 42.9% offshore to 23.4% near shore. Appearance frequency of significant wave height larger than 1.5m is about 25.0% and that is about 4.6% for the significant wave height larger than 2.0m and that is calmer compared with the offshore results.

Offshore Extreme waves

According to the study report “Ghana 2x350MW Supercritical Coal fired Power Plant Terminal-Numerical Wave Model Study” performed by Hohai University in November 2015, design wave parameters are cited as follows:

HHU applied satellite altimeter observational wave data time series from October 1992 to February 2009, NOAA hind cast wave data from year 1997 to 2013 and HHU South Atlantic hind cast wave data from year 1979 to 2014 to estimate the offshore extreme waves, after full comparison, the final recommended offshore extreme waves are presented in **Table 5-6**.

Table 5-6 Offshore Extreme Waves (Water Depth: -3000m)

Return Period		1 year	2	5	10	20	25	50	100
Dir			years	years	years	years	years	years	years
S	Hs(m)	2.56	2.64	3.00	3.25	3.48	3.56	3.79	4.01
	Tm(s)	9.4	9.5	10.7	11.5	12.4	12.7	13.5	14.4
SSW	Hs(m)	2.70	2.81	3.14	3.32	3.47	3.52	3.64	3.76
	Tm(s)	10.1	10.3	11.4	12.1	12.7	12.9	13.4	13.9
Omni	Hs(m)	2.79	2.86	3.23	3.46	3.66	3.72	3.91	4.09
	Tm(s)	10.2	10.4	11.6	12.4	13.0	13.2	13.9	14.5

5.4 Physical Environment

5.4.1 Geomorphic and Sediment Condition

Bathymetry observation has been performed in July 2015 for area measuring about 7 km² with scale of 1:2000. The landside area which about 100 meters away from the coastline is characterized by fluctuating terrain topography with many rocks outcrop composed by granite and covered by sparse weeds and low shrubs. Elevation of the landside is about 15m to 30m characterized by large area of exposed rocks.

The water depth of the site changes significantly from 5.3m near the coastline to 18m offshore. A change of 1 m vertically in the water depth of 8m to 14 m corresponded to a 150m to 180 m horizontal distance.

The area is in a state of erosion due to long period of wave action. Exposed rocks can be seen along the coast from west to east with coarse sand deposits between them. Depth contours of between 10m and 20m are observed parallel to the coastline with distance of about 0.7km and 5.0km away from the coastline respectively.

As there are no sand bars and no rivers around the area, eroded coastal sand is the main source of sediment. However, this is very limited as the coast is in a state of erosion. The tendency of alongshore sediment transport from west to east can be significant, which can be caused by the long period of SSW to SW swells; alongshore sediment transport from east to west may be ignored due to low appearance frequency of SE waves. However, the amount of actual alongshore sediment transport from west to east is insignificant due to the limited sediment source.

Sediment concentration within the surf zone seems high; however, it can also be observed that the seawater is very clear beyond the surf zone. Bed load transport from west to east is dominant due to the coarse size of the sediment and consequently hardly able to be suspended.

Water depth around the south breakwater head would about 11m to 13m and also being far away from the surf zone with low sediment concentration around the breakwater head. Based on the analysis the actual alongshore sediment transport would not be significant.

Accordingly, it is estimated that the siltation rate within the port would be about 0.1m/annum and for the approach channel would be approximately 0.3m/annum.

5.4.2 Topography, Landform and Engineering Sediment

The measurement of the water area of the terminal was carried out in July 2015 and estimated to cover 7 km². The water depth varies a lot inside water area. The water depth is much shallower near the coastline, with the minimum water depth being 5.3m, which gently varies to 18m towards the outboard side.

The topographic relief of the land area 100m behind the coastline is large. There are many rocks exposed outside with sparse vegetation dominated by weeds and low shrubs. However, the houses are clustered within the fishing village in the middle area and are blocked by walls.

5.4.3 Engineering Geology

Geological works involving field drilling started from October 2015, arranging 7 drilling holes on Site. The details are shown in the following **Figure 5-2**.

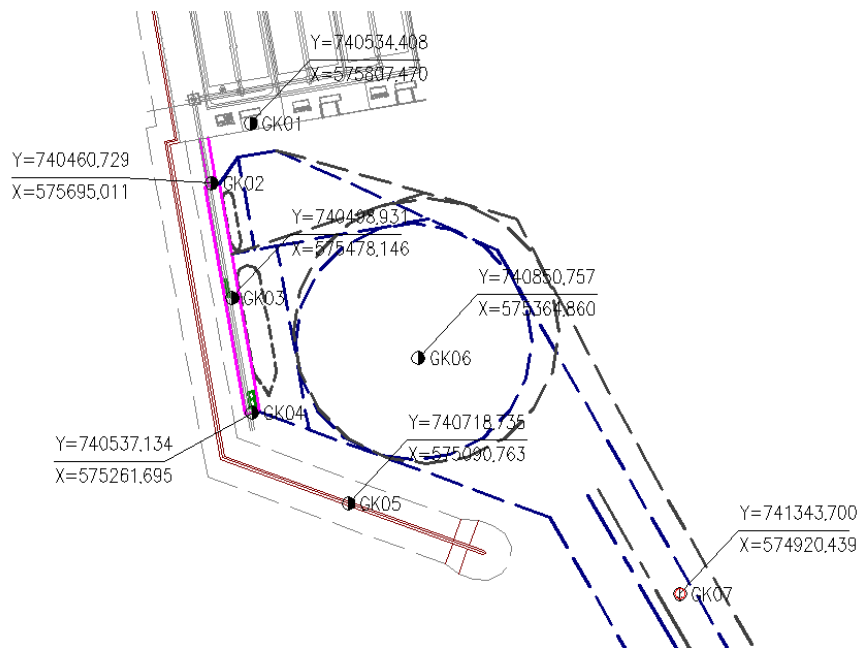


Figure 5-2 The Drilling Holes Arrangement

According to “Geological map of Ghana (1:000000)” published by Ghana Geological Survey Department in 2009, the bedrocks that mainly developed in the site area and nearby are early Archean biotite granites, the metamorphic complex sandstone, amphibolites and pyroclastic sedimentary rocks.

According to the field drilling, the strata encountered from above to below in the quay wall area and harbour basin are shown as following:

- **Fine sand, clayey fine sand:** grey, locally brownish yellow, very loose to loose, poorly graded, with about 15% of very soft clay in the harbour area; with a lot of shell fragments; locally of medium sand and clayey medium sand. The thickness is about 1.8m~9.0m, the depth is about 12.9m~17.5m. The encountered thickness of this layer was thicker in the quay wall area, and thinner in the harbour basin. The field SPT value of this layer is about 1 to 8 blows, so it can be characterized as low strength and high compressibility.
- **Organic clay:** greyish black, greyish brown, very soft to soft, with a lot of humus and little sand. The thickness is about 0.5m~9.1m, the depth is about 17.0m to 25.1m. This layer is not completely exposed in the harbour basin, and the encountered thickness of this layer is different in the quay wall area. Engineering property indexes of the soil include field SPT value of about 1~4 blows, $\omega=58.4\%\sim 81.6\%$, $\rho=1.36\text{g/cm}^3\sim 1.55\text{g/cm}^3$, $e=1.810\sim 2.521$, $\omega_L=57.6\%\sim 78.1\%$, $I_p=21.6\sim 31.7$, $C_q=10.1\text{kPa}\sim 13.7\text{kPa}$, $\phi_q=2.7^\circ\sim 5.8^\circ$, $E_{s1-2}=1.4\sim 2.1\text{MPa}$, $a_{v1-2}=1.82\sim 2.36\text{MPa}^{-1}$. The layer can be characterized as low strength and high compressibility.
- **Completely weathered granite:** extremely weak, greyish white and the original rock structure has been largely destroyed. This layer is outside the harbour basin, and has thickness of 3.1m~4m in the quay wall area. The depth is about 20.1m~29m. The field Standard Penetration Test (SPT) value of this layer is about 30~50 blows, and therefore it can be characterized as higher strength and low compressibility.
- **Highly weathered granite:** very weak, gray, greyish white, coarse grain structure, block structure and more weathered fracture. Mostly, the original rock structure has been destroyed. The main mineral composition includes feldspar, quartz, mica and so on; The encountered thickness of this layer is 1.0m~1.2m in the quay wall area. The top elevation is about -20.7m to -29m. This layer can be characterized as high strength and low compressibility.
- **Moderately weathered granite:** medium strong, grey, greyish white, coarse grain structure, block structure with the main mineral composition including feldspar, quartz, mica and so on. The encountered thickness of this layer is 6.1m~6.3m in the quay wall area, but the layer is not exposed completely. The top elevation is about -21.3m~-22.8m. This layer can be characterized as high strength and low deformation.

5.4.4 Beach Profile

Beach profiles for three sections (the western, eastern and middle sections) of the study area are provided in **Figure 5-3**, **Figure 5-4**, and **Figure 5-5** below. Beach gradient (Height: Distance) measured for all the sections, revealed that all the three sections showed quite high gradients with very steep profiles. Generally, the beach within the project area exhibited a very steep profile and uneven particularly in the middle section.

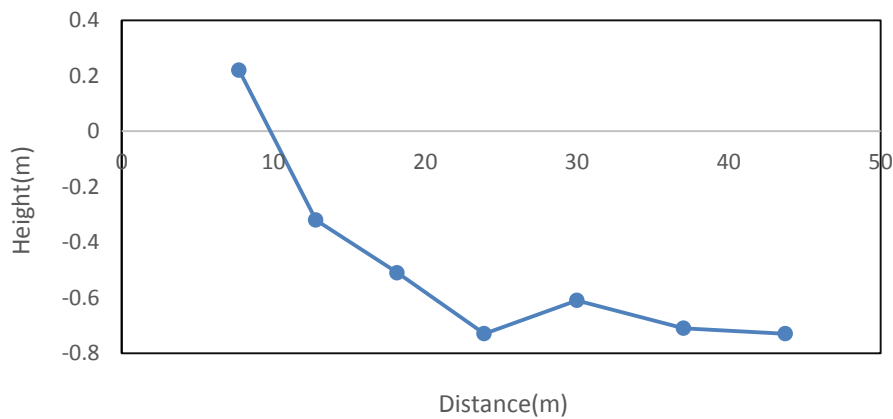


Figure 5-3 Beach Profile of Western Section

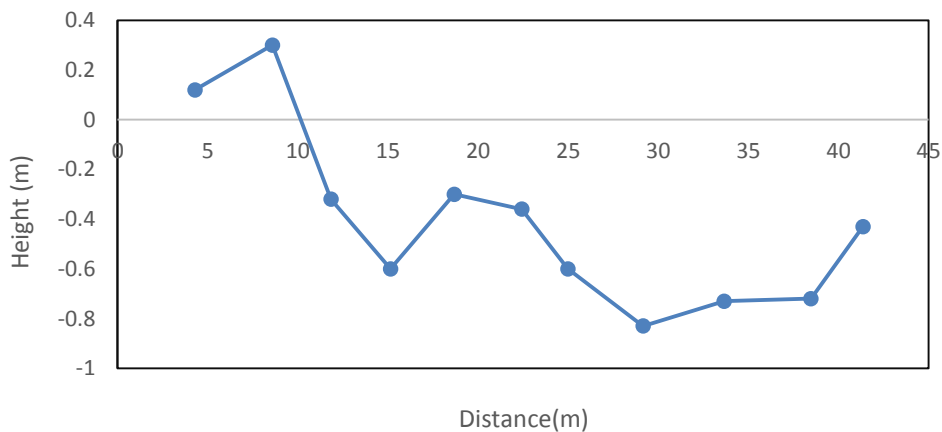


Figure 5-4 Beach Profile of Middle Section

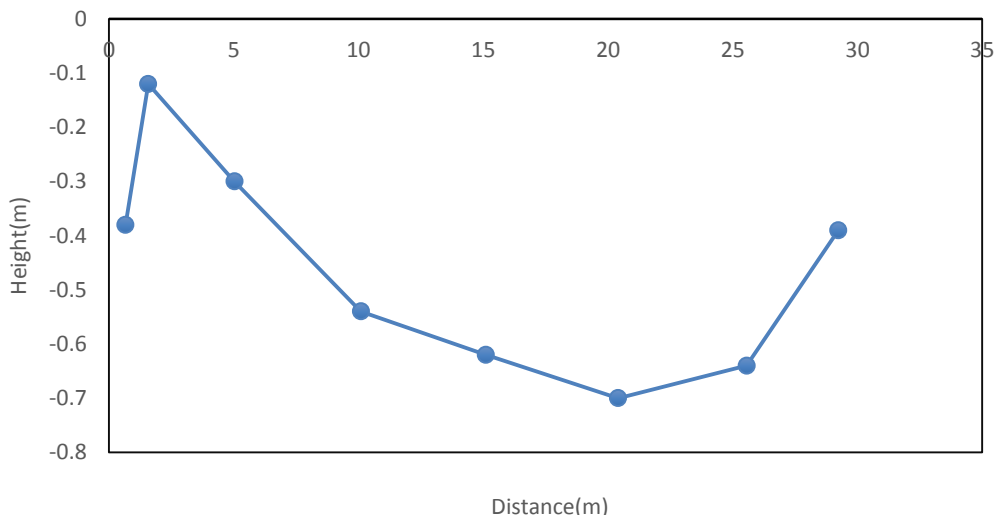


Figure 5-5 Beach Profile of Eastern Section

5.4.5 Chemical Analysis of the Sediment

The results of the heavy metal analysis conducted on the sediment samples showed the presence of all the metals in the sediment except for Lead (Pb) which recorded concentrations below detection limit of the AAS used. The concentrations of Iron (Fe) in the sediment samples were higher than the rest of the metals ranging from 4271 mg/kg at MS2 to 5100 mg/kg at MS3. The concentration of Manganese (Mn) also ranged from 120 mg/kg at MS 2 to 213 mg/kg at MS 1 as shown in **Table 5-7**.

Table 5-7 Heavy Metal Concentrations in the Sediment Samples

Sample ID	Fe (mg/kg)	Cr (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	Pb (mg/kg)	Cu (mg/kg)
ST 1	5021	46.2	213	47.0	<1.25	0.80
ST 2	4271	38.1	120	38.8	<1.25	1.10
ST 3	5100	47.4	121	27.8	<1.25	1.70
ANALYSIS IAEA 365	23900	65.1	309	980	320	345
IAEA 365 (MEDIAN)	24100	69.8	312	977	347	365

In terms of heavy metals, it can be concluded that there exist variable concentrations of heavy metals in the marine sediment even though the concentration of Lead (Pb) was below detection limit.

The analysis result PAH (Poly Aromatic Hydrocarbons) is presented in **Table 5-8**.

Table 5-8 Poly Aromatic Hydrocarbons Analysis Results of Sediment Samples

Parameter	Units	PES1	PES2	PES3	PES4
Naphthalene	mg/kg	ND	ND	ND	ND
Acenaphthylene	mg/kg	ND	ND	ND	ND
Acenaphthene	mg/kg	ND	ND	ND	ND
Fluorene	mg/kg	ND	ND	ND	ND
Phenanthrene	mg/kg	ND	ND	ND	ND
Anthracene	mg/kg	ND	ND	ND	ND
Fluoranthene	mg/kg	ND	ND	ND	ND
Pyrene	mg/kg	ND	ND	ND	ND
Benz(a)anthracene	mg/kg	ND	ND	ND	ND
Chrysene	mg/kg	ND	ND	ND	ND
Benzo(b)fluoranthene	mg/kg	ND	ND	ND	ND
Benzo(k)fluoranthene	mg/kg	ND	ND	ND	ND
Benzo(a)pyrene	mg/kg	ND	ND	ND	ND
Indeno(123-cd)pyrene	mg/kg	ND	ND	ND	ND
Dibenz(a,h)anthracene	mg/kg	ND	ND	ND	ND
Benzo(g,h,i)perylene	mg/kg	ND	ND	ND	ND
ND: <0.001mg/kg					

5.4.6 Earthquake

According to “seismicity map of southern Ghana” Published by Ghana Geological Survey Department in 2004, there are no records about seismic activity in this site. Earthquake of magnitude over 4.1 has been recorded in Accra, which is 75 km to the northeast of the site. According to “Global Seismic Hazard Map” Published in 1990, The peak ground acceleration (PGA) is about 0.4~0.8 m/s² corresponding to a 475 years return period, 10% probability of exceedance in 50 years.

5.5 Biological Environment

5.5.1 Intertidal

Two (2) main intertidal fauna species (*Patella miniata* and *Perna perna*) and nine (9) marcoalgae species (*Jania rubens*, *Centroceras clavulatum*, *Ulva*

flexuosa, Sargassum sp., Codium guineense, Cladophora sp., Corallina pilulifera, Polycavenosa dentata and Chaetomorpha linum) were recorded during the study. Five (5) species each were recorded for the western and eastern sections, and ten (10) species for the middle section of the study area. Xerophytes like Paspalum varginatum grew well on the back beach of the area. Results for the macroalgae and fauna study are shown in **Figure 5-6, Figure 5-7** and **Figure 5-8**.

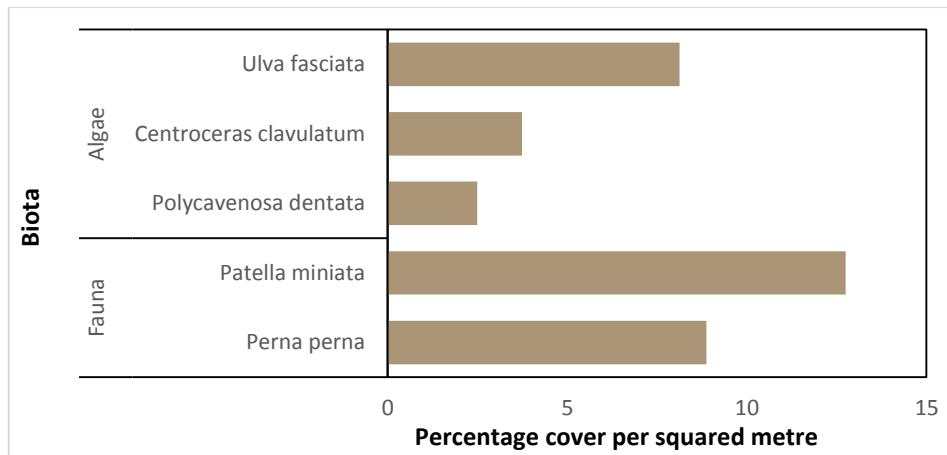


Figure 5-6 Biota of the Western Section of the Beach

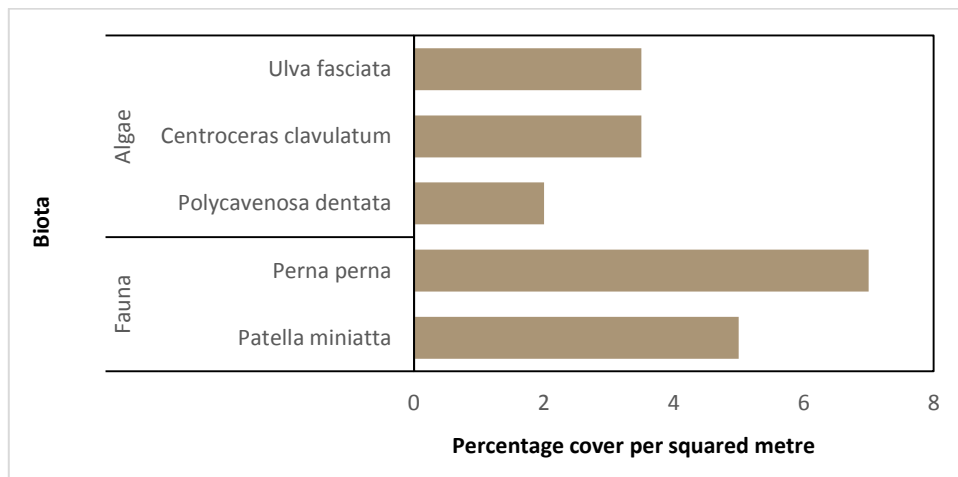


Figure 5-7 Biota of the Middle Section of the Beach

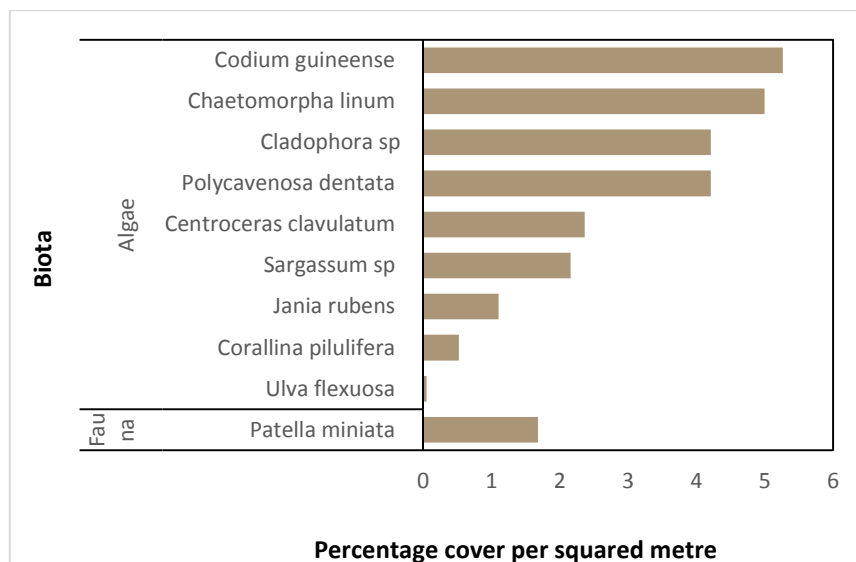


Figure 5-8 Biota of the Eastern Section of the Beach

Ghost crabs are also important fauna found in the intertidal zones of marine environment. They are ideal top carnivores in a simple, filter-feeding dominated food chain of the dune and fore beach ecotones and as such are useful indicators of ecosystem health. In general, the crab population of the study area was skewed towards smaller individuals—crabs inhabiting burrows of 0.1 to 0.2 cm in diameter constituted the largest group. The largest burrows were recorded in the middle section of the beach which also had widest range of burrow sizes observed. Results for the ghost crab ecology survey are given below.

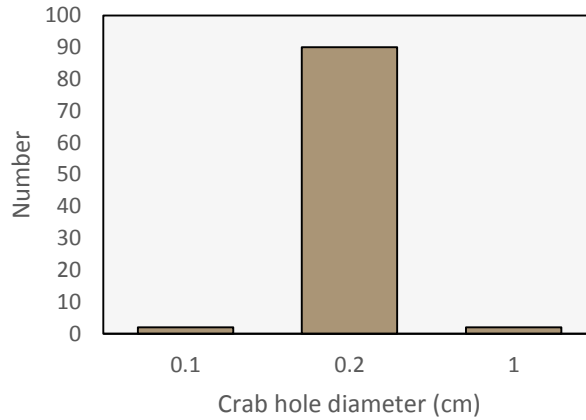


Figure 5-9 Crab Burrow Sizes and numbers of the Western Section of the Beach

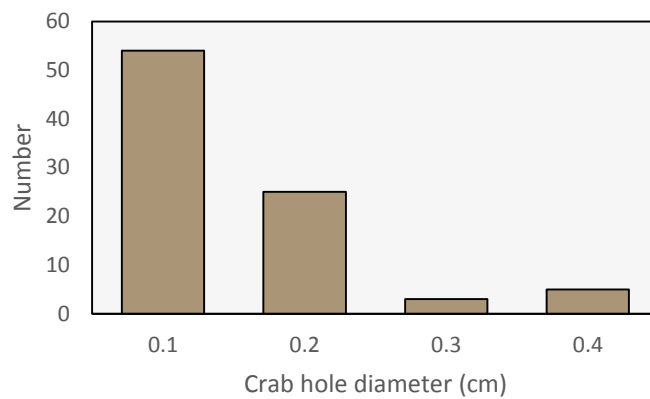


Figure 5-10 Crab Burrow Sizes and numbers of the Eastern Section of the Beach

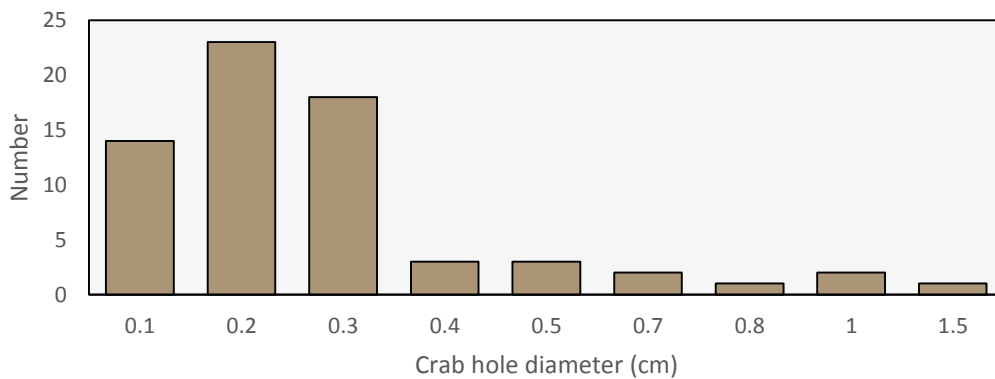


Figure 5-11 Crab Burrow Sizes and numbers of the Middle Section of the Beach

5.5.2 Benthic Habitat

The study on the macrobenthos yielded more than 1200 individuals made up of 70 different species belonging to seven major taxa. The groups include Polychaete, Crustasea, Mollusca, Echinodermata, Nematoda, Nemertea and Sipunculidae as seen in **Table 5-9**.

Table 5-9 Abundance of Macrobenthic Infauna at the Sampled Sites

Totals	Intertidal (0m)	MS 1 (5m)	MS 2 (10m)	MS 3 (15m)
Total abundance polychaetes	17	11	134	34
Total abundance crustaceans	2	14	591	218
Total abundance molluscans	1	11	22	1
Total abundance others*	13	20	39	4
Total abundance	33	52	783	256

Others consist of echinoderms, nematodes, nemerteans and sipunculids.

Polychaetes and crustaceans are the most abundant group of macrobenthic organism found in the marine sediment even though they had low abundance in the intertidal and near shore zones.

5.5.3 Fishes in the Project Area

A coastal fishery survey was conducted as part of the ESIA to describe the fishing activities at Ekumfi Aboano and identify the different fish species caught; in order to understand the diversity and stock seasonality of fish of the marine environment fringing the project area. The beach seine is the only fishing gear used by fishermen at the area. The result of the fishery survey in the area is shown in **Table 5-10**.

The methodology adopted for the survey involved sample collection, interview and observation and review of secondary data. Fish samples for the study were obtained from the beach seine landing site at Kuntankure (coordinates: N 5° 12' 40.28", W 0° 49' 44.07") near the project area. The beach seine mainly targets pelagic and near shore demersal species.

Table 5-10 Fish Species Found in the Area

Family	Species	Common Name
Acanthuridae	Acanthurusmonroviae	Monrovia doctorfish, surgeon fish
Balistidae	Balistespunctatus	Grey triggerfish
	Canthidermismaculatus	Rough triggerfish
Bathidae	Scyaciummicrurum	Rock sole, flounder

Family	Species	Common Name
Bothidae	Syaciummicrurum	Channel flounder
Carangidae	Alectisalexandrinus	Alexandria pompano
	Caranx hippos	Crevalle jack
	Caranxcrysos	Blue runner
	Chloroscombruschrysurus	Atlantic bumper
	Decapteruspunctatus	Round scad
	Decapterus rhonchus	False scad
	Lichiaamia	Leer fish
	Selene dorsalis	African moonfish, African lookdown
Clupeidae	Trachinotusteraia	Terai pompano
	IllishaAfricana	Long-finned herring, West African Illisha
	Ethmalosadorsalis	Shad, Bonga
	Sardinellamaderensis	Flat sardinella
Cynoglossidae	Sardinellaaurita	Round sardinella
	Cynoglossussenegalensis	Senegal left eyed tongue sole
Dasyatidae	Dasyatis margarita	Daisy sting ray
Drepanidae	Drepane Africana	African sicklefish
Lutjanidae	Lutjanusagennes	African red snapper
Mullidae	Pseudupenusprayensis	West African goatfish
Palinuridae	Panulirusregius	Royal spiny lobster
Penaeidae	Penaeusnotialis	Pink shrimp
Pomadaysidae	Brachydeuterusauritus	Burrito, Bigeye grunt
	Pomadasysjubelini	Spotted burrito
Polynemidae	Galeoidesdecadactylus	Lesser African threadfin
Portunidae	Callinectesamnicola	Blue swimming crab

Family	Species	Common Name
Rajidae	Raja miraletus	Brown ray
Rhinobatidae	Rhinobatosalbomaculatus	White-spotted guitarfish
Rinobatidae	Rhinobatusrhinobatus	Common guitarfish
Sciaenidae	Pseudolithussenegalensis	Cassava croaker
	Pseudolithusbrachygnathus	law croaker
	Pseudolithustypus	Long neck croaker
	Pteroscionpeli	Boe drum
Scombridae	Sardasarda	Atlantic bonito
	Orcynopsis unicolor	Plain bonito
	Scomberomorustritor	Spanish mackerel fish
Sepiidae	Sepia officinalis	Common cuttlefish
Sparidae	Pagellusbellottii	Red Pandora
Sphyraenidae	Sphyraenasphyraena	Barracuda
Stromateidae	Stromateusfiatola	Butterfish
Tetraodontidae	Lagocephaluslaevigatus	smooth puffer
	Ephippionguttifer	Prickly puffer
Trichiuridae	Trichiuruslepturus	Ribbonfish
	Alectis alexandrines	Alexandria pompano
	Balistespunctatus	Grey triggerfish
	Callinectesamnicola	Blue smimmingcrab
	Pagellusbellottii	Red Pandora
	Caranx hippos	Crevalle jack
	Lutjanusagennes	African red snapper

Extensive study of beach seine catches of the central coastline of Ghana, including the study area shows that the species: *Chloroscombruschrysurus*, *Brachydeuterusauritus*, *Ilishaaficana*, *Sardinellaaurita* and *Selenedorsalis* are among the dominant species landed at the beaches whilst

Acanthurusmonroviae, *Penaeusnotialis*, *Galeoidesdecadactylus* and *Trichiuruslepturus* are in low abundance (Aggrey-Fynn & Sackey-Mensah, 2012).

5.5.4 Marine Turtle

Marine turtles play important roles in the marine ecosystem, as well as the terrestrial environment. They are used in diverse ways as dietary, medical, cultural, economic, and religious human need and wants (Laqueux, 1998; Robinson and Redford, 1991; Freese, 1997). Turtles consume diverse forms of prey, including jellyfish, crustaceans, sponges, tunicates, sea grasses, and algae. Most species of turtle increase fish stocks through feeding on jelly fishes which, when in large numbers, are considered a threat to fisheries (Mckeown *et al.*, 2003). In the sea, juvenile turtles are eaten by predators such as crabs and sharks. The extinction of various sea turtle species would thus mean a reduction in the abundance and diversity of such life. Sea turtles have been found to promote the growth and development of reefs and sea grasses. By coming ashore to nest, sea turtles transport nutrients from highly productive marine habitats such as sea-grass beds to energy-poor habitats like sandy beaches (Bouchard and Bjorndal, 2000). This helps reverse the usual flow of nutrients from land to sea and enhance vegetation growth at the beach which help stabilize the beach by reducing erosion.

In the Central region of Ghana, nesting activities of sea turtles has been reported for Green (*Cheloniemydas*), Olive ridley (*Lepidochelysolivacea*), and the Leatherback (*Dermochelysimbricata*) as the three main species that nest in along the sandy beaches (Agyekumhene *et al.*, 2014). The olive ridley and leatherback appear to nest most frequently and in appreciable quantities along the central coasts of Ghana (Allman and Armah, 2008). The green sporadically nest in the area but are also occasionally encountered at sea by fishermen when they get entangled in nets during fishing operations. The Olive ridley is known to show the highest relative abundance in in the Central Region of Ghana (Agyekumhene *et al.*, 2014).

The primary threats to the survival of sea turtle populations in the Central regions are mostly anthropogenic (Agyekumhene *et al.*, 2014). Sea turtles and their eggs are routinely harvested when deposited in proximity to fishing communities. The eggs of sea turtle are also destroyed by predation from animals such as dogs and pigs, inundation from high tides, and erosion of sandy beaches. Adult turtles are also often accidentally captured in artisanal fisheries which cause them to drown and die. These animals are typically adults that may be breeding and feeding in the area. Protecting these adults is

thus paramount to increasing the population, size and recovery of the species (Mazariset *al.* 2005).

Habitat destruction through pollution, coastal development, artificial illumination on nesting beaches, accumulation of debris on the beach and changes in beach morphology that can prevent the female turtle from ascending the nesting beaches, are among identified threats to sea turtles in the Central Regions (Wildlife Division-Winneba, *unpublished*).

The rate of beach erosion and morphological changes is increased by community members who mine sand along the beaches. Poaching of sea turtle is very common in most coastal communities of the Central regions. Nesting females are usually collected for food and therefore for sale. The low fish catch coupled with low income levels in most of these communities have increased the incidence of sea turtle poaching. There are no traditional regulations, myths or by-laws in the Central Region that offer sea turtles protection.

Unfortunately, there is no documented sea turtle data or information on sea turtle activities or threats specifically existing for the project area.

Sea Turtle Nesting Activities in the Project Area

Factors such as beach elevation or accessibility of beach, beach height, type of sediment or substrate type (muddy or sandy), and grain size of sand, compressibility of sand and thermal variations in the sandy beach have been found to influence the choice of beach for nesting by sea turtles (Stoneburner and Richardson, 1981).

Most of the beaches within the footprint of the project are rocky with high cliffs which may prevent sea turtle from nesting or accessing the back beach. The rocky intersection of the beaches in the project area is too high for any turtle to access even at the highest tide of the day. Also the soil type at the back beach in the project area is too compacted (from human activities) for any successful digging of egg chamber to occur. Major parts of the beaches within the immediate impact zones of the project are therefore unlikely to support significant sea turtle nesting. However, the beach outside the project area to the east and west have gentle slope and could therefore support successful nesting at the back beach.

Different turtles prefer different types of beaches for nesting. For example, olive ridleys and leatherbacks most often prefer open areas, wide beaches with steep slopes and sand bars at river mouths, while hawksbill turtles prefer small island beaches and often nest under overhanging vegetation (Shankeret *al.*, 2003a; 2003b). The beach type preference of green turtles also ranges from

large, open to small cove beaches (Shanker *et al.*, 2003a; 2003b). The project area has very dynamic beaches which are preferred by leatherback for nesting. However, the numerous segments at high ranging rocky shore areas of the project site reduce the suitability of the area for nesting by leatherbacks. The absence of leatherbacks nesting activities in recent times as reported in the area by local fishermen could be due to this factor.

The only section of the beach that has a wider back beach to favour olive ridley nesting was around the areas outside of the project impact zones. But the presence of intense disturbance from activities of the coastal communities such as light from homes, fishing, docking of canoes and boats on the beach etc disturbs the sandy beach and reduces the suitability of these areas for olive ridley nesting. Several boats on the beach reduce the area available for turtle to nest.

Three olive ridley shells were encountered during the two-day survey. The observations are indicative of the presence of the species in the area as reported by the local fishermen interviewed.

Sea turtles in the area face many and diverse threats both in the waters and on the nesting beach resulting in their low numbers. In the project area, nesting females are in danger of being harvested on the beach for food and income or captured in fishing gear. Turtle nests deposited on the sandy beach in the project area is susceptible to erosion or inundation by the high tides due to the narrow nature of the beach. Nests are also in danger of predation by pigs and dogs. Artificial lighting on the beach can also disorient nesting females and hatchlings but to a minimal extent.

The detailed study methodology and description of the baseline are provided in the ***Independent Report 1: Ecological Survey and Habitat Assessment Study***.

5.5.5 Dredged Material Disposal Site

The impacts of dredging and dumping of sediment within the marine environment has the propensity to intensify the rate of overfishing (both biologically and economically) and extinction of coastal fisheries resources. Prior to dredging or disposal of sediments within the marine environment, it is important that information pertaining to the stocks status within the demarcated dredging and disposal area is obtained through bottom trawl survey (BTS). Information gained from such scientific survey may form the basis for future deliberations associated with the marine environment, especially where the dredging and disposal were carried out. The apparent

option is through BTS research, because knowledge of the fisheries status (both demersal and pelagic fish species) plays a significant role in sound policy-development and proper decision-making concerning the health of the marine environment.

Based on bottom trawl survey carried out off the coast of Ekumfi within the area of dredged material disposal site to assess fish abundance by species and families; the baseline findings on fish stocks revealed total number of individual fishes encountered during the trawling period, estimated at 7140 comprising 19 fish species (both shelled and fin fish species). These belong to 15 families (both shelled and non-shelled fishes) as shown in **Table 5-11**.

The dominant fish species were *Brachydeuterus auritus*, *Chloroscombruschrysurus*, *Pteroscion peli* and *Galeoides decadactylus*.

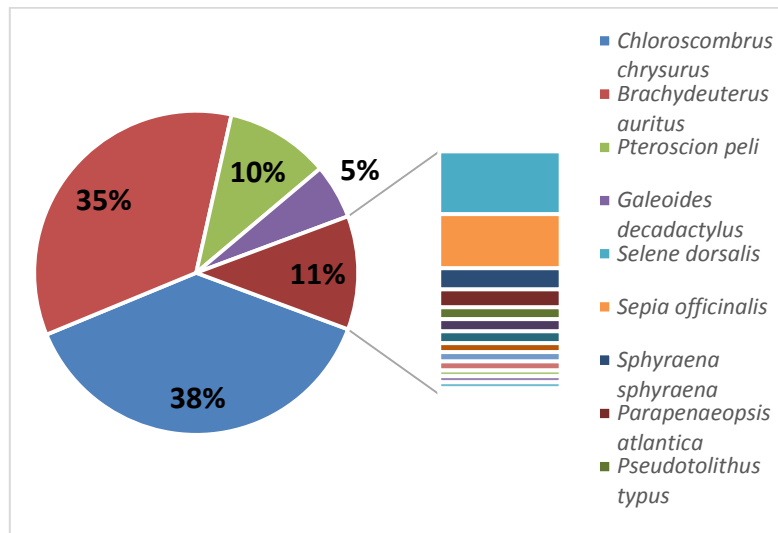


Figure 5-12 Abundance of Fish Species Encountered during the Trawling Period

However, *Chloroscombruschrysurus* appeared as the most dominant fish species (38 %) followed by *Brachydeuterus auritus* (35%). The least dominant fish species were *Pseudopenusprayensis* and *Batrachus* sp. (See **Figure 5-12**).

Table 5-11 Species Abundance Encountered during the Trawling Period

Species	Total number	Relative abundance
<i>Chloroscombruschrysurus</i>	2720	38.10
<i>Brachydeuterusauritus</i>	2480	34.73
<i>Pteroscionpeli</i>	740	10.36
<i>Galeoidesdecadactylus</i>	390	5.46
<i>Selene dorsalis</i>	210	2.94
<i>Sepia officinalis</i>	180	2.52
<i>Sphyraenasphyraena</i>	70	0.98
<i>Parapenaeopsisatlantica</i>	60	0.84
<i>Pseudolithustypus</i>	40	0.56
<i>Alectisalexandrinus</i>	40	0.56
<i>Trichuruslepturus</i>	40	0.56
<i>Pagruscaeruleostictus</i>	30	0.42
<i>Pseudolithussenegalensis</i>	30	0.42
<i>Drepaneaficana</i>	30	0.42
<i>Calapparobroguttata</i>	20	0.28
<i>Cynoglossussenegalensis</i>	20	0.28
<i>Epinephelusaeneus</i>	20	0.28
<i>Batrachus sp.</i>	10	0.14
<i>Pseudopenusprayensis</i>	10	0.14
TOTAL	7140	100

15 families (both shelled and non-shelled fishes) were found (**Figure 5-13**). Carangids recorded the highest percentage (42%), follow by Haemulidae (35%) and Sciaenidae (11%).

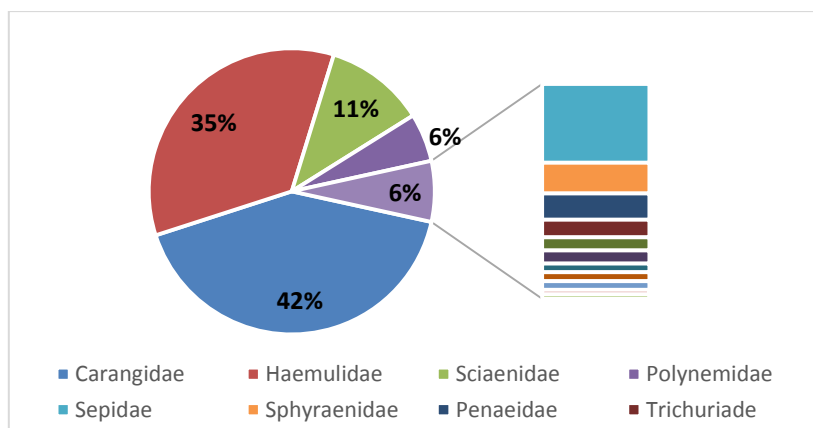


Figure 5-13 Abundance of Fish Families Encountered during the Trawling Period

Table 5-12 shows the percentage of each families encountered during the trawling session.

Table 5-12 Abundance of the Species Encountered during the Trawling Period

Family	Total number of species	Relative abundance
Carangidae	2970	41.36
Haemulidae	2480	34.54
Sciaenidae	810	11.28
Polynemidae	390	5.43
Sepiidae	180	2.51
Sphyraenidae	70	0.97
Penaeidae	60	0.84
Trichuriade	40	0.56
Sparidae	30	0.42
Drepanidae	30	0.42
Callapidae	20	0.28
Cynoglossidae	20	0.28
Serranidae	20	0.28
Batrachoididae	10	0.14
Mullidae	10	0.14
Total	7140	100

The catch composition for the present study included crustaceans, gastropods, cephalopods and elasmobranchs. Carangidae was identified as the dominant fish family from the study.

The dominant fish families were Carangidae, Haemulidae, Polynemidae and Sciaenidae. In terms of species, they were *Chloroscombruschrysurus*, *Brachydeuterusauritus*, *Galeoidesdecadactylus* and *Pteroscionpeli*.

The maximum length of the dominant fish species documented was lower than the maximum lengths obtained from similar studies, which implies incidence of overfishing.

The lengths at first capture (Lc 50) for the dominant fish species were relatively lower than the legal minimum landing fish sizes as stated in Ghana's Fishing

Regulations (L.I., 2010). This observation is an indication that the dominant fish species are currently been overfished.

The detailed study methodology and description of the baseline are provided in the ***Independent Report 2: Offshore Fish Survey of Dredged Material Disposal Area.***

5.6 Landscape and Seascape

The landscape and seascape visual characteristics generally reflect natural but exploited environment resulting from human activities.

5.6.1 Landscape Character

The site is located along the coastal beaches of Ekumfi, which also coincides with the Southern Marginal Forest in the Central Region. Generally, the site depicts maritime and coastal scrub and grassland vegetation with hilly and rocky outcrops and isolated pockets of natural thickets of forest reserves or sacred groves.

The project site, in particular, demonstrates plant outgrowth on rocky surface and lying along the coastline (***Figure 5-14***).



Figure 5-14 Landscape Characteristics

There can be a visualization of a distinct relationship between the shoreline with its different spectral colours and shades and pockets of mangrove, weeds and ground cover including thickets of coconut trees which can be subdued by an overwhelming shade of skycap. These impressions of landscape often characterize casual visits to the site. However, same is likely to be lost due to the development of the proposed coal handling terminal. The potential visual impact can therefore be described as significantly adverse on the inhabitants.

The envisaged development would result in the construction of quays along the shoreline, which would significantly alter the landscape along the immediate coastline and causing considerable change of the natural environment.

5.6.2 Landscape Visual Aspect

Presently, the topography is hilly with sparse vegetation and scattered pockets of thickets, which represent the general surrounding environment and though disturbed appears very natural landscape.

5.6.3 Seascape Character

Presently, the seascape is represented by coastline with maritime vegetation intersperse with strand and mangrove vegetation occupying the foreshore. The shoreline also portrays high water mark with outcropped rocky beach stretching almost the length of the site.

Although the ground is largely evenly laid and flat, it will lose this quality because the existing rocks, which would be removed for use as the main material for the construction of the Breakwater embankment.

At the moment, erosion is not a major concern along the shoreline. Again, the blasting and removal of the rocks is likely to result in some amount of erosion which must be checked immediately. The engineering considers cutting and filling, which would remove the rocks.

5.6.4 Seascape Visual

The sea line depicts identifiable straight line that can easily be placed in the subconscious. This identity would likely be lost and completely replaced with the development of the breakwater embankment and quays connecting the plant site and the port terminal.

The overall aesthetic quality therefore depicts natural environment which given the village setting has friendly and positive impact on the people. The vegetation continues to change through the seasonal variations also influences the visual impressions and consequent impact implications.

It can therefore be concluded that presently, the baseline visual aspects of the landscape and seascape are considerably friendly and hardly have adverse impact implications on the people.

The detailed study methodology and description of the baseline are provided in the ***Independent Report 4: Landscape and Seascape Visual Impact Assessment***.

5.7 Social and Economic Baseline

5.7.1 Administrative Structure

Ekumfi Aboano falls within the jurisdiction of the Ekumfi District Assembly, which is made up of thirty-seven (37) Assembly Members, the District Chief Executive (DCE) and a Presiding Member. The DCE is appointed by the President of Ghana with support from two-thirds of the Assembly Members. Twenty-six (26) of the 37 Assembly members are elected members and 11 are government appointees. The District has one constituency (the Ekumfi Constituency) and eight area councils namely Essarkyir, Ebiram, Ekrawfo, Otuum, Narkwa, Eyisam, Srafa (Abono) and Asaafa (Ghana Statistical Service, 2014).

The traditional capital of Ekumfi Traditional Area Council is at Ebiram where the paramount chief of the council rules from. He is supported by a number of divisional chiefs (Ghana Statistical Service, 2014). The people of Aboano are headed by a Chief who is supported by a Queen mother and elders in administering the community. All issues especially relating to land acquisition is dealt with by the Chief/elders and the respective land owners.

5.7.2 Demographics

There are approximately 52,000 people inhabiting the Ekumfi District out of which 1900 of the District's population reside in Ekumfi Aboano (GSS, 2014). The population of E. Aboano is considered youthful because approximately 55.9 % of the population is children.

In the District, females make up the greater percentage (53.8 %) with a sex ratio of 85.7 males to 100 females. This ratio is high at ages 14 years and below (103.7) and rather low in the population of age 65 years and above (49.1). Age dependency ratio is higher for males than females (111.3 and 96.3 respectively with a combined ratio of 103. There two hundred and sixty (260) homes in Ekumfi Aboano with an average of 13 – 15 people per home (Ghana Statistical Service, 2014; Global Brigades, n.d.).

5.7.3 Health

Like most areas in Ghana, the major health issue of Ekumfi Aboano is Malaria. There are however no medical facilities in the community but health centers are located at Otuum and Esaakyir about 10 and 30 minutes' drive away

respectively. It has also been speculated that the lack of toilet facilities could result in typhoid, diarrhoea, cholera and other infectious diseases (Global Brigades, n.d.).

5.7.4 Socio-economic Activities

The primary livelihood activity of the five communities is fishing and farming. However, other livelihood activities include petty trading, charcoal production, food vending, operation of drinking spot, hair dressing and dress making are complementary economic activities, which the population engage in.

Crop farming is not intensively practices in the area as envisaged. This is attributed to the poor soil fertility and productivity level for crop production. Consequently, the main crop cultivated by the people os tiger nut. Farming in these communities is seasonal primarily cropping tiger nuts.

Also, a number of socio-economic infrastructure are available within these communities and are listed to include the **Table 5-13**.

Table 5-13 Socio-economic Activities and Infrastructure

ECONOMIC ACTIVITIES	COMMUNITIES				
	ABOANO	KUNTANKORE	KOKODO	ETSIBEE DU	OTUAM
Hair dressing	2	6	5	3	8
Petty trading	8	3	9	2	23
Food vendors	4	15	9	3	43
Dress making	3	1	4	4	20
Drinking spots	7	11	7	3	16
Provision stores	5	15	2	1	71
Artisans	3	2	5	2	15
Church	7	2	5	4	18
Mosque	1	0	1	1	2
Toilets (KVIP)	3	0	1	1	3
Pipe borne water	2	3	4	4	12
Communication	4	0	2	0	9

Based on the field investigation conducted during the baseline study, the indications reveal that the socio-economic activities and infrastructure

available in the communities mentioned include hairdressing, petty trading, food vendors, dress making, drinking spots, provision stores and artisans. Other facilities are churches, mosque, toilets (KVIP), pipe borne water and communication.

5.7.5 Community Structures

The table above represents the cumulative number of house type situated in the various communities: Aboano having total number of 67 houses, Kuntankure with 84 houses, Kokodo with 60 houses, Etsibeedu 46 houses and Otuum 328 houses. Materials used in the construction of these houses are basically cement and sand, raffia and mud. Most of these are roofed with corrugated iron sheets except that of Kuntankure which are mostly roofed with raffia fronds.

Table 5-14 Community Structures and their Make

	ABOANO	KUNTANKORE	KOKODO	ETSIBEEDU	OTUAM
No. of houses	67	84	60	46	328
Cement	36	2	46	28	250
Raffia	--	2	--	18	2
Mud	31	80	14	--	76

5.7.6 Education

Educational institutions at Ekumfi Aboano offer training at the nursery, primary and junior high stages. The town has no Senior High School. The closest Senior High School is at Essakyir, 30 minutes’ drive from Ekumfi Aboano. Teacher to student ratio is 1:60 and 60 % of population is literate (Global Brigades, n.d.).

Considering the District as a whole, the majority (48.9 %) of current school attendees are at the primary stage. At this stage, females represent a slightly higher proportion though overall males represent 10, 845 and females 9,729 of the population being formally educated. Approximately 26 % of the school going population is either in nursery or kindergarten while 0.6 % attended tertiary institutions (Ghana Statistical Service, 2014).

Table 5-15 Schools and Pupil/ Student Population in the Project Area

Location	Name of School	Departments	Boys	Girls	Total No. of Pupils
ABOANO	D/A Basic school	KG/ BASIC/ JHS 3	187	178	365
KUNTANKORE	No school	--	--	--	--
KOKODO	D/A Basic school				
ETSIBEEDU	Etsibeedu D/A Basic School	NURSERY/KG/BASIC/ JHS 2	109	90	199
OTUAM	PRIVATE				
	Living Faith School	NURSERY/KG/BASIC/ JHS 1	150	120	270
	Otuam Prep. School	NURSERY/KG/BASIC/ JHS 3	185	172	357
	John Mensah Academy	NURSERY/KG/BASIC/ JHS 3	150	170	320
	OtuamAmmadiyah	NURSERY/KG/BASIC/ JHS 3	403	439	842
	Otuam Meth. Basic Sch	NURSERY/KG/BASIC/ JHS 3	282	257	539
	Otuam Sec. School	SHS 1			

5.7.7 Water and Sanitation

Challenges faced by Ekumfi Aboano regarding water resources include both quantitative and qualitative issues. Since pipe-borne water is scarce and underground water resources are economically unavailable due to salt water intrusion, community members mainly rely on rainfall and a fresh water pond. The latter is accessible by animals and also located near human excreta making it unsafe for consumption though it serves at a source drinking water usually without treatment. Defecation is primarily open-air (Global Brigades, n.d.).

5.7.8 Roads

The Accra – Cape Coast road runs 10 km north of the proposed site at Ekumfi to which a rural road of about 2 km connects to north of the site. There also exists an east-west rural road within the site region.

The detailed study methodology and description of the baseline are provided in the ***Independent Report 3: Socio-economic Impact Assessment***.

5.8 Cultural, Historical and Traditional Heritage

The Fantes constitute the dominant ethnic group in the Ekumfi District. They are believed to have migrated from the Brong Ahafo Region to the Central Region. During that period a group within the Fantes (the Ekumfis) decided to settle at the present Ekumfi District. They speak Fante. The present traditional capital is at Ebiram where the seat of the paramount chief of the Ekumfi Traditional Council is situated. The main festival of the District is “Ayerye” (Drumming) celebrated by most communities in the District including Ekumfi Aboano (Ghana Statistical Service, 2014).

There are notably varieties of historical resources, cultural and traditional heritage forming the conceptions, beliefs, reverence, obedience and faith of the people within the project area of influence, which contributes to the central point of the socio-cultural and economic well-being of the people. The relevant historical feature of the area is identified as the continued use of the foreshore for ritual libation purposes and particularly the shoreline.

Given the project would cover significant area of the sea and shoreline of the Aboano community, the fisher folks consider that there would be the need to relocate the commonly used ritual grounds along the seafront and the associated activities, which presently situate within the project area.

There would also be loss of territorial control and economic benefits due to the Chief Fisherman and his subjects as the fish landings operation would be affected, which may cause some of the fishing operators to relocate to other fishing territory.

Therefore, the project would have considerable impact on the traditional practices of the fisher folks and their activities. Also, transfer of deities and their subjects would be required to minimize the envisaged impact.

However, it has been indicated that such decisions will be taken only in consultation with the chief priests and or the different deities along the sea who are stakeholders in using the sea for ritual purposes.

5.9 Green House Gas Emissions

Greenhouse Gases (GHG) emissions into the atmosphere venting from anthropogenic sources are considered to be partly responsible for the global

warming and causing global climate change. It is recognized that the average temperature on the Earth has increased by 0.7 degree Celsius since the start of the industrial revolution.

The United Nations Framework Convention on Climate Change (UNFCCC) is aimed to disclose country level contribution to the global GHG emissions as well as provide background to analyze emissions by sources.

The principal sources of greenhouse gases emission in Ghana are identified to include agriculture, forestry, energy (fuel combustion, mobile combustion and fugitive emission), Industrial Processes and waste. The Green House Gas emission situation in Ghana is presented as following:

Table 5-16 Green House Gas Emission Baseline

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total GHG Emissions Excluding Land-Use Change and Forestry (MtCO ₂ e)	20.02	20.80	19.03	22.25	23.19	22.99	22.73	23.77	25.59	27.53	27.34
Total GHG Emissions Including Land-Use Change and Forestry (MtCO ₂ e)	51.15	51.98	50.23	53.58	54.25	54.24	53.95	55.00	56.88	58.89	58.84
Total CO ₂ (excluding Land-Use Change and Forestry) (MtCO ₂)	7.72	7.45	6.97	7.41	8.74	9.38	8.76	10.09	11.70	12.52	12.81
Total CH ₄ (MtCO ₂ e)	7.68	8.26	7.86	9.18	8.99	8.69	8.92	8.86	8.99	9.57	9.32
Total N ₂ O (MtCO ₂ e)	4.54	5.02	4.13	5.60	5.39	4.84	4.96	4.73	4.78	5.32	5.08
Total F-Gas (MtCO ₂ e)	0.08	0.08	0.08	0.07	0.08	0.09	0.09	0.10	0.10	0.11	0.12
Total CO ₂ (including Land-Use Change and Forestry) (MtCO ₂)	38.76	38.54	38.12	38.62	39.70	40.41	39.86	41.26	42.94	43.83	44.19
Total CH ₄ (including Land-Use Change and Forestry) (MtCO ₂ e)	7.74	8.31	7.89	9.26	9.06	8.84	9.00	8.90	9.03	9.61	9.41
Total N ₂ O (including Land-Use Change and Forestry) (MtCO ₂ e)	4.56	5.04	4.14	5.63	5.42	4.91	5.00	4.75	4.80	5.33	5.12
Energy (MtCO ₂ e)	9.45	9.32	9.00	9.65	11.02	11.74	11.17	12.54	13.94	14.50	16.30
Industrial Processes (MtCO ₂ e)	1.03	1.03	1.02	0.97	0.98	0.98	0.99	1.00	1.30	1.11	-
Agriculture (MtCO ₂ e)	7.72	8.50	6.93	9.45	8.94	7.98	8.23	7.83	7.91	8.94	8.36
Waste (MtCO ₂ e)	1.81	1.94	2.07	2.19	2.24	2.29	2.35	2.40	2.45	2.49	2.54

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Land-Use Change and Forestry (MtCO ₂)	31.13	31.17	31.20	31.32	31.06	31.25	31.22	31.23	31.29	31.36	31.51
Bunker Fuels (MtCO ₂)	0.41	0.41	0.41	0.51	0.50	0.54	0.57	0.64	0.66	0.84	0.98
Electricity/Heat (MtCO ₂)	1.97	1.76	0.67	1.21	2.42	2.63	1.91	1.71	3.10	2.72	3.18
Manufacturing/Construction (MtCO ₂)	0.95	0.95	1.03	1.07	1.15	1.18	1.14	1.46	1.42	1.60	1.81
Transportation (MtCO ₂)	3.36	3.11	3.61	3.57	3.61	3.81	3.70	4.99	5.09	5.66	6.74
Other Fuel Combustion (MtCO ₂ e)	2.90	3.23	3.41	3.52	3.57	3.84	4.14	4.11	4.05	4.24	4.29
Fugitive Emissions (MtCO ₂ e)	0.27	0.27	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28

6 CONSULTATIONS

The Chapter presents the findings of all the consultations and engagements in relation to informing all stakeholders to be affected by the project, including the state agencies, District Assemblies and local communities and individuals etc. The dialogue covered the various issues of concern in relation to the potential impact of the project and the mitigation proposals to alleviate potential impact.

Consultations and dialogues commenced from project conception and through the inception of project development from Pre-feasibility preparation to the feasibility phases. Furthermore, the consultations continued through the scoping phase of the ESIA and subsequently through the preparation of the ESIA.

The overall goal of the consultations and dialogues seeks to identify the potentially significant adverse and positive environmental and social issues relating to the development, operation and decommissioning of the proposed 2X350 MW Supercritical Coal-fired Power Generating Plant and affiliated Coal Handling Terminal and related facilities situated at Aboano along the coast for appropriate mitigation consideration.

The key issues identified during scoping provided the basis for defining the scope of the ESIA and the approach to addressing the issues; providing appropriate inputs to especially the design of the environmental and socio-economic baseline studies to ensure sufficiently informing the process and all relevant stakeholders of the potential impact and implications and mitigation interventions.

6.1 Public Consultation and Disclosure Plan

The Public Disclosure Plan is prepared as part of ESIA for the Coal Handling Terminal affiliated to the 2X350MW Supercritical Coal-fired Power Plant.

The Public Disclosure Plan (PDP) represent a two-way communication process between the stakeholders and the Project; facilitating effective engagement with the stakeholders. The PDP is prepared in accordance with the Environmental Impact Assessment Guideline for the Energy Sector (EPA Vol 2) and the Performance Standard (PS) of International Finance Corporation (IFC) and according to Equator Principles.

According to IFC PS-1 Stakeholder engagement is an ongoing process that provides framework involving varying degrees of the following elements: stakeholder analysis and planning, disclosure and dissemination of

information, consultation and participation, grievance mechanism, and ongoing reporting to affected communities. The nature, frequency, and level of stakeholder engagement may vary considerably and will be commensurate with the project’s risks and adverse impacts, and the project’s phase of development.

The framework therefore seeks to:

1. Ensure appropriate technical and cultural approach to engaging with all key stakeholders;
2. Ensure efficient stakeholder information sharing process with affected stakeholders and other interested parties;
3. Provide sufficient opportunity for stakeholders to express their views and concerns;
4. Facilitate integration of stakeholder concerns and commitments into operations management systems and decision-making processes.

6.1.1 Stakeholder Identification and Analysis

Based on stakeholder identification and analysis, the key stakeholder groups, including those affected directly and indirectly and positively and negatively, are listed in **Table 6-1**.

Table 6-1 Stakeholder Identification

Stakeholder	Type of Stakeholder	
	Affected Party	Interested Party
Neighbouring communities/inhabitants		
Local Fishermen	✓	
Local Farmers	✓	
Local Administration	✓	
Chief and member of Ekumfi Aboano	✓	
Chief and representatives of Ekumfi Aboano, Kuntakure, Otuaam and Estibaadu	✓	
Fisherman of Ekumfi Aboano	✓	
Ekumfi District Assembly	✓	
Institutional Agencies		
Ghana National Fire Service		✓
Ghana Grid Company Ltd	✓	
Electricity Company of Ghana	✓	
Ghana Water Company Ltd	✓	
Geological Service Department		✓
Meteorological Service Agency		✓

Hydrological Service Department		✓
Ghana Water Comp. Ekumfi District	✓	
Office of the President		✓
Chinese Embassy		✓
Regulatory Agencies		
Environmental Protection Agency (EPA)		✓
Ghana Ports and Harbours Authority (GPHA)		✓
Ghana Maritime Authority (GMA)		✓
Ministry of Power		✓
Ghana Investment Promotion Centre		✓
Public Utilities & Regulatory Commission		✓
Registrar's General Department		✓
Town & Country Planning Central Region		✓
Energy Commission		✓
Water Resource Commission		✓
Town & Country Planning Central Region		✓
NGOs		
Ghana Youth Environmental Movement (GYEM)		✓
Ghana Youth Climate Coalition (GYCC)		✓

6.1.2 Stakeholder Engagement Approach

The stakeholder Engagement Approach has been structured to consistently engage all the stakeholders both affected and interested parties and ensuring they are appropriately informed about the project development and progress during all the various phases of the project.

Furthermore, the engagement is expected to provide the appropriate channel for receiving information on the environmental and social performance of the project, obtaining feedback on the effectiveness of the environmental mitigation measures and management initiatives as well as dialoguing on grievances and issues of mutual interest between stakeholders and the project owners.

The stakeholder consultation and engagement process involved:

1. Consultations with identified key stakeholders during the planning phase of the project, which also formed a part of the scoping activities for the project to present the proposed Project and its related components and the initiation of the ESIA process.
2. Consultations and engagement with the stakeholders have continued after the scoping phase to present reasonable details of the Project features and the identified impacts and proposed mitigation measures for

discussions. The engagement further allowed stakeholders to submit and dialogue on issues of concern in relation to the aspects of the project.

3. As part of the ESIA process, a Public Hearing at the District level with Regional representation was planned to present the Project Features and Characteristics as well as discuss the issues of concern to stakeholders. On completion of the draft ESIA report, the reports would be exhibited at designated place for public review according to the Public Disclosure Plan.
4. On completion of the Final ESIA, a National Forum would be organized to present the final ESIA on the project.
5. The engagement process would continue with the stakeholders appropriately at all levels during the project development and implementation phase to ensure that the project technical and cultural integration has been effective.

6.1.3 Public Disclosure Plan

The Disclosure Plan aims at providing detailed information to the public about the proposed Project features and development activities; including the potential impacts, the planned mitigation and monitoring measures and the environmental management plan.

The plan is intended to offer complete access to the information, consequently after submission of the draft ESIA report to EPA an advertisement and notification to the public would follow to make the information available for public review for a period of 30 days.

The notification would be made in the daily newspapers indicating the places where the report is exhibited and available for public viewing, the period of exhibition and contact information.

The places identified for the exhibition of the report include:

1. EPA Head office and Regional Office
2. Ekumfi District Assembly
3. VRA Head office

6.1.4 Stakeholder Engagement Plan

The project would maintain consistent engagement with the stakeholders during the Project development and operation phases.

The primary objectives include:

- Ensuring all stakeholders are adequately informed about project progress and granted the opportunity to present concerns or grievances.
- Receiving feedback on the effectiveness environmental management measures and initiatives.
- Ensuring that grievance mechanism is well communicated and the grievances management has been transparent and effective.
- Project updates and progress information are available to all affected and interested stakeholders throughout the Project Life.

Stakeholder Engagement Tools

The tools for communication and engagement with the stakeholders would include letters and newspaper publications and advertisement, forum/meetings, dialogue and seminars/workshops.

The tools used in specific instances would vary with the different stakeholder groups based on the vulnerability stature of the group to ensure effective communication and engagement with the stakeholder groups.

Project information and communication would consider cultural appropriateness and ease of understanding in illustrations.

Stakeholder Engagement Participation

High level representatives of the Project would always participate in the sessions to assure of the full commitment of the company to the stakeholder engagement process, which building relationships and bridging any communication gap with the stakeholder representatives.

6.2 Stakeholder Engagement Activities (SEA)

There have been consistent consultations with various identified stakeholders during the pre-feasibility study stage of the project through the scoping study phase and the preparation of ESIA of the project.

More than 20 stakeholder groupings have been engaged in various consultation and dialogue mechanisms and are informed sufficiently and further educated on the development impact and implications of the 2x350 MW Supercritical Coal-Fired Power Plant Project.

The SEA included field work which spanned several months during which the following were achieved:

- a) Stakeholder Identification and review;
- b) Notifications of key stakeholders and publications in the print and electronic media; and
- c) Seminars, workshops, fora and direct consultation meetings with the various stakeholders including national institutions and state agencies, local-level agencies and organisations and traditional authority and local groupings (including trade associations, social groups and NGOs).

6.2.1 Stakeholder Identification (Mapping)

There have been consistent consultations with various identified stakeholders during the pre-feasibility study stage of the project through the scoping study phase and the preparation of ESIA of the project.

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- c) Seminars, workshops, fora and direct consultation meetings with the various stakeholders including national institutions and state agencies, local-level agencies and organisations and traditional authority and local groupings (including trade associations, social groups and NGOs).

The consultation was extensive and inclusive involving various identified public stakeholders, which can be categorized into three levels namely National, District and Local level consultations. The National Level consultation covered for Power Generation: EPA, Energy Commission, Ministry of Energy, GRIDCo, VRA, Forestry Commission (Wildlife Division), NGOs and Central Regional Coordinating Centre (Minister's Office).



Stakeholder's Forum at Coconut Groove Hotel, Elmina



Stakeholder's conference at GS Plaza, Accra

The district level consultation engaged the District Assemblies and District Administration Agencies.

At local level the consultations engaged land owners, Chiefs and Leaders of trade associations and social groupings including the fishermen group, the farmers group, the women's group and the youth group.

Other consultative groupings engaged during the process include the media and Environmental NGOs and Social NGOs.

The public consultation process was peaked at the public hearing programme held at the Ekumfi District Assembly.

6.2.2 Notification of Key Stakeholders

The stakeholders selected during the identification process were either consulted with via fora, face to face meetings, or via written comment and media publications and announcements. During the pre-feasibility studies, public fora were held in Accra which brought together key industry players who were informed about the proposed project. Also face –to- face meetings were held with some of the keys stakeholders to further sensitize them of the project since it is a novelty in Ghana.

At the scoping stage, meetings were mainly arranged with EPA, Energy Commission and the local communities and related groupings. A background information document (BID) was developed to further sensitize the local communities on the project and related development. The BID provided an overview of the Project and also outlined ways through which additional issues and comments could be raised with VRA/SEC and the ESIA team. At the EPA, a presentation was made to further sensitize the Agency and sought their concerns. A copy of the BID is provided in **Appendix 3: Background Information Document (BID) for Scoping Consultation**.

6.2.3 History of Public Consultation

A comprehensive representation of consultative meetings by category of stakeholders is concluded in **Table 6-2**.

Table 6-2 History of Public Consultation

Public Forums

Name	Date of Meeting	Location
Public Forum	13th April 2015	Accra
Pre-feasibility Study Review	15th July 2015	Accra
Public Forum	25th September 2015	Ekumfi
Media Conference	9th March 2016	Accra
District Public Hearing	31th March 2016	Ekumfi
Media Conference	11th May 2016	Accra

Key Stakeholders

Name of Stakeholder	Date of Meeting	Location
GRIDCo	19th January 2015	Tema
Geological Service Department	30th January 2015	Accra
Meteorological Service Agency	30th January 2015	Accra
Hydrological Service Department	30th January 2015	Accra
EPA	11th February 2015	Accra
GPHA	16th February 2015	Tema
Ghana Maritime Authority (GMA)	11th February	Accra
Ministry of Power	25th February 2015	Accra
Ghana Maritime Authority	26th February 2015	Accra
Electricity Corporation of Ghana	20th March 2015	Accra
Ghana Investment Promotion Centre	20th March 2015	Accra
Public Utilities & Regulatory Commission	20th March 2015	Accra
Registrar's General Department	20th March 2015	Accra
Town & Country Planning		
Central Region	31th March 2015	Cape Coast
GPHA	1st April 2015	Tema
Energy Commission	8th April 2015	Accra

Ministry of Power	10th April 2015	Accra
GRIDCo	23rd April 2015	Tema
GPHA	13th May 2015	Tema
GMA	26th May 2015	Accra
Office of the President	14th July 2015	Accra
Chinese Embassy	14th July 2015	Accra
Ministry of Power	15th July 2015	Accra
GRIDCo	30th July 2015	Tema
Water Resource Commission	13th August 2015	Accra
GRIDCo	17th August 2015	Tema
GRIDCo	18th September 2015	Tema
Ghana Water Comp. EkumfiDist	23rd September 2015	Essakyir
ECG Ekumfi District	23rd September 2015	Essakyir
EPA	17th November 2015	Accra
Hydrological Service Department	2nd December 2015	Accra
EPA	8th December 2015	Ekumfi Aboano
Ekumfi District Assembly	8th December 2015	Ekumfi
EPA	18th February 2016	Accra
Ekumfi District Assembly	30th March 2016	Ekumfi
Town & Country Planning Central Region	5th April 2015	Cape Coast
Office of the President	19th April 2016	Accra
Energy Commission	26th April 2016	Accra
GPHA	28th April 2016	Tema
Electricity Corporation of Ghana	12th May 2016	Accra
Ghana Institute of Engineers	16th July 2016	Accra

Local Chief and People

People	Date of Meeting	Location
Chief and member of Ekumfi Aboano	25th January 2015	Apam
Chief and people of Ekumfi Aboano	6th August 2015	Ekumfi Aboano
Chief of Ekumfi Aboano	26th August 2015	Ekumfi
Chief and people of Akwidaa	7th September 2015	Akwidaa
Chief and representatives (farmer,	22nd October 2015	Akwidaa

fisherman, youth and women) of Akwidaa		
Chief and representatives (farmer, fisherman, youth and women) of Akwidaa	23rd October 2015	Ekumfi Aboano
Chief and representatives of Ekumfi Aboano, Kuntakure, Otum and Estibaadu	23rd December 2015	Takoradi
Fisherman of Ekumfi Aboano	5th April 2016	Aboadze
Chief and people of Ekumfi Aboano	21st April 2016	Ekumfi Aboano

NGOs

Name of Organization	Date of Meeting	Location
350-Reducing Our Carbon, Ghana Youth Environmental Movement	9th March 2016	Accra
350-Reducing Our Carbon, Ghana Youth Environmental Movement	8th May 2016	Tema

6.2.4 Consultative Meeting Agenda and Organization

Generally, each of the meetings followed this general format:

Introduction by the meeting facilitator, the stakeholders present VRA/SEC team and the ESIA team;

Brief description of the collaborating proponents;

Description of the development and components of the proposed 2x350 MW Supercritical Coal-Fired Power Plant and affiliated Coal Handling Terminal; and

Discussion of key issues and any information that may be relevant to the Project.

The stakeholders participating in consultative meetings during process duly registered their presence by signing attendance register. History of consultation, notes of the consultative meetings, attendance registers, written comments and correspondence received were collated and reviewed accordingly. Samples of the consultation records are provided in **Appendix 4: Consultation Records**.

A semi-quantitative method together with professional judgment and experience was used to identify and extract the key issues raised by

stakeholders during the scoping phase. A summary of these comments raised before and during the scoping consultations is as follows.

- **Ghana Maritime Authority (GMA)**
 - a) GMA explained that they regulate the marine environment by providing Security Compliance Code in accordance with the International Ship & Port Security Code (ISPS)
 - b) VRA/SEC to submit the Terminal Plan for assessment and subsequent approval by the National Security Committee which must be endorsed by the Minister of Transport
 - c) GMA also advised that they have the mandate to provide navigational aids for vessels within the Ghanaian Maritime environment as such would offer such service for a fee to VRA/SEC.
 - d) GMA will assign the navigational chart to the terminal once GPHA gives their approval among other services.

- **Ghana Ports & Harbours Authority (GPHA)**
 - a) GPHA indicated that since the terminal will be unique in terms of the cargo handled and may not duplicate any port cargo being presently handled in the Ports, they do not have any objection to the building of the terminal but due process need to be followed
 - b) GPHA advised that the feasibility as well as the scoping studies needs to be done comprehensively
 - c) GPHA also advised on the other stakeholders to be contacted such as the Survey, Metrological, Geological and Maritime Authorities
 - d) GPHA inform VRA/SEC that their services such as pilotage, towage among others are available for a fee.
 - e) GPHA suggested to VRA/SEC to build the coal handling terminal at their preferred location which will fit into GPHA's ports development programme for the Central region.

- **Energy Commission (EC)**
 - a) The EC has no objection to the proposed project but advised VRA/SEC to use the best available technology to limit pollution.
 - b) EC also informed VRA/SEC to apply for a Wholesale Electricity Supply License which will allow for generate power



Consultative meeting with Energy Commission

- **Ghana Investments Promotion Centre (GIPC)**

- a) GIPC acknowledges the enormous potential benefits of the project including employment, skills development through technology transfer, foreign exchange savings etc
- b) GIPC advised VRA/SEC to register under the GIPC Act 2013 (Act 865) to enjoy incentives such as custom duty exemption etc.

- **Ghana Water Company Limited (GWCL)**

- a) GWCL inform the VRA/SEC that Ekumfi Aboano and its environs receive water from the new Essakyir Water Treatment Plant that currently operates only 10% of its installed capacity of 14400m³/d.
- b) GWCL will conduct a technical assessment to determine the feasibility of supplying water to the proposed plant
- c) GWCL requested for a joint site visit to be acquainted with the project location

- **Environmental Protection Agency (EPA)**

- a) EPA requested for a site visit to be acquainted with the location
- b) EPA suggested to VRA/SEC to look into different coal-fired power plant technology in generating electricity
- c) VRA/SEC need to provide to the Agency the characteristics of the coal to be used and the fly ash
- d) EPA cautioned VRA/SEC to critically assess the siting of the plant since the current location is only 0.6km away from the nearest village. Modelling need to be done to determine the extent of impact on the nearest village.



Presentation to EPA



Meeting with GRIDCo

• **Chief and Elders of Ekumfi Aboano**

- a) The issue of disposal of chemical waste into the marine environment
- b) The effect of the exclusion zone round the coal handling terminal on the fishing activities
- c) Compensation for lands acquired
- d) The effect of blasting during construction and its effect on the building and also health of the people
- e) Social benefits for the community such as free electricity, clearing of rocks to aid fishing etc.
- f) Project will provide alternative source of income and employment for the youth in the community
- g) Effect of breakwater construction on the shoreline including erosion and flooding



Consultative meetings with the Chief, Elders and the people of Ekumfi Aboano

• **Encounter with Media**

The Proponents have held two engagements with the Media, which involved delivery of various presentations, followed by questions and answers session to inform the media appropriately and adequately. This is also in

pursuit of the public awareness programme.



Encounter with the Media- March 2016



Encounter with the Media- May 2016

- **Traditional Elders**

Consultations with the chiefs and elders of the communities during investigation of the historical resources and heritage assets as well as related traditional practices of the communities.



Consultations with traditional elders on Historical Resources and Heritage Assessment

- **Public Hearing Programme**

The scale of project development required public hearing forum bringing the various stakeholders together for public disclosure and discussion of concerns. Consequently, with the support of EPA, a Public Hearing forum took place on the 31st of May 2016 at the Ekumfi District Assembly community hall premise. In attendance were the chiefs, queenmothers and sub-chiefs of the communities within the catchment area, the people of the communities, the various governmental agencies from the regional and district levels.



Public Hearing Forum at Ekumfi District Assembly Community Hall

6.2.5 Main Inquires, Proposals and Concerns

The main inquires, proposals and concerns presented by Stakeholders during the Consultation process and corresponding responses are concluded in **Table 6-3**.

Table 6-3 Main Issues Raised the Various Reponses during Public Consultation

No.	Stakeholder	Location	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses
1	Neighbouring communities/inhabitants			
	Fisherman of Ekumfi Aboano and Kuntankure	Ekumfi	Effect of the facility on the fishing operation, especially fish landing considering the type of fishing practiced	The project would provide alternate fish landing site
	Farmers of Ekumfi Aboano and Kuntankure	Ekumfi	Land acquisition and compensations issues	VRA/SEC would follow national regulation and good international practices
	Chief and representatives of Ekumfi Aboano, Kuntakure, Otuum and Estibaadu	Ekumfi	Emission standards, blasting and consequent impact, effect of breakwater construction on shoreline erosion and flooding, disposal of chemical waste, exclusion zone and effect on fishing operation, property acquisition and compensations, employment generation for the youth and other social benefits.	Environmental standards including emissions would meet the national and international standards. Property acquisition and compensation process would also conform to the national and international standards and practices. Varied types of employment opportunities would be offered for hundreds of workers.
		Ekumfi	Emission standards, waste disposal management, property acquisition and compensations and employment generation	Emissions would meet the national and international standards and property acquisition process would also conform the national and international standards. Varied types of employment opportunities would be offered for hundreds of workers.

No.	Stakeholder	Location	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses
2	Institutional Agencies			
	Ghana National Fire Service	Accra	Fire safety requirements and certification process for the internal fire system and functional features	The project would conform to national and international fire safety requirements
	Ghana Grid Company Ltd	Tema	Grid connectivity issues and requirements for environmental permitting and grid construction	The Grid Impact Study has been completed by Gridco. Environmental Impact Assessment study would be conducted.
	Electricity Company of Ghana	Accra	Project capacity and supply availability and reliability issues.	The project is design to have high availability and reliability
	Ghana Water Company Ltd	Accra	Local water supply system and operational capacity to supplement water requirements of the project as well as its feasibility.	Arrangement for a joint site visit.
	Ghana Ports and Harbour Authority	Tema	Discussion on the adequacy of existing port facilities to meet the requirements of shipping coal from South Africa to Ghana. Requirements for development of port facilities	Shipment requirements of coal for the operation of the Power Plant are higher than can be accommodated by the existing port facilities
	Water Resource Commission	Accra	Water-use demands for the development and operation of the power plant and supply requirements.	Regulatory requirements for water-use.
3	Regulatory Agencies			
	Environmental Protection Agency (EPA)	Accra	Request for site visit, consideration of best available coal-fired technology and providing information on the characteristics of the coal and fly ash. Concerns of minimum distance to neighbouring communities and the need for modeling to predict the extent of	The project is adopting the best available technology given the design parameters and the environmental circumstances

No.	Stakeholder	Location	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Responses
			impact on the nearest village.	
	Ghana Ports and Harbours Authority (GPHA)		Conflict of the Operational features and requirements of the Terminal with the mandate of GPHA. Due process for development of the Terminal reckoned with needed consultations with Survey, Metrological, Geological and Maritime Authorities. GPHA services and fit of the Terminal with GPHA's ports development programme for the Central region.	The project is intended to meet the regulatory requirements of GPHA for the development and operation of port facilities and also international requirements for port safety
	Ghana Maritime Authority (GMA)		Regulation of the marine environment, provision of navigational aids for vessels and assigning navigational chart to the port.	Submission of Port Plan for assessment and subsequent approval
	Ghana Investment Promotion Centre		Acknowledgement of the potential benefits of the project and advice to register under the GIPC Act 2013 (Act 865) to enjoy incentives such as custom duty exemption etc.	The project would consider registration under the GIPC Act.
	Energy Commission		No objection to the proposed project, deployment of best available technology to limit pollution and application for wholesale Electricity Supply License.	Affirmation to deploy the best available technology.
	Town & Country Planning Central Region		Zoning provisions within the project area and no conflict with the existing land use.	Project area is not particularly zoned.

6.3 Scoping Notice

According to the requirements under the EIA process in accordance to the Regulation 15 (1) of LI 1652, the Administrative procedure for scoping exercise required that the public is adequately and appropriately informed. Accordingly, notices are issued to relevant ministries, departments and agencies including Assemblies. Furthermore, advertisement was published in the Daily Graphic and the local radios.

6.3.1 Local Scoping Notice

The notice was placed in various locations within the communities and are listed to include:

- a) Ekumfi District Assembly (Notice board)
- b) Etsibeedu Palace (Delivered to the Chief)
- c) Aboano Palace (At the entrance)
- d) Hotel Facility at Aboano (Electric pole at the entrance of the hotel premise)
- e) Aboano Village (Electric pole within the community)
- f) Redemption International School, Aboano (Electric pole within the school premise)
- g) Kuntankure settlement (Electric pole within the vicinity)
- h) Otuum (Assemblyman’s office notice board)

Copy of the notice is attached as **Appendix 5: Scoping Notice**.



At the Aboano Palace



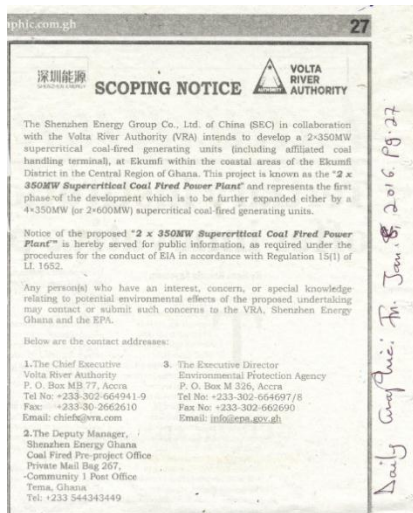
At the Aboano Village



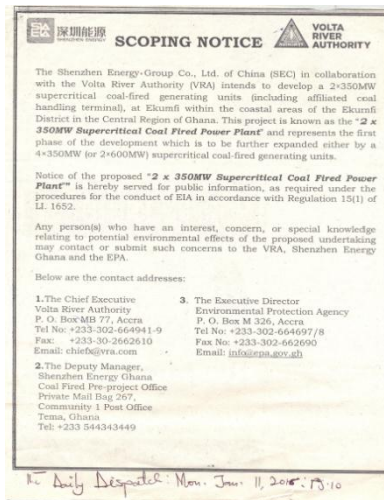
At the Hotel Facility

6.3.2 National Scoping Notice

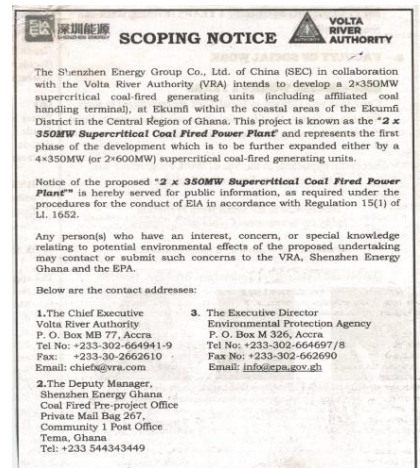
The notice was published on the national newspapers, including Daily Graphic (8th January, 2016), Daily Dispatch (10th January, 2016), and Ghanaian Times (11th January, 2016).



On Daily Graphic



On Daily Dispatch



On Ghanaian Times

7 IDENTIFICATION, ANALYSIS AND EVALUATION OF IMPACTS

The chapter provides detailed description of the occurrence and intensity of potential impacts of the proposed the development including the methodology used for the impacts identification and assessment. Information on potential, positive and negative impacts of the proposed undertaking from the environmental, social, economic and cultural aspect in relation to the different phases of the development of the undertaking is provided. The potential sources of impact have been carefully assessed and the identified potential impacts are described in terms of their nature, duration, magnitude, extent and frequency and categorized into all the phases of the project, particularly Pre-constructional, Constructional, Operational and Decommissioning Phases of the project.

The project would involve the development, operation and decommissioning of 70,000 DWT Coal Handling Terminal and 10,000 DWT Material Offloading Facility affiliated to 2X350 MW supercritical coal-fired power plant. The development is envisaged to result in a number of potential impacts arising from activities related to the pre-construction, construction, operational and decommissioning phases of the project, which may affect the various receptors and the nature conservation interest within the project area of influence.

7.1 Approach and Criteria

7.1.1 Identification of Potential Environmental and Social Impacts

The potential impact identification process involves comprehensive assessment of the potential source of impact of the project development and associated activities to predict and evaluate the potential effects on the physical, biological, social and cultural environment within the project area of influence. The process started with scoping the project's environmental risk and impact implications in its area of influence and has continued through the preparation of the ESIA.

The methodology involved objective evaluation of the incidence of identified impacts in relation to the nature, magnitude, duration, extent and frequency of occurrence. The review would then consider measures identified to avoid, minimize, mitigate or compensate for the adverse impacts. In the incidence of positive impacts, the review would consider measures enhancing the positive impact where possible. Furthermore, indications would be given relating to monitoring of relevant residual impacts and mitigation intervention to modify mitigation intervention and optimize overall environmental performance with minimal cumulative impact.

The methodology is therefore illustrated as following:



7.1.2 Identification of Residual and Cumulative Impacts

Residual Impact is here considered as the impacts that remain following the implementation of mitigation measure, which may relate to each of the four key phases of the project namely design, construction, operation and decommissioning. On the other hand, Cumulative Impact is taken as the combined effect of individual impacts occurring when a receptor is affected by more than one impact during any phase of a development.

It has been widely recognised that project-level EIA alone cannot lead to comprehensive environmental protection or sustainable development ². Assessing the impacts of an individual project cannot always satisfactorily address the more strategic aspects of the project or the cumulative effects that may arise. Considerations of Strategic Environmental Assessment (SEA) are supposedly reviewed to address cumulative impact assessment and ensure that environmental consequences are addressed appropriately.

The environmental and social impacts are therefore assessed considering the environmental risk factors and parameters, identified impact implications in relation to the environmental resource/receptors. The assessment of impact therefore assesses the environmental parameter such as seawater quality and ambient temperature, ambient air quality, noise etc. and evaluates the impact source in relation to the environmental resource/receptor such as water body, community, terrestrial environment, marine environment etc.

The process is depicted as following:



²Guidelines for Landscape and Visual Impact Assessment 3rd edition – consultation draft

7.1.3 Impact Assessment Criteria

The assessment of impact would be based on quantitative and qualitative data available and based on experience. The qualitative risk assessment would be rated accordingly to the following impact classifications:

Table 7-1 Impact Classification

Classification	Rating
Significance	Magnitude, extent, duration
Intensity	Low, medium, high
Severity	Minor, Limited, Serious and Catastrophic
Probability	Low, medium, high
Frequency	Low, medium, high
Reversibility	Temporal or permanent

The significance of the impact is determined by the acceptability of a predicted impact to the resource or receptor and also the sensitivity (environmental value) and the magnitude of the impact (degree of change).

The approach therefore involves:

- a) Assigning receptor sensitivity;
- b) Assigning impact magnitude;
- c) Assigning impact significance;
- d) Predicting Cumulative Impacts.

Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource/receptor.

The magnitude designations are as follows:

- a) Positive
- b) Negligible
- c) Small
- d) Medium
- e) Large

The criteria for assessing the significance of impact consider:

- a) The likelihood of exceeding project standards in relation to

environmental quality and the National Environmental Quality Guidelines;

- b) Impact affecting protected areas, valuable resources including nature conservation areas, rare or protected species, protected landscapes, historic features, livelihoods, important sources of water supply and other key ecosystem services;
- c) Conflict with the Corporate Environmental Policy and Practice.

The significance of impact is rated as Negligible, Minor, Moderate and Major and may be determined using the impact matrix below:

Table 7-2 Significance of Impact

		Sensitivity / Vulnerability / importance of Resource /Receptor		
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

Impacts on receptors can be varied and can be considered as negative, positive, direct or primary, indirect or secondary and cumulative, short term, long term and permanent. The importance and sensitivity of the receptors is defined by the relevance to its local, national, regional and international designation, its importance to local or wider communities, ecosystem function and economic value. The assessment takes into account the likely response of the receptor to change and the ability to adapt to and manage the effect of the impact.

Subsequent to the scoping study and assessment of identified potential, mitigation interventions have been considered and incorporated at the project design stage of project development process. The contemporary approach to impact assessment and mitigation adopted by the project placed emphasis on reduction of potential adverse impacts and optimizing potential benefits through appropriate design interventions.

Consequently, a number of design options providing mitigation measures to minimize identified potential impacts and environmental performance enhancement have been considered at the project design phase. The assessment would therefore define the impact and the mitigation measures in order to avoid or minimize the impact. Residual impact, if applicable would be defined and assessed using the impact significance matrix. Furthermore, the assessment is carried in accordance with the Environmental, Health and Safety Guidelines for Ports, Harbours and Terminals of IFC/World Bank Group, April 2007.

Currently, realization of the project would involve construction and operation periods, which entails activities that could have potential impact on environmental resources and receptors within the area of influence.

7.2 Pre-Construction Phase Impacts

The pre-construction phase involves project pre-investment activities particularly including feasibility studies involving technical investigations, environmental assessment and preparatory works activities.

The technical investigations included marine and geotechnical investigations, hydrological studies, erosion survey, soil testing, bottom trawl survey and engineering investigations.

The process also involved consultations with various stakeholders, both the affected and interested groups, on the development of the Coal Handling Terminal and Material Off-loading Facility affiliated to the proposed 2X350MW Supercritical Coal-fired Power Plant.

These pre-construction activities principally involve physical assessment and chemical analyses of test samples where necessary, which are in smaller quantities and localized sites. Consequently, the environmental impact and implications in relation to air quality and marine ecology would be negligible.

7.3 Construction Phase Impacts

The construction phase would generally involve the following construction activities and developments:

- a) Erection of temporary construction compound and storage areas for construction materials;
- b) Blasting and dredging works; removal and management of dredged

- materials including sediments, debris of rocks and other materials;
- c) Installation and operation of construction machinery and equipment;
 - d) Construction of basin, breakwater and channel infrastructure and related works, and erection of structure and installation of unloading facilities.
 - e) Transportation of materials;
 - f) Repair and maintenance works of vehicles and machinery;
 - g) Removal of site offices/compounds and final site clearing and disposal of constructional materials at the completion of construction works;

The various activities are likely to result in environmental incidents, which potentially could impact of sensitive environmental resources/receptors.

7.3.1 Dredged Material Management

Dredging and dredged material disposal would make significant changes to the marine ecology and have consequent impacts on the marine habitats. It is envisaged that the total dredged volume of the dredged areas is estimated at 4.62 million cubic metres and the dredged materials would include 0.07 million cubic metres of reef explosion, 2.56 million cubic metres of fine sand and 1.99 million cubic metres of clayey sand.

The dredged materials would be disposed and discharged at about 18 km from the project site with a 25-metre water depth. The blasted reef would be cleaned and deposited in the mud-dumping area. The deposition would involve appropriate spread of dredged material over suited identified sites in order to minimize any change of the physical environmental characteristic.

The principal activities within the site area have been fishing using the beach seine fishing method consequently the site does not have history of on-site activities that might result in possible hazardous deposition including heavy metals and persistent organic pollutants. In addition, the off-site activities within the project vicinity have been mainly subsistence agriculture with little use of agro-chemicals if any. The nature of traditional agricultural practices and other off site activities in the area is not likely to have resulted in contamination from possible deposition of hazardous pollutants from urban surface or agricultural runoff. Consequently, the sediments are not contaminated from any on-site and off-site activities.

Two dredging methods are adopted for the dredging operations during construction of the basins; the grab dredger and trailing suction hopper dredger. These dredging methods have been carefully selected also based on the nature and characteristic of the seabed to ensure controlled and reduced re-suspension of sediments during the dredging operation.

The grab dredger uses bucket mounted on crane to collect the sediment, holding the material consolidated with little water content and therefore reducing the need for dewatering; while the trailing suction hopper dredger sucks the sediments from the seabed, pumping through trailing into a hopper.

Excavation and dredging methods as well as disposal options would facilitate minimized suspension of sediments and safeguard destruction of benthic habitat. At the same time the methods would ensure increased accuracy of the dredging operation and appropriately maintaining the density of the dredge material.

Furthermore, the blasting and dredging operations and the disposal of the dredged material would be carefully conducted in a fashion so as to avoid fish migration or interruption of sensitive areas for marine life such as feeding, breeding, calving, and spawning.

The operation would adopt appropriate techniques to control suspension of sediments to minimize adverse impacts on aquatic life; ensure routine inspection and monitoring of dredging activities would be instituted to evaluate the effectiveness of impact prevention strategies, and where necessary re-adjust the prevention strategies.

However, should the operation observe contaminated materials or sediments, the operation would adopt the use of borrow pits to reduce the spread of the sediments and control the consequent effects on benthic organisms. Where necessary, the process would also consider the use of level bottom capping or combination of borrow pits with capping to reduce underwater spread of contaminated material.

7.3.2 Air Quality

The key source of air pollution would be earthworks along the shore and exhaust emissions from the operation of construction machinery and equipment into the atmosphere; furthermore, trucks and equipment supplying boulders and construction materials to the site would generate dust and exhaust fumes on site and off site. Also the vessel transporting the dredged materials to the dumping site would generate emissions into the atmosphere.

The principal pollutants would include dust, sulfur dioxide (SO₂), nitrogen oxides (NO_x), particulate matter (PM), and carbon monoxide (CO).

The impact of the identified emissions could be assessed based on the estimated exhaust gas emissions levels generated by the activities. This could be determined by calculations using emission factors including manufacturers' specifications, which are internationally accepted and AERMOD software to model the dispersion and outfall. However, the type specification and number of construction machinery that would be deployed and their related operational requirements are not provided at this stage. Consequently, it would be difficult to determine quantitatively the level of air emission generated by the identified sources. In this regard, qualitative assessment is considered in determining the relative impact on ambient air quality.

The principal likely receptors are operatives of the fishing sector within the immediate vicinity, residents of adjoining communities and the construction workers.

From available data and indications especially relating the construction activities the pollution could be moderate and confined to the project site. Furthermore, the duration and extent would be limited to the period of construction.

In relation to the baseline ambient air quality situation of the AOI, the impact on air quality, particularly from the exhausted fumes on the identified receptors could be rated as moderate and the severity rated as low.

Generally, the construction operation would ensure that the construction machinery and equipment would be carefully selected, operated and maintained to ensure minimal exhaust emission.

The residual impact is expected to be minimal and therefore considered as minor and severity would be minor however occurrence is likely.

7.3.3 Noise and Vibration Impact

Earthworks and construction processes including drilling, blasting, dredging and excavation, cutting, hammering, welding etc, operation of machinery and vehicles, movement of machinery and vehicles and increased human activities would be the identified principal sources of noise and vibration generation and nuisance.

The quantitative amount of earthworks and construction works have been specified, however it would be difficult to specify the number and nature of construction equipment and vehicles that would be deployed and the related

operational requirements and movement at this stage. Consequently, determining the noise and vibration nuisance generated by the identified sources would be difficult. Consequently, qualitative assessment is used to determine the relative impact on the potential receptors.

The key identified receptors include the construction workers, inhabitants of close by communities and marine fauna. Additionally, on-site visitors may also be affected by the noise nuisance.

Given the scale of construction works, the ambient noise level is expected to increase considerably beyond the baseline value resulting from the massive construction activities and both machinery operation and vehicular movement to and from the project site. However, the duration and extent would be limited especially to the initial stages of construction operation.

Potential noise impacts associated with the construction phase are illustrated in **Table 7-3** below.

Table 7-3 Potential Noise Impacts Associated with the Construction Phase

Activity	Potential impact	Magnitude of potential impact	Sensitivity of impact	Significance of potential impact	Need for Mitigation	Comment
Construction machinery and vehicles	Noise disturbance and annoyance	Medium	Local	Minor/ Negligible	Relevant	The source of noise may be the engine and exhaust. The potential impact is general disturbance and annoyance. The type of mitigation required includes proper operational procedures and operating sequence as well as effective engineering maintenance practices in accordance to manufacturers' instructions.
Compressors and generators	Noise disturbance and annoyance	Medium	Local	Minor/Negligible	Relevant	The source of noise may be the engine, pulleys, valves and nozzles. The potential impact is general disturbance and annoyance. The type of mitigation required includes proper operational procedures and operating sequence as well as effective engineering maintenance practices in accordance to manufacturers' instructions.
Blasting, drilling, excavation, dredging, hammering and welding	Noise disturbance and annoyance	Medium	Local	Minor/Negligible	Relevant	The source of noise may be the tool bit or entire machine. The potential impact is general disturbance and annoyance. The type of mitigation required includes proper operational procedures and operating sequence as well as effective

						engineering maintenance practices in accordance to manufacturers’ instructions.
Cement mixing, materials handling and batching plant	Noise disturbance and annoyance	Medium	Local	Minor/Negligible	Relevant	The source of noise may be the engine, filling, cleaning or impacts. The potential impact is general disturbance and annoyance. The type of mitigation required includes proper operational procedures and operating sequence as well as effective engineering maintenance practices in accordance to manufacturers’ instructions.

7.3.4 Waste Water

Construction work and activities would consume considerable amounts of water and also generate significant amount of waste water. The principal activities consuming water include concrete works, cleaning of construction equipment and domestic applications. Waste water resulting from construction works would relate to cleaning water, domestic sewage and possible dewatering of sediment, which may be insignificant, if well managed and monitored. However, domestic sewage would be a key source of waste water generation.

Similarly, considering the scale of development and related operational requirements, the human activities would be significant as it is estimated that more than three hundred people would be involved in the constructional phase. Consequently, the domestic sewage could be significant if not well managed and controlled and could possibly pollute the receiving water bodies.

The principal receptor would be the sea, nearby surface water and underground water as the sewage may drain or sip in to these water bodies. Such impact could be rated as moderate and the severity also as low.

Domestic sewage would be appropriately managed and disposed through the district assembly waste management system.

The residual impact is expected to be minor and the severity also rated as minor.

7.3.5 Solid Waste

Solid waste generation may result from construction debris and excavations including rocky materials as well as waste from packaging materials like cartons, wooden cases and pallets and domestic activities including food wrappers and leftovers. There would be large quantity of dredged and excavated materials, which would be managed under the Marine Dredging Management Plan discussed above. Construction activities, especially blasting and removal of spoils would be planned and arranged to ensure minimal nuisance to marine organisms and habitats is caused by the operation.

Considering the shoreline and wharf construction works, it is expected that debris from construction works would be mainly grass vegetation and smaller rock boulders. Additionally, waste from packaging materials and domestic waste including food leftovers could be significant.

The main receptor is the physical environment which would receive the waste materials. Indiscriminate dumping of waste would be avoided to ensure proper

management and disposal of the waste generated using the municipal authorities and waste management system.

The impact on the identified receptor could be rate as minor and the severity could also be rate as low. The likelihood is rated unlikely.

7.3.6 Traffic and Transport Impact

The principal transportation requirement relates to transportation of dredged materials for disposal within 25 km offshore and transportation of boulders from the inland quarry sites to the construction site.

Special purpose vessels would be used to meet the operational requirements for disposal and containment of dredged materials. Traffic impact would relate to other operative at sea including the canoe fishermen. However, the impact is expected to be minor as primarily fishing method and activities within the vicinity is purse seine draw net, which is restrictive and operate principally near shore and therefore remote from the disposal site. Nonetheless, fishing operations in the area would be restricted to the right and left sides of the port restricted zone.

Also heavy duty vehicles and trucks carrying construction and building materials to and from the project site during construction may affect traffic flow and could even cause accidents on existing access roads, particularly the Accra – Cape Coast highway, which is relatively narrow.

The main receptor could be the general public and especially road transport operators plying the route daily.

It is envisaged that larger proportion of the construction materials would be generated on site through cutting and would be reused on site. Consequently, transportation of construction materials would be considerably limited. However, the principal impact would involve transportation of heavy duty construction machinery and trucks to the project site. Breakdown of such truck could create heavy traffic on the highway if not managed. Escorts would be provided during such operation and where necessary. In addition, visibility of the vehicles would be greatly enhanced through the use of reflectors and flags to improve being noticed at distance.

In general, the residual impact would be minor as traffic incidence would be limited and can be managed and controlled effectively. Consequently, the severity would also be minor and unlikely.

7.3.7 Ecosystem

Construction works would mainly involve large scale dredging and blasting and disposal of dredged materials. These would impact significantly on the immediate or direct marine ecology in changing the physical structure of the sea bed and the general environment of the area designated for the construction of the terminal and disposal of the dredged materials.

Generally, the sediment samples taken from offshore Ekumfi showed rich diversity and abundance of macro benthic infauna with as much as 70 different species identified. Macro-invertebrates are the primary food base for many fishes, birds, amphibians, and reptiles. The organisms, which are also central elements of intertidal and nearshore ecosystems, provide good indicators of environmental health.

Similarly, based on bottom trawl survey conducted within areas the dredged material disposal site the observations revealed that the fish species caught in the area designated as disposal site, the anchorage site as well as for the dredging basin and channel are common species found in Ghanaian waters. Also, it worth noting that the sizes of the fish caught were much smaller as compared to the maximum attainable sizes, indicating that these species are currently overfished.

No endemic/vulnerable/threatened fish species was captured thus no conservational concerns can be attributed to the use of the area as disposal site. However, monitoring of the site must be undertaken during construction and post construction periods to make sure any unforeseen changes are detected early enough and mitigation measures applied.

The same conclusion applies to the benthic infauna baseline survey undertaken. No endemic/vulnerable/threatened infaunal species were found, thus no conservational concerns can be attributed to the use of the area as disposal site. Monitoring, at least twice a year, preferably during the major or upwelling seasons, is required as early signals to safeguard against unforeseen adverse impacts to the infauna which are a major source of food for demersal fishes.

It can be concluded that the envisaged change in the project area, which forms a smaller part of the offshore environment of Ekumfi Aboano with high diversity and abundance of benthos, is not likely to alter any significantly the sedimentary characteristics of the near sea and consequently unlikely to impact on the rich diversity and abundance of macro benthic infauna.

Therefore, the construction activities are not likely to alter the ecological structure, especially the sedimentary characteristics of the intertidal and near-

shore ecosystem within the Ekumfi shore area; and therefore unlikely to have any significant adverse impact on the marine fauna.

Similarly, based on bottom trawl survey conducted within areas the dredged material disposal site the observations revealed that the abundant fish species are overfished and are in relative abundance in other areas along the coastal region. It is therefore concluded that disposal of dredged material in the designated area would not create any significant adverse impact on the marine ecology and marine resources.

The residual impact would therefore be low and unlikely.

However, an Environmental Monitoring and Evaluation Programme would be instituted to incorporate the intertidal and near-shore ecosystem monitoring to prevent, reduce or mitigate the release of harmful elements/chemicals such heavy metals into the sedimentary environment from constructional as well as operational activities. The monitoring programme would involve quarterly evaluation of the sediment quality especially the macro benthic in fauna (benthos) abundance in the near sea within the project area.

7.3.8 Occupational Health and Safety

Construction activities including blasting, dredging, earthworks, construction works, operation of the construction machinery and movement of vehicles and machinery would generate dust, fumes and noise that could lead to possible respiratory problems, hearing loss and other health related problems to humans. Accidental tipping of construction materials and tools, use of power tools and accessories, falling gadgets, cuts from sharp objects as well as the inhalation of exhaust fumes from vehicles and equipment could cause potential injuries and harm to health of especially construction workers and neighbouring residents.

The main receptors are the construction workers and the residents of the nearby communities.

Given the various mitigation interventions to eliminate or minimize dust generation, noise generation and exhaust gas emission and the limited duration of the impact during construction period, the residual impact, which would be localized, could be rated as low and since the impact is considerably short-term its severity could be rated as low.

Construction workers would be provided with appropriate and adequate personal protection equipment (PPEs), while ensuring effective use of the PPEs. This practice is expected to improve personal protection considerable and could

eliminate or minimize residual impact where needed. The residual and cumulative impact could be rated as minor and severity also negligible.

7.3.9 Community Health and Safety

Community health and safety issues during the construction of the Terminal relate to noise nuisance, vibration, traffic accidents and communicable diseases associated with the high influx of temporary construction labour.

The potential public health risks and insecurity resulting from the construction works and activities would relate to increased community population and the resulting demand on community health and educational facilities, demographic changes and cultural and moral implications. The key issues would relate to:

- Potential health risk due to degraded air quality, noise and vibration, visual impact and resulting emotional stress.
- Potential increase in traffic accidents
- Increased community population and attendant demand on community health and educational facilities and Increased public insecurity
- Increased economic activities (trading) and competition for local economic operators
- Decent jobs for local inhabitants (unskilled labour) and income opportunities
- Increased local population
- Constraints to fishing operation and potential loss of landing site and reduced fishing output

The potential impact would largely be positive and control interventions would seek to enhance overall benefits to the communities.

7.4 Operational Phase Impacts

The operations of the Terminal may be categorized into land-based operations and water-based operations.

The land-based operations would include cargo handling; fuel and chemical storage and handling and ship support services; waste and wastewater management; vehicle and equipment maintenance; and buildings and grounds maintenance.

The water-based operations would include berthing of ship and maintenance dredging of the harbour basin and access channel.

Both the land-based operations and water-based operations are likely to impact considerably on sensitive environmental resources/receptors. The likely impacts include ambient air quality, water quality, marine ecology and human health.

7.4.1 Air Quality

The most significant sources of air pollutants from the operations of the Coal Handling Terminal include dust from discharge and transfer of coal, combustion emissions from the propulsion and auxiliary engines and boilers of ships visiting the terminal, emissions from vehicles and auxiliary engines operating at the terminal. The pollutants would mainly consist of sulfur dioxide (SO₂), nitrogen oxides (NO_x), greenhouse gases (e.g. carbon dioxide [CO₂] and carbon monoxide [CO]), particulate matter [PM], and volatile organic compounds [VOC]). Volatile organic compounds (VOC) may also be emitted from fuel storage and transfer operations.

The principal mitigation measure involved enclosure of the coal unloading and handling facilities (Conveyor system).

The principal mitigation measures include:

- a) Timely watering would be employed on the wharf to reduce the re-entrainment of dust.
- b) The Unloader includes dust suppression sprinklers to prevent coal dust floating into the sea when handling.
- c) The belt conveyor involves the enclosure to prevent coal dust while transporting.
- d) Rapid flushing device is set up on coal wharf and the belt conveyor trestle for the regular flushing.
- e) Auxiliary machines and vehicles operating at the terminal would be selected based on high efficiency low emission engines.

The residual impact is expected to be low and therefore considered as minor and severity rated minor and occurrence is unlikely.

7.4.2 Waste Water

Waste water would include facility cleaning water, storm water and sewage from domestic effluent from the operation of the terminal, bilge water, ballast water and vessel cleaning wastewater from ships calling at the port. The sewage and waste water received from ship may contain high levels of BOD, Coliform bacteria, dissolved solid, oil, other chemicals and also have low pH levels. The vessel cleaning water may contain residues such as oil.

Measures to minimize or eliminate pollution from effluent would include:

- a) Storm drains would be provided in the terminal area and would have filtering mechanisms (eg drain inlet protection and sediment traps) to prevent sediments and particulates from escaping. Catch basins may be provided if appropriate to trap storm run-off before release into the sea.
- b) Containment basins for storm drains would be adopted in areas of high risk of accidental releases of oil and other hazardous materials (including coal and fuel oil), other than storm drainage catch basins discharging directly into the sea.
- c) Run-off collection points would be fitted with oil / water separators in identified runoff collection areas with likely risk of spillage. Oil / water separators and trapping catch basins would be maintained regularly to ensure optimized operation at all times. Solids and liquids contaminants recovered from storm water would be managed and disposed of as hazardous materials.

The residual impact is expected to be low and therefore considered as minor and severity rated low and occurrence is unlikely.

7.4.3 Waste Management

The solid and liquid wastes relating to the operation of the terminal would include solid waste from packaging materials, maintenance operations and administrative offices. In addition, the solid and liquid waste would also include the waste from vessels operating from or calling at the Terminal. The wastes originating from the vessels may include oily sludge and other materials such as food packaging, and food waste.

Generally, the facilities at the terminal to receive and manage effluents and wastes would be arranged to be adequate to meet both the internal requirements of the Terminal and the requirements of the ships calling at the Terminal. The collection and disposal system for ship-generated garbage for

ships alongside and at anchor, which would also be in accordance with the national regulatory requirements and regulations of MARPOL Convention 73/78, would be developed consistent with the International Maritime Organization Comprehensive Manual on Port Reception Facilities. The system would be primarily based on the contracted collection and disposal arrangement off-site. However, closable skips would be provided at the berths and ships at anchorage would be urged to discharge waste at berth. Food waste from ships would be managed according to local regulatory requirements.

The residual solid waste pollution impact is expected to be low and therefore considered as minor and the severity is also rated minor with its occurrence is rated unlikely.

7.4.4 Hazardous Materials and Oil Management

Hazardous materials at terminal would include oil, fuels, lubricants, solvents and other chemicals used in maintenance operations. Such hazardous materials may spill resulting from accidents (eg. collisions, fires etc), incidence of facility malfunction and failure (e.g hoses, flanges, pipelines burst), or improper operating procedures during transfer or handling of oils, fuels, lubricants etc.

Hazardous materials and oil management processes would be developed to ensure control, minimization and prevention of pollution and contamination. The control measures would include spill prevention and spill control planning such as:

- a) Temporary storage areas would be provided with covered and ventilated leaking hazardous cargo containment, designed to facilitate collection of leaks and spills (e.g. with sloping surface to allow capture of spills, use of catch basins fitted with valve that allow spills and releases to enter a dead-end sump from which spilled materials can be pumped).
- b) Hazardous materials storage and handling facilities would be arranged remote away from active traffic areas and further protected from vehicular accidents, where necessary.
- c) Oil and chemical-handling facilities would be located with consideration of natural drainage systems providing physical separation where possible.
- d) The operation of the Terminal would be guided by a spill prevention and control management plan and emergency response procedure and preparedness plan, which would be consistent with the IMO Manual on

Oil Pollution.

7.4.5 Noise

Noise sources within the operational areas of the Terminal would include coal unloaders and handling facilities, particularly the conveyor system. The selection of unloaders and handling facilities would take into account the noise levels of the individual machines and equipment to ensure that the overall residual noise level is minimal.

Additional noise sources would include noise from ships and other vessels calling and operating from the Terminal. However, these sources would remain temporary and brief as coal import would be efficiently managed to control transportation and its attendant pollution.

7.4.6 Ecosystem and Biodiversity

The potential impact of the operation of the Terminal may result from the mooring and anchorage of ships calling at the Terminal. Moored ships may cause disturbance through noise and movements of ships and therefore cause disturbance to marine fauna and possibly birds feeding within the intertidal area.

Anchorage

Anchoring of the ships, especially the envisaged size of ships calling at the Terminal, may cause significant disturbance or damage to the marine fauna and plants on the seabed. The impact may be temporary resulting from the increased suspended sediments due to the disturbance of the sea bottom soil or through direct contact with dragging anchors.

The key factors influencing the level of disturbance from anchoring include the frequency, magnitude and location of activity, type of sediments, and the sensitivity of benthic communities.

The impacts are significant in areas with sensitive or slow growing species, such as shellfish beds, soft corals and sea grasses. On the other hand, the impacts are low where the seabed sediments are soft and the damage caused by anchoring is likely to be minimal and any disturbance is generally temporary. Generally, the absence of sensitive rocky environment like subtidal reef habitats presents likelihood of low impacts of the anchoring operation.

Discharge of Ballast Water

Additionally, discharge of ballast water from ships calling at the Terminal during port operations may result in the introduction of invasive/non-native marine species into the marine ecosystem.

The mitigation measures to prevent and control the identified impacts include:

- a) Ballast discharge and facilities for cleaning ballast tanks would be arranged to provide adequate reception and treatment including filtration and sterilization facilities and also chemical treatment (biocides) to control and prevent introduction of invasive / non-native species. The operating structure would be in accordance with the Global Ballast Water Management Programme;
- b) The Terminal would develop Port and Port Authority Ballast Water Management requirements, which would include the availability, location, and capacities of reception facilities and information on local areas and situations where ballast water uptake should be avoided.

The wharf construction and existence of huge ships calling at the terminal may become sight obstruction for birds feeding from the intertidal feeding areas in the immediate environment.

Maintenance Dredging

Dredging during maintenance of the Terminal and disposal of dredged spoils may lead to short and long-term impacts on the immediate marine ecology and habitat as well as the shoreline. Direct impacts may include the physical removal or covering of sea bed, shoreline habitat, possible changes to water flow patterns and related sedimentation rates and patterns.

The indirect impacts may result from changes to water quality from sediment suspension or discharges of storm water and wastewater if any. These are likely to impact on the fishery resources and probably the other benthic organisms.

7.4.7 Occupational Health and Safety

Occupational health and safety issues during the operational phase of the Terminal would include exposure to dust and hazardous materials that may be

present in cargo and maintenance materials, and physical hazards associated with the use of heavy equipment and tools.

Specific occupational health and safety issues relevant to port operations primarily include:

- a) Exposure to physical hazards relating to cargo handling and use of associated machinery, lifting devices and vehicular transportation, work processes and access;
- b) Exposure to chemical hazards; workers at the terminal may be exposed to chemical hazards from handling bulk coal, solvents and other chemical materials. The workers may be presented with risk of exposure to volatile organic compounds (VOC) via inhalation or skin contact during normal use or in the case of spills. Coal dust and fuels are flammable and may present risk of fire and explosions;
- c) Exposure to organic and inorganic dust;
- d) Exposure to noise nuisance;
- e) Exposure to hazards relating to confined spaces.

The mitigation interventions would include:

Physical Hazards

The main sources of physical hazards at the Terminal would be associated with cargo handling and use of associated machinery and vehicles.

Mitigation measures for the prevention, minimization, and control of risk of physical hazards include the following:

1. Coal unloading and material handling facilities would be significantly automated to limit human interventions;
2. Safe access arrangements suitable for the transportation and handling of large and heavy plant components, machinery and materials off loaded at the terminal would be provided and ensured;
3. Lifting appliances would be equipped with means of emergency escape from the driver's cabin as well as a safe means for removal of an injured or ill driver;

Chemical Hazards

Chemical hazards represent potential for illness or injury resulting from severe exposure or chronic exposure to toxic, corrosive, sensitizing or oxidative substances. Chemical hazard can also represent risk of fire and explosion, if incompatible chemicals are inadvertently mixed.

Workers at the terminal may be exposed to chemical hazards from handling bulk coal, solvents (including paint materials) and other chemical materials. The workers may be presented with risk of exposure to volatile organic compounds (VOC) via inhalation or skin contact during normal use or in the case of spills. Coal dust and fuels are flammable and may present risk of fire and explosions.

Mitigation measures to prevent, minimize, and control risk of exposure to chemical hazards would include adopting the use of less hazardous substitute where possible.

Confined Spaces

Confined space at the Terminal, in which hazardous atmosphere could develop as a result of the contents, location or construction of the confined space, would include cargo holds, silos, sewage tanks, water tanks, and others. The potential for accidents in relation to serious injury or fatality can result from inadequate preparation to enter a confined space or attempting a rescue from a confined space. The operation of the Terminal would develop and integrate the implementation of confined space entry procedures, which would include among others procedures that prevent the use of combustion equipment in the interior of confined space.

Proposed measures to control and minimize identified hazards would include:

1. Design arrangement would consider avoiding characterized confined spaces where necessary; and characteristic confined spaces would be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. Adjoining access area to a confined space would be provided enough room for emergency and rescue operations;
2. Design of confined spaces would meet the specifications of the current ISO and EN standards;
3. Mechanical equipment in the space would be disconnected, de-energized, locked-out, and braced, as appropriate.

Dust

Potential exposure to fine particulates would be associated with unloading and handling of coal. Dust nuisance in the Terminal relates to the poor air quality resulting from the coal dust, which may possibly cause respiratory irritation, discomfort or illness to workers.

Interventions for prevention, minimization, and control of dust generation to maintain good air quality within the work area would include:

1. Unloading, handling and transporting discharged coal and storage practices would be enclosed as far as practicable to minimize release of fugitive contaminants into the work environment. The operation has therefore adopted grab unloader, enclosed conveyor system and enclosed coal stockyard.
2. Consistent watering of coal to suppress dust.
3. Ensuring contaminant dust concentration level remain below NEQG standards in the work;
4. Work shifts would be planned and arranged to control maximum worker exposure to contaminants.

Fire and Explosions

Fires and or explosions may result from ignition of coal dust, which may lead to loss of property as well as possible injury or fatalities to workers.

Prevention and control strategies adopted include:

1. Coal handling and storage areas are arranged remotely from ignition sources and entry and exit points;
2. Floor, roofing and fixtures would be constructed with spark-proof materials, and capable of flame suppression for moderate period and allowing appropriate floor and roof level ventilation;
3. Adequate fire extinguishing devices and self-closing doors would be provided;

4. Fire hazard areas would be well defined and labeled to warn of special rules including prohibitions in the use of smoking materials, cellular phones, or other potential spark generating equipment;
5. Specific and appropriate training would be provided to the workers in handling of flammable materials, and in fire prevention or suppression processes;
6. Electrical grounding, spark detection, and quenching systems would be provided

Noise

Noise sources in the Terminal area may include unloading, coal handling, material handling, vehicular traffic, and ship traffic. Noise nuisance may arise resulting from operation of the facilities. However, operation of these facilities would be occasional and brief. The residual impacts are therefore expected to be low and likely.

The primary receptors would be the workers and visitors to the plant site.

7.4.8 Community Health and Safety

Community health and safety issues at the Terminal may relate to noise nuisance, vibration, traffic accidents and communicable diseases associated with the high influx of temporary visitors.

Other issues during the operational phase would relate to safety to visitors calling at terminal, and the related security at the terminal and visual impacts implications.

Interventions to minimize the associated impact and implications would include:

1. Terminal Safety

The Terminal would adopt and implement a Safety Management System (SMS) capable of effectively identifying and correcting unsafe conditions routinely. The safety system would include procedures to regulate the safe movement of vessels within the terminal (including pilotage procedures), protect the general public from dangers arising from marine activities at the harbour, and prevent incidents that may result in injury to workers, the public, or the environment.

The Safety Management System would also include comprehensive emergency preparedness and response plans which would provide coordinated response to manage emergency situations.

2. Terminal Security

The management of the Terminal would develop clear understanding of their responsibilities, including national and international legal and technical obligations to provide security to users of the Terminal. This would be in accordance with the requirements of Ghana Port and Harbour Authority and applicable international legal requirements for port security arrangements including access control and appropriate clothing of workers and visitors.

The operation would also develop Facility Security Plan for the Terminal.

3. Visual Impacts

The constructions and installations would cause significant changes to the landscape and result in visual changes to the landscape, especially in relation to illumination at night at the Terminal. Furthermore, ships calling at the port would also cause visual changes to the seascape.

The significance of the landscape and seascape changes in the vicinity would create landmark both for onshore communities' inhabitants and offshore operatives. Visual intrusion is expected to be positive as the structures would have aesthetic appeal or attraction. The landmark is envisaged to significantly facilitate navigation at sea.

Excessive illumination may also result in changes to invertebrate flight paths and settlement as well as breeding patterns; consequently, the project would arrange interventions seeking to prevent or minimize the visual impacts. The measures would include limiting excessive background illumination and adopting installation of natural visual barriers including light shades where applicable.

The location and color of unloading and handling facilities would be arranged to minimize any related intrusive visual impacts.

7.5 Cumulative Impacts

Cumulative impacts would be the result from the successive, incremental, and/or combined effects of the development with other existing and planned

developments, which are of significant importance in relation to the key valued environmental and social components (VECs)³ and/or having scientific concerns e.g. Climate change.

The cumulative impact assessment process reviews the potential impacts and risk of the proposed developments in relation to the potential effects of other human activities and natural environmental and social external drivers on the chosen VECs over time; and further proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible.

Cumulative impact assessment and management has become relevant given concerns relating to contributions to cumulative impact on marine shoreline and ecosystem, community and social conditions and cultural aspects of the communities.

7.5.1 Marine Shoreline

The embankment of seawater may increase water along the shore and therefore increase the risk of increased shoreline erosion. Generally, the shoreline is high pitched terrain with more protruding common reef with ground elevation between 7m to 24m. The project site has small seasonal flash floods ditch with small drainage area on the west side of the site. However, the site is not affected by the Atlantic Ocean tidewater which the Return period is 100 years, but the site may be affected by the local watershed water catchment from the north. It is therefore envisaged that flooding and risk of erosion is unlikely and the cumulative effect would consequently be minimal.

7.5.2 Marine Ecosystem

Cumulative impacts on marine flora and fauna are not expected to be any significant as the impacts resulting from dredging and disposal of dredged materials are not consistent and the impact would remain temporary. Similarly, the probable high sediment pollution of the ecosystem in the anchorage area resulting from anchoring operation would also not be consistent, especially given the number of vessels calling at the Terminal. Consequently, the impact would be temporal and the cumulative impact would be minimal.

³ Acronym originally coined by Beanlands and Duinker (1983) to refer to “valued ecosystem components.” – Ref: IFC Good Practice Handbook, Cumulative Impact Assessment and Management.

7.5.3 Community and Social Condition

The development would have considerable cumulative impacts on the communities and the socio-economic condition of the area resulting from the significant induced economic and social changes including incremental migration, population and demographic changes, increased transport and traffic congestion with the attendant increased risk of accidents within the project area of influence.

Additionally, the development may result in increased employment rate, with induced skills developed as well as improved quality of employment of the population over the years. The incremental employment would result in incremental income/wage levels of the local inhabitants leading to overall improvement and sustainability of the livelihood conditions within the communities.

Nonetheless, the community would likely experience incremental changes in the demand on social services in line with the incremental population growth. Social services and related facilities including health, education and sanitary services generally would improve considerable. However, the influx of migrants and related increased population may likely introduce new diseases and increased crime activities. The diseases may include sexually transmitted diseases.

7.5.4 Cultural Aspects

The likely changed demographic structure of the communities may result in cultural changes including adulteration of cultural practices as well as perspectives and even acceptance of certain cultural processes.

7.6 Heritage Impacts

The people of Ekumfi Aboano have a tradition of performing rituals at the sea front to the sea by the chief Fisherman and his subjects. It is emphasized that the sea is not only for fishing but also serves for rituals purposes, which are performed on the sea shores just as they are done in the hinterlands by the people.

The project occupies a significant part of the sea shore along the coast of Ekumfi Aboano. However, the major part of the coast line remains unoccupied and consequently available for the traditional ritual performance. Generally, the development of the coal handling terminal has not necessarily dislocated the deities and the traditional ritual activities as practiced by the fisher folk

along this sea line. The practice can continue although with some restrictions in relation to the location and convenience.

Consequently, the impact on the practice is minor and unlikely.

7.7 Decommissioning Phase Impact

It is expected that decommissioning of the Coal Handling Terminal would involve dismantling of the coal unloading and transport facilities and possibly demolition of the wharf and breakwaters. However, the specific action would be dependent on the outcome of discussions with GPHA to find alternative uses of the facility.

In the situation where alternative use is not realized, the activities of the decommissioning process, which also would involve structural demolition, site dismantling and scrap recovery, waste generation and disposal could result in considerable environmental impacts and implications.

Depending on the market for scrap metal, the dismantled coal unloader and transporting facility (enclosed conveyor system) may be sold to the local steel industry or reshipped to China.

The Project is intended to engage the services of professional demolition contractors to carry out the demolition works and ensure appropriate measures taken to prevent unnecessary or undue degradation and where necessary minimize the impact and implications.

8 MITIGATION MEASURES

This chapter presents the description of the proposed mitigation measures from the pre-construction, construction, operational and decommissioning activities; and outlines the details of the specific mitigation options and considerations for preventing, minimizing or eliminating the effects of significant negative residual impacts identified.

The mitigation measures have been developed to address the residual impact remaining after design mitigation measure and the possible cumulative impact; and are also in accordance with the requirements of IFS/World Bank EHS Guideline requirements.

The impact is characterized by its magnitude and the likelihood of occurrence. Likelihood is estimated on the basis of experience and/or evidence that such an outcome has previously occurred given the set conditions. It is defined as a measure of the degree to which the unplanned event is expected to occur; and not the degree to which an impact or effect is expected to occur as a result of the unplanned event (Uncertainty).

Table 8-1 Likelihood of Occurrence

Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions
Likely	The event will occur during normal operating conditions (i.e. it is essentially inevitable)

8.1 Construction Mitigation Measures

8.1.1 Dredging and Disposal of Dredged Materials

A Marine Dredging Management Plan would be developed, which would include measures to ensure minimal dredging and dredged materials, particularly only necessary dredging would be carried out in accordance with the specified component infrastructure including the channel and basin; appropriate handling of dredged materials including cleaning of reef blasts and dewatering where necessary would adopted in line with international practices.

Additionally, appropriate deposition of the dredged materials using suitable techniques to avoid, minimize or control impacts from disposal of dredged

materials on the marine ecology and habitats would be adopted as detailed in **Section 7.2**.

The possible dredged material has been analyzed and it is proposed for open water disposal in the 12 km area off the coast. However, routine monitoring of the dredged material would be carried out to ensure appropriate disposal or beneficial reuse of the materials.

The Project considers a process involving consistent monitoring of the quality of the dredged materials and the nature of discharged/dumping sites. Site-specific discharge quality standards would be established depending on the type and toxicity of the effluents and the discharge location.

8.1.2 Air Quality

In general, the construction operation is unlikely to generate any significant air pollutants. However, the mitigation strategy would seek to ensure minimal emission of pollutants into the atmosphere. Primarily, mitigation interventions would promote and ensure routine maintenance of all construction machinery and equipment according to manufacturers' recommended programme; to assure effective and efficient operation of the machinery and equipment, with higher efficient fuel consumption and consequent minimal emission.

Vehicular emissions and dust generated from various construction activities during along shore site preparation, construction and transportation of materials would be controlled using the most appropriate measure for each scenario. Dust suppressants such as water spraying would be employed to control dust emissions during site preparation and excavation. Tarpaulin covers would be provided for all aggregate materials and sand being transported from quarries and related sites to project site. Trucks carrying construction materials would be limited to a speed of 40km/h.

Additionally, movement of machinery and vehicles especially supplying boulders for breakwater construction would be control by ensuring full adoption of recommended speed limit. Monitoring and management will be vital in these processes to ensure appropriate level of intervention mechanisms to achieve the expected mitigation control.

The residual impact is expected to be low and therefore considered as minor and severity rated minor and occurrence is unlikely.

8.1.3 Noise and Vibration Control

The noise and vibration related impacts are predicted could be moderately significant. Noise and vibration generated from initial drilling and blasting works, operation of machinery and vehicular movement would be significantly controlled to minimize the level and the consequent nuisance through the adoption of appropriate techniques.

Generally, the techniques are identified to include:

- a) Ensuring properly maintained operating machines and equipment.
- b) Appropriately controlled drilling and blasting schedules and timing to ensure minimal impact. Drilling and blasting after 6:00pm would be strictly prohibited.
- c) Use of acoustic enclosures based on the isolation effect to envelop construction activities and construction machinery and equipment.
- d) Developing noise barriers where appropriate to limit ambient noise during construction period.

Other measures to minimize noise would include:

- a) *Earth Moving Plant:* The use of effective exhaust sound reduction equipment and ensuring manufacturers enclosure panels are closed at all time. Alternative super-silenced plant may be considered where available;
- b) *Compressors and Generators:* The use of effective sound reduction equipment, dampening of the metal body casing and ensuring manufacturers enclosure panels are closed at all time. Screens may be erected and some equipment may be placed in a ventilated acoustic enclosure;
- c) *Breakers and Drills:* The use of mufflers, sound reduction equipment, fixing airline leaks, use dampened bits, screening and enclosures would be adopted; and
- d) *Cement Mixing, Materials Handling and Batching Plant:* The use of effective engine sound reduction equipment, enclosing the engine, ensuring aggregates are tipped at minimal height and not dropping materials from excessive heights.

Ear protectors will be provided to ensure the health and safety of on-site construction staff to control exposure to higher noise areas.

Emergency mitigation measures would include informing EPA and the community of unusual activities of significant potential noise and vibration generation or significant changes to the construction programme that may result in increased noise levels and time of noise nuisance. Particularly, construction works outside the premises of the project (external) will be carried out only in exceptional instances and with prior consent of the local authorities.

In addition, the Environmental Management team would be particular and take serious any noise and vibration concerns and complaints especially from neighbouring residents.

In general schedule of construction works that is likely to generate significant noise would remain within the time period of 7 am to 6 pm.

Considering that a larger part of the construction area would be significantly offshore and the construction machinery and vehicles would be well maintained according the manufacturers recommended maintenance program, the residual noise level would be considerably abated and the impact significance could be rated as low while the severity could be rated as negligible especially to the communities.

Also, monitoring and management would be crucial to ensuring effective control intervention of any unlikely noise nuisance.

8.1.4 Vehicular Traffic

Construction materials would be delivered to the site by trucks using the access road. Maximum tonnage requirements for heavy trucks and vehicles would be strictly adhered to in order to prevent road damage during their transport to site. Maximum speed limits would be observed to ensure safety and fuel efficiency as well.

Nonetheless, the project is not envisaged to contribute to creating any significantly higher traffic on the Accra – Cape Coast highway during the construction period. Transportation would be limited as majority of the boulders and related construction materials will be generated on site; hence any change in traffic composition (residual impact) would be minor and can be effectively mitigated by appropriate control measures.

Appropriate road signs would be used to alert road users to the potential dangers posed by trucks driving on the main road; turning, entering and crossing the main road as well. Long vehicles transporting heavy duty

machines would be clearly labelled to adequately warn other road users. Transportation of heavy equipment would be restricted to daytime. Only vehicles that are road worthy would be used for the project so as to avoid any breakdowns and unnecessary obstructions and potential accidents on the roads.

8.1.5 Waste Water

Mitigation measures to control and minimize waste water pollutions especially from ships calling at the terminal would include:

- The terminal operation would contract Environmental Management Service Provider to provide transfer, collection, and treatment services, and where necessary storage facilities of sufficient capacity for all types of wastewater including sewage generated by ships and other vessels calling at the terminal in accordance with MARPOL 73/78 and national regulations.
- Oily waste and toxic wastewater from the vessels would be collected by the Environmental Management Service company for off-site treatment prior to discharge in accordance with the provisions of MARPOL
- As part of the Project's Environmental obligation, the operating procedure would ensure that incompatible substances shall not be mixed in the collection system and ensure that treatment would be established based on the characteristics of the effluent.
- Sewage from ships would be collected and treated off-site as appropriate.

Waste water pollution would be considerably negligible if any, and the residual impact significance could be rated as minor while the severity could be rated as low especially to the communities. The likelihood of occurrence is rated unlikely.

8.1.6 Hazardous Materials and Oil Management

Hazardous materials at terminal including oil, fuels, lubricants, solvents and other chemicals used in maintenance operations of the construction machinery and equipment may potentially spill.

Mitigation interventions for control, minimization and prevention of pollution and contamination would include spill prevention and control planning such as:

- Identifying areas within the terminal that are sensitive to spills and releases of hazardous materials and location of seawater intake, outlining responsibility for managing spills, releases, and other pollution incidents, including reporting and alerting mechanisms to ensure any spillage is reported promptly to the Authorities and personnel are informed to take appropriate action;
- The terminal provided with specialized oil spill response equipment (e.g. containment booms, recovery devices, and oil recovery or dispersant application vessels);
- Providing appropriate training for the response personnel in deployment of equipment, and testing of the contingency plan through regular reporting and alerting programme.

Pollution by hazardous materials would be considerably negligible, and the residual impact significance could be rated as low while the severity could be rated as low and occurrence is unlikely

8.1.7 Ecosystem

Dredging during construction and maintenance of the terminal, disposal of dredge spoil, construction of wharf, breakwater, and other water-side structures may lead to short and long-term impacts on marine ecology, marine habitat and shoreline.

The mitigation measures to prevent and control the identified impacts include:

- The affected areas including the dredged and disposal sites have been studied to review the prevailing ecological situation to prevent destruction of habitat and shoreline vegetation.
- Construction activities, especially blasting and removal of spoils would be planned and arranged to ensure minimal nuisance to marine organisms and habitats is caused by the operation.
- Construction of breakwaters may contribute to protection of intertidal features.

8.1.8 Occupational Health and Safety

Occupational health and safety issues during the construction and decommissioning would include exposure to dust and hazardous materials that may be present in construction materials and demolition waste and physical hazards associated with the use of heavy equipment, and explosives.

Operational procedures would ensure works use the appropriate PPEs.

8.1.9 Socio-economic

The socio-economic impact is largely positive and effort would seek to enhance and optimize the impact. Local inhabitants would be organized and supported to improve their competences in vocational skills and entrepreneurship, thereby enhancing the opportunity for decent jobs for the local inhabitants with better income opportunities.

The resulting increased population can be managed by improve social facilities including health facilities, schools and other amenities.

The construction works offshore would cause limitations to the fishing operation and potential loss of fish landing beach as well as reduced fishing output. Effective management of the engagement with the primary stakeholders and provision of additional landing site is recommended to minimize the potential impact.

8.1.10 Community Health and Safety

The potential public health risks and insecurity resulting from the construction works and activities would relate to increased community population and the resulting demand on community health and educational facilities, demographic changes and cultural and moral implications. The key issues would relate to:

- Potential health risk due to degraded air quality, noise and vibration, visual impact and resulting emotional stress.
- Potential increase in traffic accidents
- Increased community population and attendant demand on community health and educational facilities and Increased public insecurity
- Increased economic activities (trading) and competition for local economic operators

- Decent jobs for local inhabitants (unskilled labour) and income opportunities
- Increased local population
- Constraints to fishing operation and potential loss of landing site and reduced fishing output

The impacts, which are largely positive, would be managed through developed management system and control processes to enhance overall benefits to the community including:

- Stakeholders engagement and monitoring scheme established to manage and control community participation
- Appropriate compensation of fishermen for loss of fish landing site by providing additional landing site located at the western end of the project site.
- Adequate education of the fishermen

8.2 Operational Mitigation Measures

8.2.1 Air Quality

The most significant sources of air pollutants from the operations of the Coal Handling Terminal include dust from discharge and transfer of coal, combustion emissions from the propulsion and auxiliary engines and boilers of ships visiting the terminal, emissions from vehicles and auxiliary engines operating at the terminal.

Measures to mitigate emissions would centre on Emissions Management Strategies including the adoption and promotion of use of low-sulfur fuels at the terminal and selection of high efficient and low emission vehicles and operating equipment used at the Terminal.

8.2.2 Waste Water

Waste water including facility cleaning wastewater, storm water and sewage from domestic effluent from the operation of the terminal, bilge water, ballast water and vessel cleaning wastewater from ships would be treated on-site and off-site where appropriate.

Mitigation measures to minimize or eliminate pollution from effluent would include treatment of wastewater from facility cleaning, and the preliminary storm water with on-site treatment facilities before final discharge. The storm water catch basin would be 350m³. Waste water received from ships would be

treated by suitable off-site facilities, which meets the requirements of national environmental standards and MARPOL Convention and particularly prevent introduction of invasive marine species.

The residual and cumulative impacts are expected to be minor and the severity is rated minor and occurrence is unlikely.

8.2.3 Waste Management

The solid and liquid wastes relating to the operation of the terminal and from ships calling at the Terminal, which would include solid waste from packaging materials, maintenance operations, administrative offices, oily sludge and other materials such as food packaging, and food waste would be received and treated off-site in accordance with the national regulatory requirements and MARPOL Convention consistent with the International Maritime Organization Comprehensive Manual on Port Reception Facilities.

The management of the terminal would ensure that appropriate information to identify solid waste reception facilities and acceptable handling procedures at terminal is consistently available to the vessel operators calling at the terminal. On the other hand, discharge of solid waste from vessels shall be prohibited while in port in accordance with MARPOL and national regulations.

8.2.4 Hazardous Materials and Oil Management

Hazardous materials at terminal including oil, fuels, lubricants, solvents and other chemicals used in maintenance operations may spill resulting from and incidence of facility malfunction and failure or improper operating procedures during transfer or handling.

Mitigation measures to control, minimize and prevent of pollution and contamination would primarily be based on spillage prevention and spill control planning including arranging facilities remotely from active traffic and located to have natural drainage systems for spill collection and containment.

Furthermore, the operation of the Terminal would ensure that the spill prevention and control management plan and emergency response procedure and preparedness plan are consistently adhered to.

8.2.5 Noise

Noise sources within the operational areas of the Terminal include coal unloaders and handling facilities, particularly the conveyor system and noise from operating ships and other vessels at the Terminal.

High level noise or nuisance would be controlled by a number of measures considered from the design stage through operational phase. The main focus would be on minimizing the exposure of workers to high level of residual noise from the unloaders. The residual noise exposure to the neighbouring community would be significantly low if any.

In general, the worker would be compelled to use personal protective equipment to minimize or eliminate any high unforeseen residual noise.

Additional mitigation measure to minimize impact of higher residual noise is ensuring the establishment of work programme that limit the duration of workers' exposure or attenuation to such higher residual noise.

8.2.6 Biodiversity

Dredging during maintenance of the Terminal and disposal of dredged spoil may lead to short and long-term impacts on the immediate marine ecology and habitat as well as the shoreline. Maintenance dredging would be carried out once a year or two years depending on the outcome of the monitoring programme.

The mitigation strategy would seek to ensure minimal dredging and therefore disposal of minimum dredged spoils to control and minimize the resulting impacts on the marine habitat. Furthermore, strict adherence to ballast discharge practices and ballast water management programme would be maintained to ensure prevention of the introduction of invasive marine species.

Furthermore, managing anchoring would contribute to minimizing the impact on the ecosystem. Additionally, compliance with regulations covering cargo operations and promotion of good practice would be emphasized.

8.2.7 Occupational Health and Safety

Occupational health and safety issues during the operation of the Terminal would include exposure to dust and hazardous materials and physical hazards associated with the use of heavy equipment and tools.

Mitigation measures to control, minimize or prevent residual impact would include ensuring international regulatory standards and best health and safety practices are adopted; particularly, where necessary workers would use personal protective equipment to control high residual impact.

The hazard control measures would include maintaining clearly marked vehicular and human access ways with railing and appropriate signage and related safety provision; again ensuring that work processes are stringently according to operational manuals and safety regulations as well as international best practices.

8.2.8 Community Health and Safety

The potential public health risks and insecurity resulting from project implementation and subsequent increased community population and attendant demand on community health and educational facilities.

The mitigation measures would include maintaining and ensuring that safety management systems and plans are functional at all times and operational procedures are strictly adhered to; ensuring improved public health and prevention of incidents that may result in injury to workers, the public, or the environment. There would be increased public health education and sensitization on potential health risks including emotional stress and sexually transmitted diseases (STD). The grievance mechanism instituted would be practiced to optimized public engagement and resolution of concerns of mutual interest.

Table 8-2 Mitigation Measures of Construction Phase

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
Air	Degradation of ambient air quality and attendant effect on workers and neighbouring communities	Low and very unlikely	Construction Contractor to implement dust suppression techniques on construction surfaces Provision of tarpaulins for trucks delivering sand and gravels to the site. Regular maintenance of construction vehicles and heavy machinery and equipment. The exhaust emissions of vehicles and heavy machinery and equipment would be monitored and controlled.	Minor	Minor
Noise	Nuisance to workers and residents of neighbouring communities	Low and unlikely	Regular maintenance of machinery and ensuring noise from the machines is low. Working areas on the project site would be fenced. Working periods would be controlled and would be between 7:00 am to 6:00 pm.	Low	Negligible

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
Traffic	Congestion and accidents	low and likely	Trucks would be appropriately marked with reflectors and warning signs indicating long vehicle and speed limits to caution other drivers	Low	Minor
Water Resources	<ul style="list-style-type: none"> Contamination of marine water from disposal of dredged materials and dewatering. Damage to aquatic environment and fishery activities 	Moderate and likely	Construction Contractor would adopt strict recommended management system and control procedures. Develop spill response and management plan and measures.	Minor and likely	Minor
Land	<ul style="list-style-type: none"> Indiscriminate Waste disposal Contamination of soil Soil erosion Landscape visual impacts 	Moderate however unlikely	<ul style="list-style-type: none"> Development of a Waste Management Plan. Waste Management Training of construction personnel. Secure fuel storage areas and develop strict fuelling and spill control procedures Develop greening and landscape management scheme 	Minor	Minor
Ecology	Disturbance to the terrestrial ecosystem due to construction activities and disposal of dredged materials.	Moderate and unlikely	Control of construction activities ensuring marine mammal have ample time to migrate. Management of dredge disposal activities to control disturbance of	Moderate	Minor

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
	Disturbance to the marine ecosystem and mammals	Moderate and likely	the marine ecosystem.		
Occupational Health and Safety	<ul style="list-style-type: none"> • Health risks including respiratory problems and hearing impairment. • Exposure to hazardous materials. 	Moderate and likely	<ul style="list-style-type: none"> • Health and Safety education and awareness • Provision and appropriate use of personal protective equipment • Use of suitable clothing • Emergency response plan • Monitoring and reporting scheme established 	Minor and unlikely	Minor
Socio-economic	<ul style="list-style-type: none"> • Increased economic activities (trading) and competition for local economic operators • Decent jobs for local inhabitants (unskilled labour) and income opportunities • Increased local population • Constraints to fishing operation and potential loss of landing site and reduced fishing output 	Moderate and likely	<ul style="list-style-type: none"> • Stakeholders engagement and monitoring scheme established • Appropriate compensation of fishermen for loss of fish landing site • Adequate education of the fishermen 	Moderate and likely	Moderate

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
Community Health and Safety	<ul style="list-style-type: none"> • Potential health risk due to degraded air quality, noise and vibration, visual impact and resulting emotional stress. • Potential increase in traffic accidents • Increased public insecurity • Increased community population and attendant demand on community health and educational facilities 	Moderate and likely	<ul style="list-style-type: none"> • Improved public health facilities and management • Increased public education and sensitization • Traffic and transportation management plan • Controlled public access to construction sites and restricted areas • Public security management plan (improving Police Post) • Institution of grievance mechanism • Public Health and Safety Management Plan 	Minor and unlikely	Minor

Table 8-3 Mitigation Measures of Operational Phase

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
Air	Deterioration of air quality due to emissions from operating machines.	Low and unlikely	<ul style="list-style-type: none"> Air quality measurement and audits would be done periodically to validate the level of concentration of emission pollutants. 	Minor and unlikely	Minor
Noise	Nuisance to workers and residents of neighbouring communities	Moderate and unlikely	<ul style="list-style-type: none"> Regular maintenance of machinery, greasing of rotating parts to ensure minimal noise levels. Workers and visitors would be provided with suitable PPEs 	Minor and unlikely	Minor
Traffic	Increased traffic and related congestion and accidents	Low and unlikely	<ul style="list-style-type: none"> Staff movements would be coordinated and planned to promote group movement. Use of mass transported where appropriate and restricting individual movements. 	Minor and unlikely	Insignificant
Waste	Generation of waste and indiscriminate disposal and the associated impacts.	Low and unlikely	<ul style="list-style-type: none"> Ensuring that Waste Management and Monitoring Plan are fully operational. Ensuring appropriate waste 	Minor and unlikely	Insignificant

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
			management practices are strictly enforced. <ul style="list-style-type: none"> Ensuring the adequacy of provisions made for effective and efficient waste management. 		
Land	<ul style="list-style-type: none"> Land scape visual impact 	Moderate and likely	<ul style="list-style-type: none"> Ensuring that landscape management plan and monitoring scheme are fully functional and maintained. 	Minor and unlikely	Minor
Seawater	Possible deterioration of seawater quality from discharge of waste water and bilge water from ships calling at the terminal or at anchorage.	Minor and unlikely	Ensuring strict adherence to international procedures for management of waste water and ballast water from ships.	Minor and unlikely	Minor
Ecology	<ul style="list-style-type: none"> Disturbance to the marine ecosystem 	Minor and unlikely	Continued periodic monitoring of the marine environment.	Minor and unlikely	Insignificant
Occupational Health and Safety	<ul style="list-style-type: none"> Health risks and possibilities of respiratory problems resulting from discharge of coal, and hearing impairment from noise sources Potential accidents 	Moderate and likely	<ul style="list-style-type: none"> Health and Safety education and awareness Provision and appropriate use of personal protective equipment Use of suitable clothing Spill Emergency Response 	Minor and likely	Minor

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
	including electrocution, fall etc. resulting in injuries and fatalities		Plan <ul style="list-style-type: none"> Adherence to established monitoring and reporting scheme. 		
Socio-economic	<ul style="list-style-type: none"> Increased economic activities (trading) and competition for local economic operators Decent jobs for local inhabitants (unskilled labour) and income opportunities Increased local population Loss of access to fishing area and disturbance to fishing operation. Increased fish catch due to additional illumination and increased sea depth Improved fish landing site and handling 	Moderate and likely	<ul style="list-style-type: none"> Stakeholders engagement and monitoring scheme established Restricted sea areas would be clearly demarcated New fishing route established and alternate fish landing practices encouraged Two suitable landing sites created and provided with appropriate facilities Consistent education of the fishermen 	Moderate and likely	Moderate
Community Health and Safety	<ul style="list-style-type: none"> Potential health risk due to degraded air quality, visual impact and resulting emotional stress. Potential increase in traffic accidents 	Minor and unlikely	<ul style="list-style-type: none"> Improved public health facilities and management Increased public health education and sensitization including STD. Adherence to traffic and 	Minor and likely	Minor

Environmental Parameter	Potential Impact	Significance / Occurrence	Proposed Mitigation	Residual Impact	Residual Severity
	<ul style="list-style-type: none"> • Increased public insecurity • Increased community population and attendant demand on community health and educational facilities 		transportation management plan <ul style="list-style-type: none"> • Adherence to Public Security Management Plan and Public Health and Safety Management Plan 		

9 MONITORING PLAN

The chapter outlines the monitoring measures and activities envisaged for evaluating the significance of deviations of the projected environmental performance from established baseline conditions and the guideline requirements. It also specifies the main areas and parameters to be monitored during the various phases of the project implementation. Furthermore, the section outlines the training requirements of relevant staff.

The Management of the Project would be committed to undertaking continuous monitoring of significant impact areas identified, which would form part of the managerial tool for prompt remedial action taken to correct unforeseen deviations in the effectiveness of mitigation measures. The monitoring results would offer the Project an understanding of the overall actual impacts of the Project.

The development and operation of Affiliated Coal Handling Terminal has direct linkage with the development and operation of the 2X350 MW Supercritical Coal-fired Power Plant. Consequently, the impacts implications of the development and operation of the CHT may coincide directly with the impact implications of the development and operation of the Power Plant. Consequently, the environmental performance of the two projects would also overlap and therefore monitoring and environmental management would significantly overlap.

9.1 Constructional Phase Monitoring Activities

The monitoring areas during the project construction phase would include:

- a) Seawater quality would be regularly determined at both the construction and dredge disposal areas to ensure controlled impacts of constructional activities on seawater quality;
- b) Sediment quality would also be regularly determined at both the construction and dredge disposal areas to ensure well managed disposal and controlled impacts of disposal of dredged materials on disposal areas;
- c) Wastewater quality from dewatering of sediments would be determined regularly to manage and control disposal impacts where necessary;
- d) Biodiversity would be determined consistently especially at the disposal site in order to minimize likely change and consequent potential impacts

on the disposal area;

- e) Air quality (Particulate Matter, Sulphur dioxide, oxides of Nitrogen, and Carbon Monoxide) would be determined consistently;
- f) Noise level would also be determined regularly;
- g) Resource use efficiency would be determined regularly.

9.2 Operational Phase Monitoring Activities

9.2.1 Air Quality

Air pollutants such as Suspended Particulate Matter, Sulphur dioxide, oxides of Nitrogen and Carbon monoxide shall be determined at Terminal area and the beaches. Air pollution control monitoring shall be conducted principally to involve ambient air quality monitoring.

9.2.2 Noise Monitoring

High residual noise point sources would be identified and monitored consistently. Noise level within the Terminal area and the nearby beaches would be monitored consistently and on monthly basis. Any unforeseen excessive noise from any machinery or equipment would be identified and recommended for appropriate mitigation intervention.

9.2.3 Occupational Health and Safety Monitoring

The use of personal protective equipment is very important aspect of mitigation, especially against dust, noise and physical hazards. Therefore, the availability and use of personal protective equipment would be continuously monitored throughout the various phases of the project. All damaged and defective protective equipment would be replaced promptly. Employees who refuse to use the protective equipment would be sanctioned in line with the corporate environmental policies.

Health and safety training programmes and environmental awareness creation programmes would be organised annually for all workers both the Ghanaian and Chinese worker.

9.2.4 Resource Usage Monitoring

Documentation and records on the use of resources including explosives, chemicals, water, fuel and lubricants would be established to assess the total resource use, which would be reviewed monthly to evaluate overall performance and resource use efficiency.

9.2.5 Reporting

In line with the Monthly Monitoring and Reporting requirements, the Project would establish monthly monitoring scheme and quarterly and annual reporting submissions accordingly as required by EPA to meet national compliance requirements and conform to international practices.

An annual report would encompass reporting on monthly monitoring trends and key environmental performance indicators as well as implementation of mitigation measures and environmental management issues encountered during the operational period.

10 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

The Provisional Environmental Management Plan is prepared as part of the ESIA and outlines the environmental management processes and emergency response planning. The provisional ESMP, which reflects the management structure and commitment of the project to safeguard the environmental quality and safety integrity, summarizes the roles and responsibilities, organizational requirements, implementation actions, monitoring plan and specific mitigation actions necessary to meet the projected environmental management obligations.

The Provisional Environmental Management Plan for the development and operation of 70,000 DWT Coal Handling Terminal would overlap with the Environmental Management planning for the development and operation of the power plant.

10.1 Introduction

The environmental and social impact assessment (ESIA) has involved prediction of the potential impacts and mitigation measures to form basis for informed environmental decision-making process on the proposed development and operation of the 700DWT Coal Handling Terminal. The Provisional Environmental and Social Management Plan (ESMP) is therefore relevant to outline necessary environmental management planning and commitment to the prevention and minimization of any potential residual impacts to acceptable levels of environmental quality, health and safety standards and where necessary compensation payment to alleviate potential impact would be considered.

Translating the ESIA into ESMP and implementing the plan accordingly to meet the requirements and obligations outlined in the ESIA, during the development and operation of the project justifies the usefulness of ESIA by way of its potential benefits and contribution to sound project development.

The provisional EMP outlines the processes and actions for environmental management practices based on the information established in relation to the baseline conditions of the project area and the projected impacts and mitigations. The management planning would cover project site preparation and construction phase, operational and decommissioning phases of the project and permit verification of predicted impact, adequacy and effectiveness of mitigations, monitoring relevant contingency measures and introduction of additional corrective measures where necessary. The provisional ESMP would

therefore serve the basis of precursor to the Actual ESMP developed during the project implementation phase.

The provisional ESMP has been prepared also taking into consideration the international standards and guidelines including the performance standards of IFC and Equator Principles.

The relevant sections of the Provisional ESMP would comprise the following:

- a) Mitigation plan (on-site and off-site, construction and operation)
- b) Monitoring plan (on-site and off-site, construction and operation)
- c) Emergency response plan
- d) Training and awareness creation programmes
- e) Documentation and reporting
- f) Financial requirements for effective plan implementation.

10.2 Objectives

The primary objective of the Provisional Environmental and Social Management Plan is to establish an Environmental and Social Management System (ESMS) that clearly define the procedures and action plan necessary to ensure effective and efficient implementation of identified mitigation measures to minimize the impacts from the operation of the Coal Handling Terminal. The objective would also seek to identify inappropriate mitigation measures and provide the opportunity for corrective actions or interventions.

10.3 Roles and Responsibilities of the Project

Measures to ensure effective and efficient implementation of the Provisional ESMP would include establishing Environmental and Social Management Unit (ESMU) as a part of the Project Management Team.

The Environmental and Social Management Unit shall be duly constituted and shall be responsible for coordination of the various aspects of the project relating to managing the environmental and social impacts and implications of the project. The Unit shall also provide support where needed in communication and community consultations.

Activities planned within the framework of the project include the following:

- a) Implementation of the Provisional Environmental and Social Management Plan developed and coordinating the project activities to comply with the requisite regulatory requirements.
- b) Coordination of data collection and analysis and making appropriate

recommendations to the project management team on environmental and social issues.

- c) Developing activities to coordinate environmental and social management activities of the project.
- d) Promoting resource efficiency and cleaner production initiatives.

The Provisional Environmental and Social Management Plan would incorporate an Environmental and Social Management System (ESMS) , which will be enforced to ensure compliance to all relevant standards of the National Environmental Quality Guideline. The ESMS would integrate various environmental management systems and plans including:

- a) Compliance Management Plan
- b) Waste Management Plan
- c) Resource Efficient Management Plan
- d) Health and Safety Management Plan
- e) Air Quality Management Plan
- f) Emergency Preparedness and Response Plan

The table below provides further information on the environmental action plan to be implemented. Budgetary provisions are made for all activities earmarked for implementation to facilitate meeting the required objectives of the Provisional ESMP.

Table 10-1 Summary of the Environmental Action Plans to be Implemented by the Project

ACTION	TARGET	TIMELINE	BUDGET (GH¢)	RESPONSIBILITY	RECORDS
1. Compliance Management Plan: Meetings goals and obligations Under Environmental Legislation					
Develop scope of work for the implementation of the action plan	Scope of work to be used by ESMU to implement the action plan	March 2017	-	Project environmental and social management unit	Project Management team
Establish Environmental and Social Management Unit (ESMU)	Project Management Team to endorse establishment of ESMU and related activities	May 2017	-	Project environmental and social management unit	Letter for official recognition of the ESMU by Management & records of EMSU meetings
Sensitize, educate and train staff on environment, health and safety (EHS) responsibilities at workplace	All staff participate in training in specific areas of environment, health and safety,	Annually	12,000.00	Management, ESMU and Project Environmental Consultant	Invoices, training materials, attendance list of participants
Promote behavioural changes among staff to reduce significantly resource consumption and increase recycling and reuse e.g. regular briefings and programmes	Staff engage actively in effective waste management	Daily, weekly	N/A	ESMU, supervisors & managers	Utility bills & records, & training
Collect and analyze feedback from staff and management on resource efficiency related	Monitor the progress of the ESMU towards achieving its goals set out in the	Monthly	N/A	ESMU, Supervisors & Managers	Records or minutes of ESMU meetings

ACTION	TARGET	TIMELINE	BUDGET (GH¢)	RESPONSIBILITY	RECORDS
programmes and projects	Provisional ESMP				
Environmental Monitoring Reporting and permit renewal	Monitor environmental quality and report to both Management and Regulatory Agencies	Quarterly, annual	120,000.00	ESMU, Consultants & Supervisors	Quarterly reports, annual environmental reports, EMP report preparation
Train staff to carry out daily and weekly checks on environmental compliance	Form environmentally-responsible employees selected from different departments to help promote the environmental and recycling efforts of the ESMU and the Project	To be determined	5000.00	ESMU& Consultants	Records of training, records of staff attendance of training programmes
Regular reporting and collaboration with regulatory Agencies	Ensure that all compliance is achieved for all regulatory Agencies	Regularly	10,000.00	ESMU/Consultant	Minutes of meetings, attendance sheet, reports prepared and submitted
Report regularly to Senior Management and staff on actions undertaken against targets and on future areas of focus for the next period	Communicate environmental performance to staff and directors	Quarterly	-	ESMU	Environmental Performance reports,
2. Resource Efficient Management Plan: Energy, Raw Materials And Water Efficiency					

ACTION	TARGET	TIMELINE	BUDGET (GH¢)	RESPONSIBILITY	RECORDS
Conduct Energy Audit	Identify areas where energy savings can be made.	Quarterly	20,000.00	Consultants, ESMU, Production and Maintenance Departments	Maintenance reports, purchase invoices
Conduct energy performance review of machines, electrical equipment, and carry out and resource efficient intervention.	Reduce energy consumption by 30%	2017	25,000.00	Consultants, ESMU, Production & Maintenance Departments	Invoices & Receipts
Conduct water audit (design water flow chart, compile and analyze reliable data on water use & consumption pattern)	Identify areas where water savings can be made	Quarterly	12,000.00	Consultants, ESMU, Production & Maintenance Departments	Water Audit Reports, water flow charts, invoices & receipts
Conduct raw material consumption audit	Identify areas in which raw materials are wasted	Quarterly	12,000.00	Consultants, ESMU, Production & Maintenance Department	Report on identified areas of savings
3. Waste Management Plan: Waste Generation, Prevention & Control					
Carry out a comprehensive waste audit	Identify ways by which waste can be minimized and make recommendations to accordingly	Quarterly	12,000.00	Consultant, ESMU, Production & Maintenance Departments	Waste audit report
Promote the procurement of	Minimize the use of non-	December	N/A	ESMU,	Proforma

ACTION	TARGET	TIMELINE	BUDGET (GH¢)	RESPONSIBILITY	RECORDS
biodegradable material	biodegradable raw materials	2017		Procurement, Maintenance & Production Dept.	invoices, receipts
Enforce the use of personal protective equipment	Ensure that workers are not unnecessarily exposed to health hazards	Daily	10,000.00	ESMU	Purchase of PPEs, receipts and invoices
Perform maintenance on equipment	Limit noise levels and vibrations	Daily/weekly	-	ESMU, Senior Management, Production & Maintenance Department	Replacement of equipment part, invoices and receipts
4. Fire Risk Management Plan					
Ensure warning signals are functional and broken down alarm systems are replaced	Provide protection and minimize damage in case of severe hazards	Quarterly	10,000.00	ESMU, Maintenance Department	Assessment report, invoices & receipts
Ensure regular fire safety equipment maintenance and alarm systems	Replace fire extinguishers, faulty fire alarm systems etc.	Quarterly	50,000.00	ESMU,	Reports submitted to senior management, functioning fire safety equipment and alarm systems
Prepare and review emergency response plan and organize regular fire drills	Ensure workers are alert and aware on what they need to do during fire	Quarterly	12,000.00	ESMU, Ghana National Fire Service	Signed attendance sheet,
Ensure that relevant signage	Provide direction to staff	May 2018	2,000.00	ESMU,	Invoices &

ACTION	TARGET	TIMELINE	BUDGET (GH¢)	RESPONSIBILITY	RECORDS
would be provided at visible locations within the plant	and visitors within the plant			Maintenance Department	receipts
Provide training in fire and occupational health and safety	Ensure staff know what to do in relation to safety, environmental and fire hazards	Twice per annum	8,000.00	Consultants, ESMU, Senior Management	Attendance list, invoices & receipts
TOTAL COST			320,000.00		

10.4 Health and Safety Action Plan

10.4.1 Noise and Hearing Loss

Noise levels would be measured regularly to ensure that these levels meet the EPA guidelines on noise. Monthly measurements will be taken and reported to the EPA quarterly.

There would be measures to ensure strict adherence to recommended maintenance schemes to optimize efficiency and performance of the machinery and equipment and also to promote reduction in noise levels in the installations.

Consistent monitoring and training would be instituted to ensure that workers properly use the protective equipment. In addition, there would be compulsory audiometric testing for all employees exposed to excessive noise in the workplace (i.e. 85 dB or above) will likewise enable the Project to detect hearing impairment at an early stage so that intervention may quickly occur to prevent permanent noise-induced hearing loss.

10.4.2 Terminal Lighting and Illuminance Level

The plant will be equipped with high-output energy-efficient light fixtures that are properly shielded to reduce glare. The use of daylight would be optimized. High Illuminance level would be controlled and monitored monthly; measuring light level with illuminance meter.

10.4.3 Waste Discharge

Dust particles discharged during offloading and transportation to coal stock yard would be monitored regularly to ensure effectiveness of the enclosures.

10.4.4 Personal Protective Equipment (PPE)

Protective clothing, hard hats, goggles, face masks, hair covers, gloves, and safety footwear constitute the typical forms of protective equipment that are provided to workers. The appropriate use of the PPEs would be demanded to ensure reduced risks of hazards.

Ensuring adequate supply and comfortable fit of the PPE would be crucial to ensuring consistent and effective use of the equipment.

10.4.5 Dress Code

Workers working in hazardous environments shall receive specific guidelines as to what should and should not be worn. The Project does not accept the wearing of loose clothing and large or dangling jewellery by factory workers while on the job to prevent being entangled in the driver of machine.

Workers would be provided with corporate attires to ensure conformity with appropriate safety requirements in relation to style, comfort, quality and safety.

10.4.6 Medical Monitoring

As a condition of employment, all new personnel will undergo and must successfully pass a baseline medical examination to demonstrate fitness for duty. The Project will undertake periodic (at least once a year) screening of employees to review and monitor any health changes as well as provide requisite support.

Common tests performed would include those for the diagnosis of life-threatening illnesses and communicable disease, such as tuberculosis, HIV/AIDS., typhoid, hepatitis B and C.

The Project will work with health centres in the District and Regional centres in the provision of health care.

10.5 Health and Safety Administration

10.5.1 Corporate Responsibility

The Project is intended to establish a health scheme, which would be designed to cater for the health need of the working personnel. The Project's growth depends on its employees hence will ensure all the necessary administrative support needed is made available to promote health and safety of both employees and equipment.

10.5.2 Health and Safety Committee

The ESMU would take up the role of Health and Safety Committee to facilitate and ensure consistent consideration of environmental, health and safety matters. Additionally, the Unit would be responsible for implementation of all

actions related to monitoring the health and safety performance of the employees.

10.5.3 The Role of Employees

The employees of the Project will be engaged to participate actively in the implementation processes and action plans in order to promote high sense of ownership and control.

10.5.4 Health and Safety Education

As part of the implementation of the environment, health and safety action plan, a rigorous educational campaign would be instituted to ensure that every employee is well knowledgeable in issues relating to environment, health and safety as well as the relevant aspects of the action plan.

10.5.5 Hygiene and Sanitation Practices

The Project in order to ensure the safety of its workers will ensure the following:

- a) Nurture a culture of employees playing the operative role in controlling sanitation in their units.
- b) Ensure comprehensive understanding of sanitation and hygiene issues among all categories of workers.

10.5.6 Health and Safety Action Plan

The Project would secure instruments for monitoring employee exposures to noise nuisance. The equipment would be carefully checked and calibrated by the Ghana Standards Authority to ensure that the measurements are accurate. Audiometric testing of various stall personnel would be implemented to establish baseline audiograms of employees before exposure to high noise area of 85 dBA or above.

In addition, regular monitoring of high noise areas would complement decision of Audiometric testing.

Table 10-2 Summary of Health and Safety Action Plan

Impact	Mitigation Action	Actual Action	Objective	Target	Budget (GHS)	Timeframe	Responsible party
Occupational health and safety	Strict application of occupational health and safety rules to ensure workers' compliance with the use of PPEs Medical Monitoring	Ensuring adequate supply of personal protective equipment to all staff at all times.	Appropriate and adequate Personal protection ensured at all times	Workers, contractors and visitors	200,000.00 Provided under the Power Plant provisions	2017 -2018	Health and Safety Committee (HSC)
		To determine the health status of newly and existing employees and access their impacts on the Project operations.	Institute laid down procedures for routine health and safety monitoring	Workers	100,000.00 included under the Power Plant Programme	2017 Annual	Medical Consultant
Noise nuisance	<ul style="list-style-type: none"> • Noise minimization • Noise and Hearing Loss Survey 	<ul style="list-style-type: none"> • Monitoring of noise levels within premises • Implement preventive and corrective maintenance activities, lubricating worn-out machine parts to reduce friction • Communicate noise levels within the factory to all employees and 	All higher noise areas are identified and designated. Noise generations sources are well maintained to reduce noise generation to the minimum	Workers, contractors and visitors	Monitoring stations are provided under the Power Plant provisions	2017	Health and Safety Committee

Impact	Mitigation Action	Actual Action	Objective	Target	Budget (GHS)	Timeframe	Responsible party
		<p>contractors through training sessions, meetings and signs</p> <ul style="list-style-type: none"> • Provide and enforce the use of ear defenders such as ear plugs and muffs. • Institute controlled exposure to higher noise areas. 					
Dust emission	Appropriate and adequate personal protection	<ul style="list-style-type: none"> • Suitable PPE identified • Supply and stocking appropriate and adequate PPE 	Adopting suitable PPE for the coal dust	Workers	50,000.00	2017- 2018	Consultant/ HSC
Coal Spill	Risk control and Emergency Response Plan	<ul style="list-style-type: none"> • Identify any risk of potential hazard to the environment and workers and take actions in readiness to emergency response. • Protect life and property through addressing any potential hazards. 	Identifying all potential risk and creating emergency response team and resources	Coal Spill response plan action	20,000.00	Bi-annual	Consultant/ HSC
Incidents/ Accidents	<ul style="list-style-type: none"> • Documentation of incidents 	<ul style="list-style-type: none"> • Reporting of all incidents including near misses 	Employ laid down procedures	Workers	5,000.00	2017-2018	HSC

Impact	Mitigation Action	Actual Action	Objective	Target	Budget (GHS)	Timeframe	Responsible party
	and accidents	<ul style="list-style-type: none"> Investigating all accident and tracking the implementation of corrective and preventive actions Ensure all injuries and dangerous occurrences are reported to relevant regulatory agencies as stipulated by the regulations 					
TOTAL COST					375,000.00		

10.6 Environmental Quality and Monitoring Plan

There will be regular environmental monitoring based on requirements from the Environmental Protection Agency. The table below gives a summary of the requirements for the environmental monitoring.

Table 10-3 Summary of Environmental Monitoring Plan

Parameter	Indicator	Frequency	Method	Reporting	Budget	Responsibility
Ambient Air quality	TSP, PM ₁₀ , NO _x , SO _x ,	Monthly	Measuring device or monitoring stations	Quarterly Report	Included in the Power Plant monitoring programme	HSC/ Consultant
Seawater Quality	pH, Total dissolved solids, Total suspended solids, BOD, COD, turbidity, conductivity, Oil and Grease, Lead, Iron, Zinc, Copper, Total Chromium.	Monthly	Seawater sampling and analysis	Quarterly Report	Included in the Power Plant monitoring programme	HSC/ Consultant
Noise	Noise level	Monthly	Measurement of noise level using calibrated sound level meter	Quarterly Returns to EPA	Included in the Power Plant monitoring programme	HSC/ Consultant
	Hearing loss	Annually	Audiometric testing	Annual Report		
Illuminance	Light Level	Monthly	Light level measurement with illuminance meter	Quarterly Report	30,000.00	HSC/ Consultant
Waste Discharges	Dust Level and dust plume	Monthly	Visual and Dust Measuring device or monitoring stations	Quarterly Report	Included in the Power Plant monitoring programme	HSC/ Consultant
Effluent	Total dissolved solids, Total suspended solids, BOD, COD, turbidity, conductivity, colour, chlorine, E. coli, Total	Monthly	Laboratory test and analytical assessment	Quarterly Report	24,000.00	HSC/ Consultant

Parameter	Indicator	Frequency	Method	Reporting	Budget	Responsibility
	coliforms, Ammonia, nitrate, cadmium, oil and grease.					
Water	Process water and non-process water consumption	Daily	On-site measurement	EPA Akoben	-	Environmental Manager, Environmental Consultant
Electricity	Electricity production and consumption	Daily	On-site measurement	EPA Akoben	-	Environmental Manager, Environmental Consultant
Employment	Persons employed	Monthly	Head count	EPA Akoben	-	Environmental Manager, Environmental Consultant
Complaint	Public complaints	Monthly	Physical count	EPA Akoben	-	Environmental Manager, Environmental Consultant
Personal Protection Equipment (PPE)	Supply level	Monthly	Physical Inspection and Inventory	Quarterly Report	Included in the Power Plant monitoring programme	HSC/ Consultant
	Appropriate use of PPE	Annual	Training			
Dress Code	Supply level	Monthly	Physical Inspection and Inventory	Quarterly Report	Included in the Power Plant monitoring programme	HSC/ Consultant
	Appropriate use of PPE	Annual	Training			

Parameter	Indicator	Frequency	Method	Reporting	Budget	Responsibility
Medical Monitoring	Worker fitness	Annual	Health screening and Medical test	Quarterly Report	Included in the Power Plant monitoring programme	HSC/ Medical Consultant
Total					70,000.00	

10.7 Reporting Schedule

There are various types of reports to be submitted to the regulatory Agencies. The table below indicates the types of report and corresponding actions to be taken.

Table 10-4 Summary of Report Types

Report type	Frequency	Responsibility	Regulatory Agency
Environmental quality performance	Quarterly	Consultant/ESMU	EPA
Annual environmental report	Annual	Consultant/ESMU	EPA
Environmental Management Plan	3 years	Consultant/ESMU	EPA
Crane maintenance report	Annual	Consultant/ESMU/Maintenance Dept.	EPA/FID

10.8 Emergency Preparedness and Response Plan

The development and operation of the Coal Handling Terminal comes with varied hazards and risks and hence the Project shall take all necessary steps to mitigate the impact these hazards will have on the staff and the environment. The main aim of the emergency preparedness and response plan is to provide necessary guidelines for assistance to ensure safety of people, protection of environment, protection of installations and restoration of operation in emergency situation.

The objectives of the plan would seek to achieve:

- a) Improved state of preparedness to meet any contingency/emergencies.
- b) Enhanced response time in organizing resources to assist in rescue and response.
- c) Key resources, man power, materials & equipment needed to make the plan operational are identified and organized.
- d) Optimized the combined deployment of the available resources for emergencies.

Detailed standard operating procedure will be developed and used for emergency response during accident. Some of the risk/hazards which may occur include the following:

- a) Fire hazards
- b) Chemical Spillages and leakages
- c) Air pollution
- d) Explosions

- e) Equipment failures and malfunctions.

The Project would be prepared for any unexpected emergencies which may occur during the operation of the plant. This would require the Project responding to any emergency situation within the shortest possible time.

An emergency response team will be established to lead efforts during an accident. The emergency response team will be made up of selected members from all the departments who include:

- a) Production Department
- b) Wastewater treatment plant Department
- c) Maintenance Department
- d) Health and Safety Department
- e) Administration Department

These team members shall be given rigorous training on rescue and emergency responses to any potential accident likely to occur within the plant. They shall also lead coordination efforts to ensure safety within the plant.

The emergency response team shall have the following responsibilities:

- a) Direct actions within the affected area taking into consideration safety of the terminal in accordance with international requirements and best practices.
- b) Liaise with fire and security personnel for immediate action.
- c) Ensure that all non-essential workers / staff in the affected area are evacuated or rescued to safer places.
- d) Set up communication points
- e) Report all developments and requirements / assistance needed.
- f) Preserve all evidences so as to facilitate any inquiry into the cause and circumstances which caused or escalated the emergency
- g) Coordinate with other public agencies for necessary security, finance, medical and law & order etc.

The emergency response team shall liaise with the following public agencies;

- a) Ekumfi Municipal Assembly
- b) Ghana National Fire Service
- c) The Winneba District Hospital and Cape Coast Regional Hospital
- d) National Ambulance Service
- e) Environmental Protection Agency
- f) Ghana Police Service

In order to have an effective response to emergency situations, there will be three (3) types of response elements established. These response elements include:

- a) Operational response – this type of response is to bring the accident/incident under control and ensure that normal activities can continue.
- b) Management response – this involves the allocation of resources and making critical decisions.
- c) Communication response – this will involve the communication with employees and their families, officials, other agencies and the media.

Actions necessary at the time of emergency response may include:

- a) Exchange and provision of information in terms of event description, its severity and action plan.
- b) Preparation of checklist to ensure all evacuation and rescue procedures are followed appropriately
- c) Identification of resources needed and their deployment in relation to technical expertise, man power, equipment, spare parts and other materials.
- d) Early restoration and facilitation of re-inspection as needed.
- e) Field/site surveys including damage assessment.
- f) Post-accident investigation and analysis and future strategy.

10.9 Post Emergency Response

Actions necessary in post emergency/accident situation may include:

- a) Damage Assessments: Immediately following an accident, an initial damage assessment must be performed by the plant emergency response team.
- b) Hold meetings with staff and discuss the departments' performance.
- c) Assess the condition of structures under department's jurisdiction and carryout repairs as needed.
- d) Assess the condition of departmental vehicles and equipment and organize their repair and maintenance.
- e) Draw lessons from the performance and identify actions to be taken for future improvement.

- f) Review and document or record actions taken.
- g) Implement action plan for improving future performance.
- h) Training of staff in emergency response situations.
- i) Develop checklist and contingency plans.

11 DECOMMISSIONING

The chapter describes the activities to remove the installed facilities and equipment and return the site to a condition as close to a pre-construction state as feasible to ensure public health and safety, environmental protection, and compliance with applicable regulations. It further outlines the procedures and activities for reclamation during and after completion of project operation as well as measures to be taken to prevent unnecessary or undue degradation.

Decommissioning may become necessary for reasons of loss of relevance or usefulness of the Terminal resulting in closure of the operation of the affiliated coal-fired power plant.

Several considerations would be taken into account in decommissioning the coal Handling Terminal, which would also include strategic steps to contain costs and prevent spiraling liabilities. The basis of these considerations may be the economic model, technology assessment and environmental issues and also options for the site. Seeking professional assistance in this regards would be given due consideration from the beginning.

Nonetheless it is envisaged that decommissioning the Coal Handling Terminal would involve primarily dismantling of the coal unloading and transport facilities and possibly demolition of the wharf and breakwaters.

The activities would involve:

- Permitting
- Environmental and ecology assessment including ground investigation, noise mitigation and pollution.
- Structural demolition
- Site dismantlement and scrap recovery
- Waste disposal
- Environmental clean up
- Site remediation and restoration
- Costing

The Project would engage the services of professional demolition contractors to carry out the work and ensure appropriate measures would to be taken to prevent unnecessary or undue degradation.

Depending on the market for scrap metal, the dismantled coal unloader and transporting facility (enclosed conveyor system) may be sold to the local steel industry or reshipped to China to offset cost.

12 CONCLUSIONS AND RECOMMENDATIONS

VRA and SEC have carried out an Environmental and Social Impact Assessment of its proposed affiliated 70,000 DWT Coal Handling Terminal intended to support the operation of the 2X350 Supercritical Coal-fired Power Generating Plant to be situated along the coast of Aboano in the Ekumfi District of the Central Region.

The ESIA team has carefully evaluated the project design and environmental pollution control measures, and have further identified and assessed the likely residual impacts and recommended appropriate mitigation measures to eliminate, minimize or compensate where necessary for any significant residual impacts.

The likely primary potential hazards are identified to encompass air quality degradation, noise nuisance, seawater quality degradation, soil and water resource quality degradation, and occupational safety and health issues of employees and community health and safety issues. Consequently, the Project has carefully evaluated the residual impact in the context of EPA guidelines, IFC Environmental Health and Safety Guideline and in line with Equator Principles and China Banking Regulation.

In conclusion, the development and operation of the affiliated 70,000 DWT Coal Handling Terminal if appropriately managed as prescribed in this report are unlikely to have significant adverse effect on the environment with climate change. The health and safety situation of the workers and the community are also not likely to be affected by the implementation project development and operation.

Generally, it is envisaged that the project would likely to have immense positive social and economic impacts on the inhabitants in the surrounding communities and the nation as a whole.

The project would also facilitate the supplement provision of power generation capacity to boost Ghana's realization of stable and secure baseload. The project will again influence the socio-economic lives of the inhabitant and locals through the provision of decent jobs and consistent income flow both directly and indirectly, technology transfer and diffusion as well as boosting the commercial activities of the people.

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14 APPENDICES

Appendix 1: General Layout and Coordinates of the Project

Appendix 2: Location of the Anchorage Area and Dredged Material Disposal Area

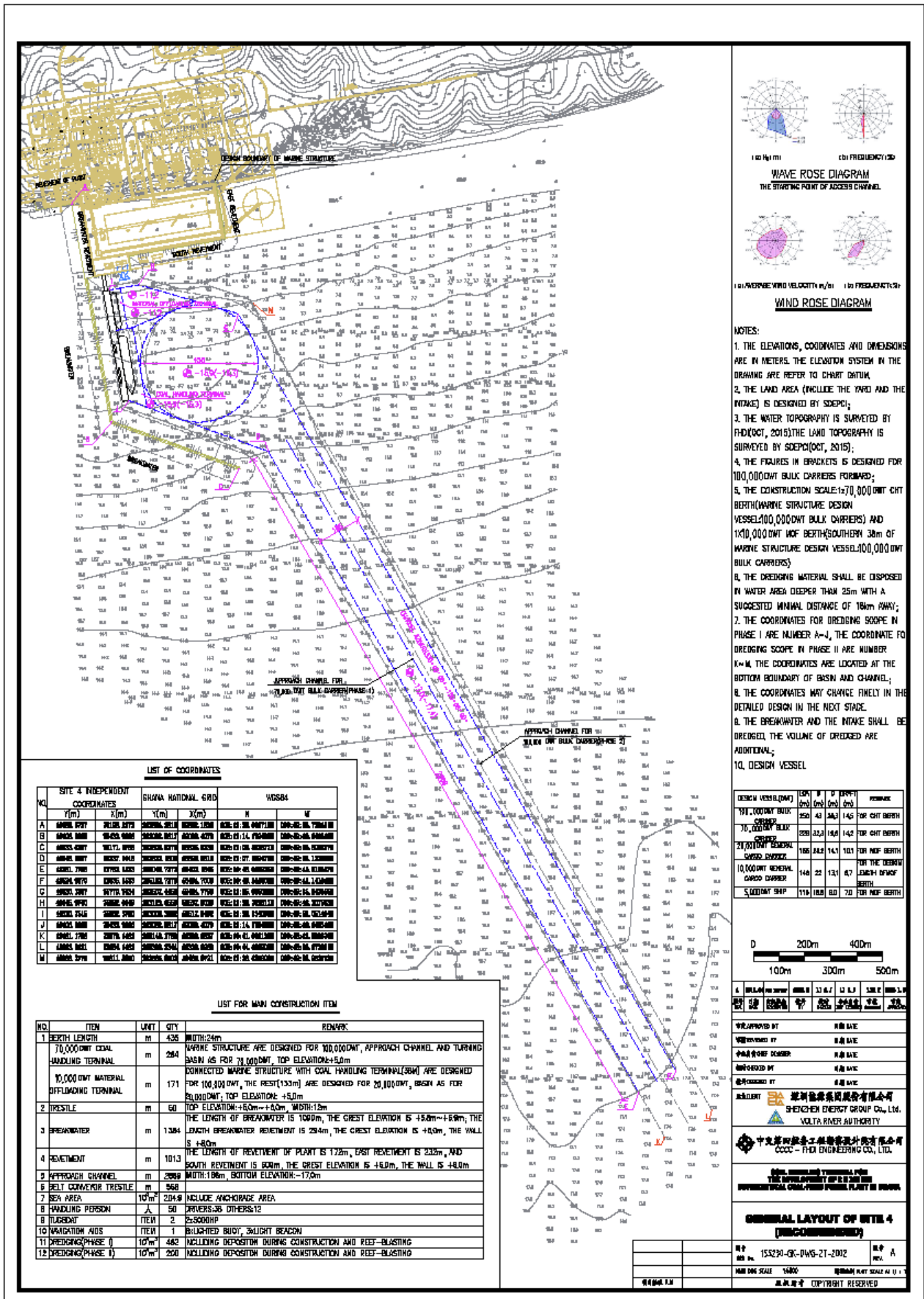
Appendix 3: Background Information Document (BID) Used for Scoping Consultation

Appendix 4: Consultation Records

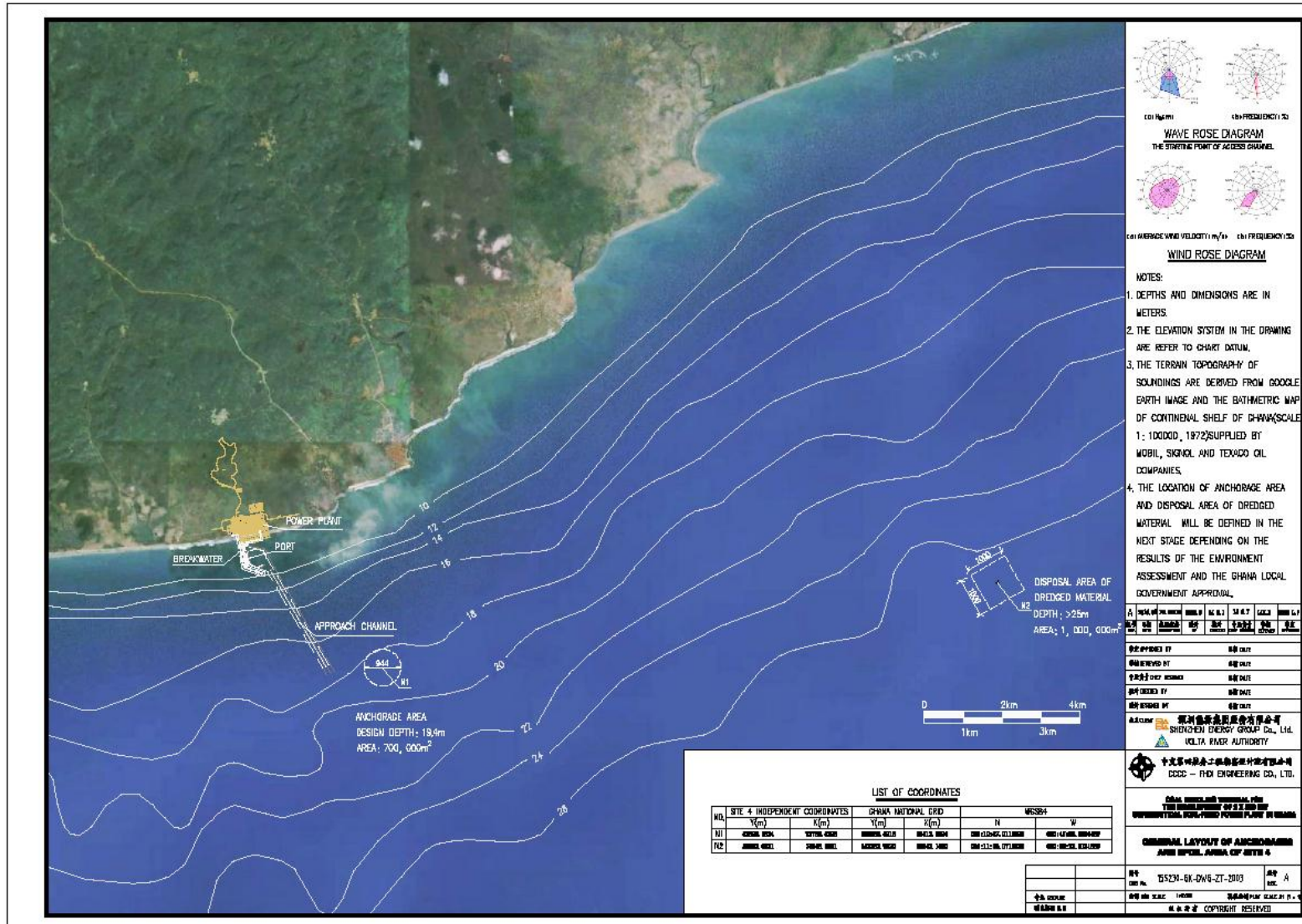
Appendix 5: Scoping Notice

Appendix 6: Profile of ESIA Team

Appendix 1: General Layout and Coordinates of the Project



Appendix 2: Location of the Anchorage Area and Dredged Material Disposal Area



Appendix 3: Background Information Document (BID) for Scoping Consultation

➤ **Background Information**

1. The Shenzhen Energy Group (SEC) in collaboration with Volta River Authority (VRA), intends to develop a supercritical coal-fired generating facility within the coastal region of Ghana.
2. The overall installed capacity of the generating plant is proposed to be 2,000MW in total for the coal-fired power plant project.
3. The project is planned to be developed in two phases; Phase 1 would be 2 × 350MW supercritical generating units construction, and Phase 2 is planned for 2 x 600 MW supercritical generating units construction.
4. Phase I project is planned to be commenced in August 2016 and the 2×350MW units will be completed and put into commercial operation from 2019.
5. The project main components comprise:
 - 5.1 Super-critical coal generation plant
 - 5.2 Coal handling Terminal
 - 5.3 Power transmission line (ROW)
6. It is preliminarily considered to use thermal coal from South African with Net Calorific Value not less than 5,500kcal/kg as the coal source.
7. The coal is shipped from the South African Richards bay and then transport to the affiliated 100,000 DWT coal handling terminal of the power plant. Backup coal source can be available from Columbia or other countries.
8. Environmental standards would comply to EPA guideline for the local requirements of Ghana; flue gas emission shall also meet the relevant IFC and World Bank Group standards.
9. It is proposed to adopt seawater once-through circulation water system for the Project; the circulating water is taken from the basin of coal handling terminal.
10. The fresh water of the power plant is initially supposed to obtain through seawater desalination system; however local sources are being considered.

➤ **Project Activities**

Construction Phase

Transportation, Drilling, Blasting, Installation and Construction works would account for the vast majority of the activities and consequently the related impact on the atmosphere environment.

Operational Phase

Operation of the plant including uptake and discharge of sea water, arrival and dispatch of vessels carrying coal and evacuation of electric power.

Environmental and Social Impact Assessment

Environmental and Social Impact Assessment Report for the development of a 2 X 350MW Coal-fired generating plant and associated facilities would be prepared

The detailed ESIA study to determine the impact of the project on the environment, workers and society and to propose environmental, health and safety impact mitigation measures for the pre-construction, construction/demobilization, operational and decommissioning phases, taken into consideration, review comments from the EPA, other stakeholder agencies and the general public especially the community.

➤ **Stakeholder Comment Sheet**

We solicit your response to the following questions to inform of your concerns and appreciation of the project.

1. What are the primary concerns and or benefits the project is likely to cause to you and the community; particularly relating to environmental, economic and social aspects?
2. In your opinion, what are the positive and negative aspects of the proposed project?
3. Do you have or know of any information that might be relevant to the EIA (e.g. environmental information and community, social or economic information).

Appendix 4: Consultation Records

GHANA MARITIME AUTHORITY

In case of reply, the number and the date of this letter should be quoted

GMA 10/3/01/083

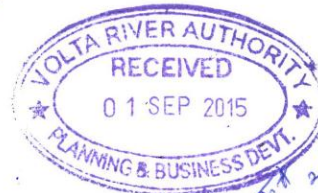
My Ref. No.....

Your Ref. No.....



Ministries Post Office
P. M. B. 34, Ministries
Accra
28TH AUGUST 2015

W. King 19/15
**THE DIRECTOR
PLANNING AND BUSINESS DEVELOPMENT
VRA. P.O. BOX MB 77
ACCRA**



W. King 19/15
W. King / Peter 19/15
Your attention pls.
W. King 19/15

Dear Sir,

RE: COAL - FIRED POWER PLANT PROJECT

We write with respect to the subject matter mentioned above.

Following the VRA / Shenzen Energy Group and GMA meeting held on May 26, 2015 and the stakeholders' forum on the Pre-feasibility Study Report (PFSR) of the project on July 15, 2015, we submit below relevant comments from the Ghana Maritime Authority.

Minutes of VRA/SEC and GMA - May 26, 2015

3.2

To be captured as follows:

GMA explained that they regulate, monitor and coordinate activities in the maritime industry.

GMA superintends over the Ghana Shipping Act, 2003 (Act 645) as amended and the Ghana Maritime Security Act, 2004 (Act 675) as amended and associated Legislations.

GMA therefore ensures the safety and security of Ports, vessels and other installations including subsea structures within Ghana's maritime jurisdiction.

With respect to the proposed port, GMA will have to ensure that it complies with the provision of the International Ship and Port facility Security (ISPS) Code as specified in the Ghana Maritime Security Act. Therefore a detailed Plan of the proposed port has to be submitted to GMA for the Authority to carry out a port facility security assessment which shall be reviewed and approved by the National Maritime Security Committee. A Port Facility Security Plan shall subsequently be developed and approved for implementation by the port operator.

4.0

To be captured as follows:

GPHA is the body mandated to build and operate ports in Ghana. Once GPHA gives the consent for the port to be built, then the port layout and coordinates of the breakwater shall be made available to GMA so that it can be inserted on the appropriate nautical charts, safe navigational routes as well as aids to navigation will also be indicated. (Also 8.3.3 of the PPPFSR))

Other issues

During construction and operations: (Also 8.3.3 of the PPPFSR)

Statutory documents of vessels to be engaged in the dredging and construction and other operational works to be submitted to GMA for vetting permission. (Also 8.3.3.1.1 (6) of the PPPFSR)

Any subsea structures such as pipelines intended to be buried on the sea bed must be made known to GMA for clearance before installation.

Statutory certificates / documents of vessels intending to call at the port shall be submitted by the agent of the vessel to GMA. The vessels once in port will also be subjected to Port State Control inspections by GMA staff.

For the Power Project Prefeasibility Study Report (PPPFSR)

4.3.2 Meteorology of the Power Project Prefeasibility Study Report

Comment

The GMA Vessel Traffic Management Information System (VTMIS) is installed with meteorology sensors and the Control Centre equipment in Accra, Takoradi and Tema display the following indicators:

- a) Wind speed and direction
- b) Humidity
- c) Atmospheric Pressure
- d) Temperature

The above indicators are displayed for eight (8) coastal towns viz:

- Keta
- Ada
- Tema
- Winneba
- Cape Coast
- Takoradi
- Axim
- Half Assini

Data from the VTMS Sites could be used to determine the climatic conditions of the five (5) candidate sites of the project.

We do apologise for the late submission but we hope that you will find the above remarks useful in your study.

Please do not hesitate to contact us should you require any further clarification or information.


Thank you.

Yours faithfully,

A handwritten signature in dark ink, appearing to read 'Inusah A. Nasir', with a stylized flourish at the end.


**CAPT. INUSAH A. NASIR
DEP. DIRECTOR (Environ. & Safety)
For: DIRECTOR GENERAL**

Appendix 5: Scoping Notice



深圳能源
SHENZHEN ENERGY

SCOPING NOTICE



**VOLTA
RIVER
AUTHORITY**

The Shenzhen Energy Group Co., Ltd. of China (SEC) in collaboration with the Volta River Authority (VRA) intends to develop a 2×350MW supercritical coal-fired generating units (including affiliated coal handling terminal), at Ekumfi within the coastal areas of the Ekumfi District in the Central Region of Ghana. This project is known as the “**2 x 350MW Supercritical Coal Fired Power Plant**” and represents the first phase of the development which is to be further expanded either by a 4×350MW (or 2×600MW) supercritical coal-fired generating units.

Notice of the proposed “**2 x 350MW Supercritical Coal Fired Power Plant**” is hereby served for public information, as required under the procedures for the conduct of EIA in accordance with Regulation 15(1) of LI. 1652.

Any person(s) who have an interest, concern, or special knowledge relating to potential environmental effects of the proposed undertaking may contact or submit such concerns, etc., to:

<p>The Chief Executive Officer AND</p> <p>Volta River Authority P. O. Box MB 77, Accra Tel No: +233-302-664941-9 Fax: +233-30-2662610 Email: corpcomm@vra.com</p>	<p>The Executive Director Environmental Protection Agency P. O. Box M 326, Accra Tel No: +233-302-664697/8 Fax No: +233-302-662690 Email: info@epa.gov.gh</p>
--	--

Or

The Deputy Manager,
Shenzhen Energy Ghana
Coal Fired Pre-project Office
Private Mail Bag 267,
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Tema, Ghana
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Not later than 31st January, 2016

Appendix 6: Profile of ESIA Team

The Specialist team conducting the environmental and social impact assessment for the 2x350MW Supercritical Coal-Fired Power Plant is a consortium comprising Premier Resource Consulting, ESL Consulting and Envaserv Research Consult. The team members have over fifteen years of experience in Environmental Technology and Management as well as sector specialist knowledge.

The specialists and expected roles on the team are presented below:

SPECIALISTS	NAME	ROLE
ESIA and Environmental Technology Specialist	Mr. Felix P. Quansar (ESIA LEAD CONSULTANT)	Coordination of the entire study Baseline assessment Environmental Technology Transfer Process Analysis Environmental Impact Analysis Safety and Risk Design Public Consultation Drafting ESIA Reports and Quality Assurance of Independent Reports
Subtidal and Intertidal Ecology	Lead: Mr. Ayaa Kojo Armah (ESIA ASSISTANT LEAD CONSULTANT) Assistant: Amanor Kisseih	Assist Coordination of Entire Study and Quality Control Coordinator for Ecological Survey & Habitat Assessment Study Loss and disturbance to subtidal benthos
Modeling Specialist	Lead: Mr. Emmanuel Lamptey Assistant Selorm Dzako Ababio	Air quality monitoring Emission Monitoring Noise Monitoring Conducting Air Emission Dispersion, Noise and Seawater modeling Green House Gas Emission and Climate Change assessment
Assistant Ecology Review Coordinator	Anthony Bentil	Will assist Project manager in all activities which include project planning, baseline surveys, environmental and social impacts identification, analysis and mitigation. Will be involved in stakeholder consultations and report writing.
Marine Mammals and Turtles	Lead: Mr. Andrews Agyekumhene Assistant:	Potential impacts on marine mammals, including endangered and vulnerable species that are thought to be present in the local area and known to be present in the wider

	Enoch Armah	area; Potential impacts on sea turtle species that may nest in the area of works and migrate across the area; rapid sea turtle field verification survey
Marine, Fresh Surface and Ground Water Quality Related Impacts/ Marine Sediments	Lead: Dr. Ansa-Asare Assistant: Victor Mante	pH and Temperature Salinity and Conductivity Biological and Chemical Oxygen Demand Turbidity Dissolved and Suspended Solids Hydrocarbons Oil and Grease Heavy Metals Nutrients Microbiology Grain size analysis
Fisheries	Lead: Richmond Quartey Assistant: Emmanuel Klubi	Potential impacts on fish nursery and spawning grounds Plankton and benthos assessment
Sociologist/Stakeholder Consultation	Lead: Adu-Nyarko Andorful Assistant: Bright Yeboah	Possess extensive experience in the six coastal districts with local communities and other stakeholders. Will lead all stakeholder consultations Socio-economist/rap expert
Landscape and Seascape Specialist	Maxwell Mensah Clottey	Landscape, Seascape and Visual Impact Assessment
Historical Resource Specialist	Maxwell Mensah Clottey	Historical resource and cultural heritage assessment

15 INDEPENDENT REPORTS

Independent Report 1: Ecological Survey and Habitat Assessment Study

Independent Report 2: Offshore Fish Survey of Dredged Material Disposal Area

Independent Report 3: Socio-economic Impact Assessment

Independent Report 4: Landscape and Seascape Visual Impact Assessment