DRAFT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT FOR THE PROPOSED BONNY DEEP SEA PORT PROJECT

IN

BONNY ISLAND, BONNY LOCAL GOVERNMENT AREA, RIVERS STATE

BY FEDERAL MINISTRY OF TRANSPORTATION

SUBMITTED TO THE

FEDERAL MINISTRY OF ENVIRONMENT HEADQUARTERS

MABUSHI, ABUJA

DECEMBER, 2020

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PREPARED BY

ESCHOLES INTERGRATED SERVICES RESOURCES LIMITED

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LIST OF ABBREVIATIONS, SYMBOLS AND ACRONYMS

%	Percentage
<	Less Than
AAS	Atomic Absorption Spectrophotometry
ALARP	As Low As Reasonably Practicable
APHA	American Public Health Association
AQ/MET	Air Quality and Meteorology
ASTM	American System of Testing and Methods
BH	Borehole
BSI	British Standard Institution
BOD	Biochemical Oxygen Demand
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CRCC	China Railway Construction Corporation Limited
DO	Dissolved Oxygen
EBS	Environmental Baseline Survey
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Monitoring Plan
Fig	Figure
FMEnv	Federal Ministry of Environment
FMoT	Federal Ministry of Transport
GPS	Geographic Positioning System
H_2S	Hydrogen Sulphide
HSE-MS	Health, Safety and Environment – Management System
ISO	International Standard Organization
kg	Kilogram
LFN	Law of the Federal Republic of Nigeria
L.G.A	Local Government Area
M	Million
m	Metre
m/s	Mitres per seconds
m^2	Square metre
mg/l	Milligram per liter
Mg^{2+}	Magnesium ion
ml	Milliliter
NESREA	National Environmental Standards and Regulations Enforcement Agency
NH_3	Ammonia
Ni	Nickel
NOx	Oxides of Nitrogen
NRB	Non-Returnable Bottle

NTU	Nephelometric Units
^{0}C	Degrees Celsius
p.a.	per annum
ppm	parts per million
PRM	Packaging Raw Material
RAM	Risk Assessment Matrix
RH	Relative Humidity
RTAs	Road Transport Accidents
µS/cm	Micro Siemens per centimetre
$\mu g/m^3$	Microgramme per cubic metre
SAMP	Social Action and Management Plan
SED	Sediment
SG	Standard Gravity
SKU	Stock Keeping Unit
SO_4^{2-}	Sulphate ion
SOx	Oxides of Sulphur
sqm	square meters
STIs	Sexually Transmitted Infections
TDS	Total Dissolved Solids
THB	Total Heterotrophic Bacteria
THC	Total Hydrocarbon
THF	Total Heterotrophic Fungi
THUB	Total Hydrocarbon Utilizing Bacteria
TOC	Total Organic Carbon
ToR	Terms of Reference
TSS	Total Suspended Solids
TPH	Total Petroleum hydrocarbon
VOC	Volatile Organic Carbon
WHO	World Health Organization

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EXECUTIVE SUMMARY

0.1 INTRODUCTION

There are six major seaports (Apapa Port, Tincan Port, Onne Port, Warri Port, Port Harcourt and Calabar Port) with a combined cargo handling capacity of 40 million tons and annual cargo throughput of over 100million tons (Nigerian Ports Handbook 2018 - 2019). Apapa and Tincan Ports are the biggest and busiest port in West Africa which undertakes about 70% of the import and export goods transportation. In Nigeria, 70% of the foreign trade is loaded and unloaded through the ports. The port of Lagos focuses mainly on inbound goods, and there are fewer outbound goods the cargo handling ratio of Apapa Port Area and Tincan Port Area which are the two major ports is 55:45.

A viable Deep-Sea port project is needed to keep up with the demand for capacity, as the existing ports in the country have been overwhelmed or have been surrounded by urban developmental facilities which has made expansion impossible (like the case with the ports in Lagos State). The proposed Bonny Deep Sea project will reduce the transportation challenges, boost economic activities, create job for the growing youth population, generate revenue and to a large extent solve the problem of traffic congestion currently experienced in the ports.

The proposed Bonny Deep Sea Port project is amongst the key financing and construction project approved by Federal Government of Nigeria. It is also part of the implementation of FGN's Economic Recovery and Growth Plan (ERGP) of 2017 to 2020 which is targeted at increasing the infrastructures in the country, solve the persistent transportation bottleneck occasioned by the congestion of the existing Nigeria Ports amongst others.

The project would be undertaken by China Civil Engineering Construction Corporation (CCECC) under a Private Public Partnership (PPP) program. China Civil Engineering

Construction Corporation (CCECC) is a duly registered company incorporated on 7th September, 2016 under the Companies and Allied Matters Act 1990.

In compliance with the Environmental Impact Assessment (EIA) Act No. 86 of 1992; Cap E12 LFN, 2004, Escholes Integrated Service Resource Limited was commissioned to carry out the Environmental and Social Impact Assessment (ESIA) of the Bonny Deep Sea Port in order to ascertain the baseline environmental and social data around the project vicinity.

The ESIA covers the entire life cycle of the proposed Project i.e. pre-construction, construction, commissioning, operation and decommissioning and it has been carried out in line with the relevant requirements of the Federal Ministry of Environment (FMEnv).

Legal and Administrative Framework

The ESIA has been carried out in line with the applicable legal and administrative framework, including relevant international guidelines and conventions. Some of these include, but not necessarily limited to the following: EIA Act Cap E12 LFN 2004; Labour Act of 1990 (amended in 2004); Forestry Act, Cap LFN 36, LFN, 2004; Rivers State Ministry of Environment Law; World Bank Group Environmental, Health and Safety (EHS) General Guidelines; International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability, 2012 and World Bank Environmental and Social Framework.

In the course of this study, the following legislations were also consulted:

- Environmental Impact Assessment (EIA) Act No. 86, 1992.
- Environmental Impact Assessment Sectoral Guidelines for Infrastructures 1995.
- National Policy on Environment (2017).
- National Guidelines and Standard for Water Quality 1999.
- National Guidelines on Environmental Management Systems (EMS) 1999.
- National Environmental Protection (Pollution Abatement in industries and facilities generating wastes) Regulation S.I. 9 of 1991.

- Guidelines and Standards for Environmental Pollution Control in Nigeria 1991.
- Sectoral Guidelines for EIA 1995.
- Harmful Wastes (Special Criminal Provisions) Act CAP 165 LFN, 1990.
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act of 2007.
- Nigerian Ports Authority Act 1954 (CAP 155).
- Nigerian Shippers' Council Decree No. 13, of 1978.
- Nigeria Maritime Administration and Safety Agency (NIMASA) Regulations of 2006.
- National Inland Waterways Authority (NIWA) Decree No. 13, 1997.

Overview of project proponent

Federal Ministry of Transportation (FMoT) located at Bukar Dipcharima House, Central Business District, Abuja is a cabinet Ministry of the Government of the Federation, it has several department among is the Marine Services Department which oversees Agencies such as Nigerian Maritime Administration and Safety Agency (NIMASA), Nigerian Ports Authority (NPA), Nigerian Inland Waterways Agency (NIWA) and other Marine and River Transport systems with a mission to build a safe, secured and efficient aviation industry focused on making Nigeria a hub that meets international Standards and Best Practices for the African Continent.

0.2 PROJECT JUSTIFICATION

Need for the Project

Maritime transportation is one of the key sectors of the Nigerian economy. According to Nigerian Ports Authority cargo throughput data of 2007 – 2019, the cargo throughput handled in the Nigerian ports increased from 66,908,322 metric tonnes in 2009 to 74,910,284 metric tonnes in 2010 indicating a 12% increase. According to global trends in port development, out of a total of 100 plus seaport developments being executed the world over, approximately 60 to 75 percent of these are deep sea ports or terminals. The balance is mostly inland water way ports and Jetties. Nigeria needs new better designed port facilities in line with increased cargo traffic nationally and globally, new and bigger marine vessels that need deeper harbour drafts and global logistics trends and practices have made the need for deep sea port more imperative.

The Federal Ministry of Transportation has therefore decided to develop a sea port and to situate it in Rivers State, by virtue of the location in the Southern border, being washed by the Atlantic Ocean the State is clearly the most strategic in Nigeria were a deep sea port will serve the entire Northern States in the country and also feed into the proposed Eastern Railway line.

Envisaged Sustainability of the Project

Economic Sustainability: The proposed Bonny Deep Sea Port project shall promote business opportunities and enhance the Nation's economic development thus increasing the country's foreign reserves and gross domestic product (GDP).

Social Sustainability: The Federal Government of Nigeria through The Federal Ministry of Transportation shall also put up robust and implementable Memorandum of Understanding detailing issues about Corporate Social Responsibilities, employment, compensation for land, affected farms among other to the Project Host Community.

Technical Sustainability: The design, construction and operation of the proposed Project will be handled by properly trained and experienced personnel according to the pre-established standards and procedures.

Environmental Sustainability: This project would have some potential negative impacts on the environment. The ESIA will identify all potential impacts associated with the proposed project and proffer appropriate mitigation measures that will ensure that all the impacts are minimized or completely avoided.

Project Alternatives

The various alternatives considered for the proposed Deep-sea port Project are briefly described as follows:

Go Ahead Project Option: This option allows for full implementation of the project after all considerations of the concerned environmental, technical, economic and social factors. Based on the availability of sufficient natural draft for large vessels to sail, requisite land availability, adequate geo-technically wholesome soil, the Eastern Railway System linked directly to the deep sea port for cargo evacuation among other climatic, environmental and social factors etc., this option is recommended for the project to be carried out with strict compliance with the recommendations of the ESIA study as approved by the Federal Ministry of Environment.

Proposed Project Site Selected: Very short dredging distance to attain sufficient draft for large vessels to sail, nearness to the deep Atlantic Ocean, land availability, adequate geo-technical nature of the soil/ground, proximity to the extended portion of the Eastern Railway Line for cargo evacuation among other climatic, environmental and social factors make Oluma in Bonny Local Government Area of Rivers State (the proposed project site) apt for the project.

03 PROJECT OVERVIEW

The project Intent is to construct a 100,000DWT Container Vessel and 50,000 DWT Bulk Vessel capacity Deep Sea Port on a land take of 275.22Ha at Bonny Island, Bonny Local Government Area of Rivers State with components such as Dredging of basin, dredging of channel, reclamation for land area, pilling works, fabrication of beams, installation of superstructures of berth, construction of revetments and buildings of terminals.

The Project activities can be categorized as follows:

Pre-construction Phase/Construction: Site selection/land take; Construction of workers'/Temporary access road; Mobilization of personnel, materials, and equipment to site; site preparation, Civil /Mechanical work activities, Dredging, Installation of equipment and machinery, installation of ancillary facilities; Waste generation and disposal

Decommissioning: phase: Removal of equipment and port infrastructure; Site remediation and rehabilitation; Waste generation and disposal.

Highlights of the project component are as follows: -

- Container Berth (100,000 DWT container berth with length of 426m.
- Berthing Area (with width of 92 m and bottom elevation -14m)
- Turning Basin (Diameter of 692m while the bottom elevation is – 16.0 m.
- Channel (240 m wide with a bottom elevation of 16 m)
- Multipurpose terminal
- Stalking yard
- Ware house
- Administrative building

0.4 DESCRIPTION OF THE ENVIRONMENT

Information and data for the description of environmental conditions of the Project's Area of Influence (AoI) were obtained through literature review and field data gathering.

A one season data gathering exercise was approved by the Ministry which took place within 22nd to 24th November, 2020 (Wet Season) witnessed by Representatives from Federal Ministry of Environment, Rivers State Ministry of Environment as well as Staff of Federal Ministry of Transportation. The wet season field data collected was augmented with dry season secondary data sourced from the Final EIA Report for Bonny Oloma Fabrication Yard Study 2018.

For the biophysical components, a 2km radius from the center of the Project site was selected as the spatial boundary while the socio-economic survey was extended to approximately 5km radius. The samples were analysed at Tudaka Environmental Consultants Limited laboratory.

Climate and Meteorology: The climate of Rivers State is tropical with alternating wet and dry seasons. The wet season period is usually between April and October, while the dry season is experienced between November and March. The climatic information for the project area is based on the analysis of the climatic data of the study area collected from NIMET Port Harcourt synoptic station, for Port Harcourt and Bonny. The climatic data spanned from 1983 to 2018. Meteorological data were also collected at thirty-two locations within the study area during the field data gathering process.

Geology: The proposed project site in Bonny Island falls within the Beach ridges on-shore geomorphic sub- environment of the Niger Delta. It consists of Pleistocene and Recent sediments deposited by fluvial and shelf hydrodynamic processes which include that of waves, tides and longshore currents that still characterized the area till date. The Island is bounded in the south by the Atlantic Ocean, in the east by the Bonny estuary and in the North and west it is bounded by another meandering tidal channel or creek that flows to the Atlantic Ocean and also connects to the Bonny estuary in the north.

Air Quality and Noise: The concentrations of air quality parameters recorded at different locations sampled in the Project's AoI were within the FMEnv's regulatory limit.

The concentration of volatile organic compounds in the air was very low and had a mean value of 0.341ppm (0.1-0.8ppm). TSP determination yielded results within the range of 5.8ppm to 20.7ppm (mean=10.26) while the $PM_{2.5}$ and PM_{10} yielded results within the range of 0.3ppm to 4.9ppm (mean=2.17ppm) and 3.7ppm to 14.8ppm (mean=7.56ppm) respectively; CO concentration obtained ranged from 0.1ppm–

1.4ppm (mean=0.631); NO_2 detected from all the sampling locations ranged from 0.01ppm to 0.04ppm; H_2S; ranged between <0.01ppmto 0.03ppm; NH3 values detected from all the sampling locations were all below equipment detection limit; SOx concentration ranged from 0.01-0.05ppm.

Soil Quality: Soil samples were collected from 3 cores from each sampling point at depths of 0-15cm and 15-30cm for top soil and sub soil respectively**.** Samples were collected with stainless screw type soil auger into plastic bags for physicochemical and microorganism analysis. Separate samples were also collected into aluminum foil hydrocarbon content determination. In the study area, the mean(s) of heavy metals concentration for top and sub soil were respectively as follow: Iron and Cu occurred in mean concentrations of 90.23 and 7.32 mg/kg respectively in top soil and then 47.23 and 2.84mg/kg in sub soil. While Zn and Cr occurred in mean concentrations of 1.50 and 0.10 mg/kg respectively in top soil and then 0.53 and 0.04mg/kg in sub soil while the others shows value below equipment detection limit.

Surface water: Surface water samples were collected from 30 different point within the proposed project area and immediately analysed for parameters with short holding analytical time such as pH, dissolved oxygen (DO), temperature, and turbidity. The results of physico-chemical and microbial properties of the groundwater samples were within Standard (FMEnv) limit.

Socio Economic Study

The socio-economic baseline description is focused on local level i.e. within Bonny Local Government Area. This is because it is expected that the proposed project will result in macro-economic benefits at a national level, the primary socioeconomic impacts of the Project will be experienced at the local level within 5-kilometer radius of the project location. In the context of this study, the AoI further includes areas around the site likely to be affected by the Project activities during the pre-construction, construction and operation phases. The effects can be positive or negative, short or long term or permanent, as well as direct and in-direct.

Bonny is situated on one of the coastal barrier islands of the lower Niger Delta region and is traditionally of the Ibani ethnic nationality. The history of the Ibani *(Igbani)* indigenous ethnic group is closely related to other neighbouring coastal groups of the Delta. Bonny Island has been an important trading centre since the 16th century. This is reflected in the complex ethnic mix of its people.

Survey Methodology for Socioeconomic Studies

The socio-economic study was undertaken during the Field work based on a review of available secondary information and primary data collected in the local communities. Primary data collected for this analysis are both qualitative and quantitative and derived from key informant interviews, village-level surveys and focus group discussions. The socioeconomic study focused on the identification of stakeholders and impact on the community in terms of their infrastructures and also on their educational learning system, the institutional analysis and the system for monitoring and evaluation among others.

The study was designed to obtain relevant socio-economic data on the community as well as key stakeholders through primary and secondary sources. This led to adopting a study strategy that involved the following activities:

- Conducting literature search and reviews
- Conducting field visit to the study area.
- Design and pretesting of household questionnaire/ appraisal tools for the study;
- Determining target population and sample size for participatory rural appraisal and interviews;
- Conducting consultations and socio-economic survey (Focus Group Discussions [FGDs] General Group Discussion [GGD] and In-Depth Interviews [IDI] with various stakeholder groups and interviews with key informants in the community

- Conduct interviews with key stakeholders involved with the project;
    - ✓ Direct observations;
    - ✓ Collating and analysing data obtained from all the sources; and
    - ✓ Report preparation.

0.5 ASSOCIATED AND POTENTIAL IMPACT

Potential environmental and social impacts (including health and safety issues) associated with the proposed Project was assessed using a modified Leopold Interaction Matrix. Impact significance was also determined. In determining the significance of impacts, the factors considered included: magnitude of impacts (which is a function of the combination of the following impact characteristics: extent, duration, scale and frequency); value/sensitivity/fragility and importance of relevant environmental and social receptors; legal/regulatory requirements; and public perceptions (based on stakeholders' consultation). The identified potential adverse impacts are summarized below along with the recommended mitigation measures.

- **Emission of exhaust fumes, noxious gases and increased ambient noise level** Personnel and equipment shall be transported to the project location using water transport crafts and land vehicles that use hydrocarbon fuels. The combustion of these fuels shall result in the production of noxious gases and fumes such as carbon monoxide, oxides of sulphur, lead, etc. into the atmosphere. This impact was described as adverse, short term, reversible, and was ranked medium.
- **Kidnapping of workers and visitors on site:** The kidnapping of workers and visitors on site are among the major security concerns in Nigeria now. During movements as required in mobilisation, personnel and company contractor may be victims of kidnappers. Some of these attacks may result in the death of victims which is negative, direct, and irreversible, thus rated high.
- **Loss of Vegetation of the Project Area:** The vegetation thriving on the site shall be removed. This impact was described as adverse, long term, reversible, and was ranked high.

0.6 MITIGATION MEASURES

In proffering mitigation measures for the identified impacts of the proposed Project, preference was given to avoidance or prevention of adverse impacts and where not feasible, measures which are practicable and cost-effective using best available technology were provided to reduce and/or minimize the impacts while compensation/offset was considered as the last resort, in line with the standard mitigation hierarchy.

The summary of the mitigation measures is provided as follows:

The associated impacts of the pre-construction phase activities shall be mitigated through the following measures, amongst others:

- Federal Ministry of Transportation and the Bonny Deep Sea Port project EPC contractor shall ensure that they involve members of the host/beneficial communities in the skilled and unskilled work force required for this project.
- Contracts for provision of minor raw materials shall also be awarded to the members of the host communities.
- Adequate compensations shall also be paid to owners of farms, economic trees and fish ponds that will be lost due to the project execution.
- All water crafts and vehicles shall be kept by periodic and regular maintenance in good working condition.
- Only well trained, experienced, physically and mentally fit craft and vehicle drivers shall be employed to convey personnel and equipment.
- All boat drivers shall maintain minimum speed to reduce turbulent wave generation.
- Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods to forestall mishaps.
- Vegetation clearing shall be restricted to only the desired area.

- Any vegetation that is cleared outside the project area shall be replanted using same species of plants that were removed.
- All workers shall wear adequate protective gear and clothing (PPE) while at work.

Decommissioning Phase

The associated impacts of the decommissioning phase activities shall be mitigated through the following measures, amongst others:

- All water crafts and vehicles shall be kept by periodic and regular maintenance in good working condition.
- Traffic caution signs shall be mounted in strategic locations along the selected route especially on land.
- Only well trained, experienced, physically and mentally fit craft and vehicle drivers shall be employed to convey personnel and equipment.
- All boat drivers shall maintain minimum speed to reduce turbulent wave generation.
- Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods. This is to forestall mishaps.

0.7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

An Environmental Social Management Plan (ESMP) has been developed to satisfy long term objectives of managing and monitoring the environmental and social impacts of the proposed Project. It covers all phase of the Project includes desired outcomes; performance indicators; monitoring (parameters to be monitored and frequency); timing for actions; responsibilities and cost estimates required for implementation of recommended mitigation measures, monitoring of the performance indicators and capacity building.

FMoT shall have principal responsibility for all measures outlined in the EMP, but may delegate responsibility to its contractors, where appropriate and monitor the implementation.

FMoT will provide specifications for environmental compliance and performance (through this ESMP and the associated plans) and, as a contractual requirement develop and provide its own specific management plans, incorporating:

Health, Safety and Environment Policy Statements, Programs, and Management Systems;

- Health, Safety, and Environment Organization;
- Health, Safety, and Environment Responsibilities;
- HSE Procedures;
- Employee HSE Training Programs;
- Waste Management Plans;
- Emergency Response/Evacuation Plans;
- Water/Land Transportation Safety Management System;
- Hazardous Materials Management Program;
- Industrial Hygiene and Medical Protection Plans.

0.8 DECOMMISSIONING AND ABANDONMENT PLAN

In compliance with National regulatory requirements (FMEnv) and International standards, decommissioning and demobilization of equipment and personnel will be planned and implemented. The main aim of decommissioning process is to restore the project area to its original state. An abandonment plan is developed to conform with the national statutory requirements contained in the Federal Ministry of Environment sectoral guidelines applicable to the project, as well as international standards. The plan includes an abandonment execution strategy to identify the components of the project that would be decommissioned and the sequence to be adopted.

0.9 CONCLUSION

This report presented an assessment of the Environmental and Socio-Economic components of the proposed Bonny Deep Sea Port project. The assessment here has painstakingly examined the anticipated and potential positive and negative impacts of the project. The beneficial potentials of the project outweigh the conceivable adverse effects, nevertheless, mitigation measures were developed for the adverse impacts based on best industrial practices. In addition, the measures developed are aimed at ensuring that the impacts on land use, vegetation, air quality, socio-economic and health are mostly localized and can be controlled and remediated to a level reasonably tolerable.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

The Federal Government of Nigeria (FGN) through the Federal Ministry of Transportation intends to construct a Deep Seaport in Bonny Local Government Area, Rivers state. In Nigeria, there are six major seaports (Apapa Port, Tincan Port, Onne Port, Warri Port, Port Harcourt and Calabar Port) with a combined cargo handling capacity of 40 million tons and annual cargo throughput of over 100million tons (Nigerian Ports Handbook 2018 - 2019). Apapa and Tincan Ports are the biggest and busiest port in West Africa which undertakes about 70% of the import and export goods transportation. In Nigeria, 70% of the foreign trade is loaded and unloaded through the ports. The port of Lagos focuses mainly on inbound goods, and there are fewer outbound goods the cargo handling ratio of Apapa Port Area and Tincan Port Area which are the two major ports is 55:45. Most of the port cargo is shipped to other cities such as Ibadan, Kano, Kaduna, Minna, and Abuja.

The proposed Bonny Deep Sea Port project is amongst the key financing and construction project approved by Federal Government of Nigeria. It is also part of the implementation of FGN's Economic Recovery and Growth Plan (ERGP) of 2017 to 2020 which is targeted at increasing the infrastructures in the country, solve the persistent transportation bottleneck occasioned by the congestion of the existing Nigeria Ports amongst others. Business Analyst put the financial loss from the gridlock at ₦4.57 trillion covering the first 9 months of 2017.

A viable Deep-Sea port project is needed to keep up with the demand for capacity, as the existing ports in the country have been overwhelmed or have been surrounded by urban developmental facilities which has made expansion impossible (like the case with the ports in Lagos State). The proposed Bonny Deep Sea project will reduce the transportation challenges, boost economic activities, create job for the growing youth population, generate revenue and to a large extent solve the problem of traffic congestion currently experienced in the ports.

The project would be undertaken by China Civil Engineering Construction Corporation (CCECC) under a Private Public Partnership (PPP) program. China Civil Engineering Construction Corporation (CCECC) is a duly registered company incorporated on 7th September, 2016 under the Companies and Allied Matters Act 1990.

In order to make the proposed Bonny Deep-Sea Port sustainable, it would be connected to the proposed Nigerian Eastern Railway Line (Narrow Gauge) and also feed the proposed Industrial Park in Ubima, Port Harcourt.

Environmental and Social Impact Assessment (ESIA) is a tool for decision-makers to identify potential environmental impacts of proposed projects, to evaluate alternative approaches, and to design and incorporate appropriate prevention, mitigation, management and monitoring measures. Environmental and Social Impact Assessment is also expected to help ensure protection, maintenance and rehabilitation of natural habitats and their functions in the context of projects in Nigeria and policy dialogue with countries.

In compliance with the Environmental Impact Assessment (EIA) Act No. 86 of 1992; Cap E12 LFN, 2004, Escholes Integrated Service Resource Limited was commissioned to carry out the Environmental and Social Impact Assessment (ESIA) of the Bonny Deep Sea Port in order to ascertain the baseline environmental and social data around the project vicinity

1.2 Project Proponent

FEDERAL MINISTRY OF TRANSPORTATION

Federal Ministry of Transportation (FMoT) with Headquarters located at Bukar Dipcharima House, Central Business District, Abuja is a cabinet Ministry of the Federal

Government of Nigeria, it has several department among is the Marine Services Department which oversees Agencies such as Nigerian Maritime Administration and Safety Agency (NIMASA), Nigerian Ports Authority (NPA), Nigerian Inland Waterways Agency (NIWA) and other Marine and River Transport systems.

A cabinet Minister heads the Ministry, supported by a Minister of State who oversees the Aviation section. The Permanent Secretary follows as the chief accounting officer while the Departments are headed by Directors. The Ministry is responsible to build a world-class transportation system which will provide a fast, safe, secure, efficient, convenient, affordable and inter-modal transport system that facilitates Nigeria's socio – economic developmental needs and enhances the quality of life of the public. Key stakeholders for the project are contained in Table 1.1 below.

Table 1.1 Key Stakeholders for the Project

Parties	Role
Federal Executive Council	Approving Authority
Infrastructure Concession Regulatory Commission	Approval Authority
Federal Ministry of Transport	Project Ownership
CCECC Nigeria Limited	Concessionaire

1.3 Objectives of the ESIA

The purpose of the study is to establish the baseline conditions in the area and to assess proactively the potential impact and associated impacts (including health and socio-economic impacts) of the proposed deep sea port on the project area. The objectives of the ESIA are summarized below:

- To assess, evaluate and predict the magnitude and significance of the potential impacts associated with sitting the Bonny Deep sea port project.
- Establish the existing land use, biological, physical and socio-economic conditions of the project areas.
- Characterize the future environment thereby identifying the resultant hazards (including social) associated with the project.
- Identify potential negative impacts that may arise as a consequence of the project implementation.
- Identify opportunities to enhance positive impacts and project benefits.
- Make recommendations to eliminate/mitigate/control the magnitude and significance of the negative hazards and effects.
- Recommend control techniques to eliminate/minimize the severity of the negative effects and to manage it.
- Recommend plans and procedures to manage the consequences.
- Ensure proper consultation with the communities bordering the proposed project site in line with FMEnv guidelines.
- Develop a comprehensive Environmental and Social Management Plan (ESMP) that will serve as an environmental guide during the various stages of the project.
- Use as an instrument for obtaining EIA project certification from the FMEnv.

1.4 Terms of Reference for the Study

The TOR of the ESIA study is intended to cover all the activities that constitute the project, this study will address the potential environmental impacts associated with the proposed project Full text of the Terms of Reference is contained in the Appendix while the summary is as follows:

i. Assessment of facilities to be installed/constructed and review of the project/process alternatives.

ii. Qualitative and quantitative assessment and description of the baseline environmental conditions of the project area. Data shall be collected on the following environmental components: -
   - Meteorology
   - Air Quality/Noise
   - Soil and sediment
   - Wildlife Resources
   - Aquatic Studies
   - Hydrobiology
   - Coastal Erosion
   - Geology/Hydrogeology
   - Land Use
   - Socio-economics

iii. Identification and assessment of real and potential impacts of the proposed Bonny Deep Seaport Facility on the various environmental components listed in (ii) above.

iv. Develop control strategies with a view to mitigate and ameliorate significant impacts of the project. This will include:
   - Identification of measures to reduce harmful effects
   - Monitoring measures or steps to avoid the occurrence of such effects if preventable, etc.

v. Provide measures to maximize beneficial impacts and eliminate or minimize adverse impacts on the ecological and socio-economic status of the host community.

vi. Estimate and describe the nature and likelihood of environmental and social damage and incidents and thus, provide a basis for contingence planning.

vii. Recommend an Environmental and Social Management Plan (ESMP): The ESMP shall contain the following:

- The environmental and social objectives and commitments
- Monitoring frequency and parameters to be monitored
- The means by which these will be achieved
- The responsibilities/accountabilities
- The corrective actions which will be employed should the need arise
- Review schedules and criteria
- Post commissioning monitoring (environmental audit, compliance monitoring, etc.).

viii. Develop decommissioning and abandonment plan after project closure including site restoration plan.

1.5 Administrative and Legal Framework

The ESIA is aimed at meeting the requirement of the Nigerian regulatory authorities and International Institutions such as IFC, AfDB, EPFI, China Exim Bank and other major lending institutions that maybe involved in the project at any time in its lifespan.

1.5.1 National Regulations

Nigeria has evolved a national policy on the environment following the ever growing awareness and concerns for greater spread of environmental protection, and has since established the Federal Ministry of Environment (FMEnv) which is charged with promulgating policies, guidelines, standards and the overall development of a framework for the protection of the environment of the nation. Consequent upon this development, a legal framework with the central purpose of providing and strengthening the necessary legislations for environmental protection procedures have come into force. In this regard, action has been taken to promulgate a number of appropriate environmental protection laws, harmonizing the existing environmental protection legislation, and make it a constitutional duty of government at all levels to safeguard the environment.

A number of guidelines and regulations on conducting Environmental Assessment Studies have been stipulated by the Federal Ministry of Environment (FMEnv), State Ministries of Environment, various Local Organizations, and the International Organizations such as World Bank. National policies on safety and environmental protection require infrastructures and facilities to be built and operated in a socially responsible and ethical manner, in order to protect and engender the safety of the environment. In the course of this study, the following legislations were consulted:

- Environmental Impact Assessment (EIA) Act No. 86, 1992.
- Environmental Impact Assessment Sectoral Guidelines for Infrastructures 1995.
- National Policy on Environment (2017).
- National Guidelines and Standard for Water Quality 1999.
- National guidelines on Environmental Management Systems (EMS) 1999.
- National Environmental Protection (Pollution Abatement in industries and facilities generating wastes) Regulation S.I. 9 of 1991.
- Guidelines and Standards for Environmental Pollution Control in Nigeria 1991.
- Sectoral Guidelines for EIA 1995.
- Harmful Wastes (Special Criminal Provisions) Act CAP 165 LFN, 1990.
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act of 2007.
- Nigerian Ports Authority Act 1954 (CAP 155).
- Nigerian Shippers' Council Decree No. 13, of 1978.
- Nigeria Maritime Administration and Safety Agency (NIMASA) Regulations of 2006.
- National Inland Waterways Authority (NIWA) Decree No. 13, 1997.

1.5.1.1 Environmental Impact Assessment Act 86 of 1992

The EIA Act 86 of 1992 also known as EIA Cap E12 LFN, 2004 requires the preparation of an EIA for projects developments. The act specifies the content of an Environmental Statement to include the assessment of all actions that will result in a physical, chemical, biological, cultural, social, modification of the environment as a result of the new project/development.

Special permits are required for access to forest reserves and other designated areas. Applications for such permits should only be made after a thorough review of alternatives and a detailed survey of the proposed route. The permit application should also include details of technical and operational controls that will be applied to minimize impact. By and large, the environmental management activities at each phase of the project should be guided by environmental standards including those imposed by legislation and those established by self-regulating industrial codes of practice.

Recently the FMEnv developed a National EIA procedure in response to the promulgation of the EIA Act No. 86 of 1992. The Procedure indicates the steps to be followed from project conception to commissioning in order to ensure that the project is implemented with maximum consideration for the environment.

The procedure for EIA involves the project proposal stage where the project proponent notifies FMEnv of the proposed project in writing. The project proposal is to contain all relevant information on the project including a land-use map. This stage is followed by screening phase, when the FMEnv carries out an Initial Environmental Examination (IEE) and assigns the project into categories based on the following criteria: magnitude; extent or scope; duration and frequency; risks; significance; mitigation measures available for associated and potential environmental impacts. The location of the project in Environmentally Sensitive Areas (ESA) is also an important criterion in the project categorization. The areas categorized as Environmentally Sensitive Areas (ESA) include: coral reefs, mangrove swamps, small islands, tropical rainforests, areas with erosion-prone soils, natural conservation areas, etc.

There are three categories in FMEnv guidelines, viz:

1) **Category I** Projects are subject to full-scale EIA requiring public display of draft report and experts' panel review process.
2) Projects listed in **Category II** may not require a full-scale EIA except when the project is located in an Environmentally Sensitive Area (ESA) and in this case the project will be assigned to Category I. The requirement for category II projects is a partial EIA. Also, ameliorative measures or changes in project design (depending on the nature and magnitude of the environmental impacts) as well as further actions may be required from the proponent. Category II Projects include reforestation/afforestation projects, land and soil management, small-scale irrigation and drainage, mini hydro-power development, small-scale development of petroleum or related activities, etc.
3) **Category III** Projects are expected to have essentially beneficial impacts on the environment, for projects in this category, the agency will issue an Environmental Impact Statement (EIS).

Another stage of FMEnv EIA procedure is the scoping stage, the main feature of which is that the proponent will be required to submit a Terms of Reference (ToR) for the proposed EIA study. In some cases, the FMEnv may demand a Preliminary Assessment Report, and any additional information from the proponent to assist in vetting the scope and the TOR of the proposed EIA study. Actual implementation of the EIA study; Preparation of Draft and Final EIA Reports; Review Process and Approval/Certification follow this stage. Apart from the general EIA Guidelines, the Agency has also prepared Sectoral guidelines for EIA in different industrial sectors.

1.5.1.2 Environmental Impact Assessment Sectoral Guidelines for Infrastructures 1995

In furtherance of the mandate of the defunct Federal Environmental Protection Agency (FEPA) now known as the Federal Ministry of Environment (FMEnv), the apex Environment and Conservation of Natural Resources as contained in Decrees 58 of 1988 and 59 of 1992, this guideline on infrastructural sector of the National Economy was developed. This is to ensure the environmental sustainability of this sector through compliance with EIA decree 86 of 1992 which makes Environmental Impact Assessment (EIA) mandatory for all new projects.

In order to achieve sustainable development, the significance of EIA for projects, process or activities cannot be overemphasized. This guideline is to assist project proponents in conducting detailed environmental assessment of projects with emphasis on significant associated and potential impacts of such projects.

1.5.1.3 National Policy on Environment 2017

The National Policy on Environment, describes guidelines and strategies for achieving the policy goal of sustainable development by;

- Preventive activities directed at the social, economic and political origins of the environmental problems;
- Abatement, remedial and restorative activities directed at the specific problems identified, and in particular:
    - Problems arising from industrial production processes;
    - Problems caused by excessive pressure of the population on the land and other resources; and
    - Problems due to rapid growth of urban centres.
- Design and application of broad strategies for sustainable environmental protection and management at systemic or sub-systemic levels;

- Enactment of necessary legal instruments designed to strengthen the activities and strategies recommended by this policy; and
- Establishment/emplacement of management organs, institutions and structures designed to achieve the policy objectives.

1.5.1.4 National Guidelines and Standard for Water Quality 1999

The National guidelines and standards for water quality in Nigeria is to guide water management with regards to maintaining safe quality of water for various uses throughout the country and in order to improve the quality of the environment and to free it from pollutant and other environmental and health hazards.

1.5.1.5 National Guidelines on Environmental Management Systems (EMS) 1999

Environmental Management System (EMS) provides a mechanism that integrates economic growth, sustainable development and environmental management within a business organization. It is a proactive approach to sustainable environmental management, which aims to enable organizations reduce their risks and liabilities, whilst enhancing their corporate image.

1.5.1.6 National Environmental Protection (Pollution Abatement in Industries and facilities Generating Wastes) Regulation S.I. 9 of 1991

Where and when applicable, the pollution abatement regulation, S.1.9 of 1991 (No 42, Vol. 78, August, 1991) imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency plan by industries; submission of lists and details of chemicals used by industries to FMEnv, requirement of permit by industries for the storage and transportation of harmful or toxic waste; the generator’s liability; strategies for waste reduction; permissible limits of discharge into public drains; protection of workers and safety requirements; for environmental audit (or Environmental Impact Assessment for new industries) and penalty for contravention.

1.5.1.7 National Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991

This document was promulgated in March 1991 to serve as a basic instrument for monitoring and controlling both industrial and urban pollution. These guidelines were initiated sequel to the promulgation of the National Environmental Policy in 1989. The guidelines and standards relates to six (6) areas of concern, among which are;

- Effluent Limitations Regulations.
- Pollution Abatement in Industries and Facilities Generating Wastes
- Industrial Emission Limitations.
- Noise Exposure Limitations.
- Management of Solid and Hazardous Wastes.

1.5.1.8 Sectoral Guidelines for EIA, 1995

Federal Environmental Protection Agency (now Federal Ministry of Environment) published sectoral EIA guidelines in September, 1995 covering major developmental projects that included shore protection and reclamation proposed by the proponent. The under listed are some of the infrastructural development projects in the sectoral guideline:

- Coastal development projects
- Ports Infrastructural projects
- Railways
- Roads and Highways
- Airports

- Urban development projects
- Domestic water supply and sanitation projects
- Electrification projects.

1.5.1.9 National Environmental Standards and Regulations Enforcement Agency (NESREA) Act of 2007

The vacuum created by the enabling law guiding the operations of the Federal Ministry of Environment especially in the area of effective enforcement of environmental laws, standards and regulations in the country, brought about the creation of NESREA. In addressing the need for an enforcement Agency, the Federal Government in line with section 20 of the 1999 Constitution of the Federal Republic of Nigeria, established the National Environmental Standards and Regulations Enforcement Agency (NESREA) as a parastatal of the Federal Ministry of Environment.

The NESREA Act was signed into law by late President Umaru Musa Yar'Adua, GCFR, and this has been published in the Federal Republic of Nigeria Official Gazette No. 92, Vol. 94 of 31st July, 2007. NESREA has responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology including coordination, and liaison with, relevant stakeholders within and outside Bayelsa on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

1.5.1.10 Nigeria Ports Authority

The Nigeria Ports Authority (NPA) came into existence as an autonomous public corporation with the promulgation of the Ports Act 1954 (Cap. 155) of the Laws of the Federal Republic of Nigeria and Cross River State. The Authority commenced operations on 1st April, 1955 having assumed responsibility for certain ports and harbour activities earlier performed by eight departments of Government of Nigeria. At the same time, the

Authority acquired the assets which had formally been used by the Government, in pursuance of her statuary duties which include:

- Responsibility for the provision and operation of such cargo handling and quay facilities as may appear to the Authority to best serve the public interest in all Nigerian parts;
- Responsibility for maintaining, improving and regulating the harbours and approaches thereto in all the parts of Nigeria presently open to ocean going vessels and in such other ports as many be designated from time to time by the Honorable Minister, Federal Ministry of Transport;
- Responsibility for dredging to desired depths and providing as well as maintaining pilot age services, lighting, lighthouses, buoys and other navigation aids in all Nigerian ports.

The responsibilities for the Nigerian Ports Authority before the port reforms being a service or a tool port cover the complete range of land and marine based operations.

1.5.1.11 Nigerian Shippers' Council

The Nigerian Shippers' Council was established on July 4th, 1978 by Decree 13 of the Federal Government of Nigeria as a response to a long felt need for a united front to protect the interest of Nigerian Shippers. This decision was as a result of United Nations Conference on Trade and Development (UNCTAD) recommendation for the creation of National and Regional Consultation machinery on Shipping. In addition to Decree 13 of 1978, the Council also operates under two other enabling regulations of the Federal Government of Nigeria, namely the Nigerian Shippers' Council (Freight Stabilization Fees on Imports and Exports) Regulations 1995 and the Nigerian Shippers' Council (Local Shipping Charges on Imports and Exports) Regulations 1997. The Nigeria Shippers Council is an agency affiliated with the Federal Ministry of Transport. It was set up to provide a forum for the protection of the interest of shippers in matters affecting the shipment of imports and exports to and from Nigeria and to advise the Federal Government on sundry matters related thereto.

Statutory Functions

- To provide a forum for the protection of the interest of shippers on matters affecting the shipment of imports/ exports to and from Nigeria;
- To promote a forum for consultation between conference, and non-conference lines, tramps owners, the Nigerian Ports Authority, and the government of the Federation on matters of common interest;
- To encourage the formation of shippers' association's all over the country;
- To liaise with the appropriate arms of the Government of the Federation and other organizations in assessing the stability and adequacy of existing services and make appropriate recommendation in that behalf;
- To advise the Government of the Federation through the Minister on matters relating to the structure of freight rates, availability and adequacy of shipping space, frequency of sailings, terms of shipment, class and quality of vessels, port charges and facilities and other related matters;
- To negotiate and enter into agreements with conference lines and non-conference lines, ship owners, Nigerian Ports Authority and many other bodies on matters affecting the interests of shippers;
- To consider problems faced by shippers with regard to coastal transport and inland waterway transport and matters relating generally to the transportation of goods by water and advice Government of possible solutions thereto;
- To promote and encourage the study and research into problems affecting shippers in Nigeria;
- To arrange from time to time seminars and conferences on any matter relating to its functions; and

- To carry out such other activities which are conducive to the discharge of its functions under this decree.

1.5.1.12 Nigeria Maritime Administration and Safety Agency (NIMASA) Regulations

The Nigeria Maritime Administration and Safety Agency (NIMASA) is the apex regulatory and promotional maritime agency. The agency was created from the merger of National Maritime Authority created by an Act in 2003 and Joint Maritime Labour Industrial Council (A former parastatal of the Federal Ministry of Transport) on the 1st August 2006. The mandate of the agency is derived from the following:

i) Merchant Shipping Act. Cap 224, 1963.
ii) National Shipping Policy.
iii) Merchant Shipping (Delegation of Powers) Notice. LN 112 of 1963.
iv) Nigerian Maritime Labour Act.2003.
v) Coastal and Inland Shipping (Cabotage) Act.2003.

The objectives of the Authority as stipulated are to:

- Correct any imbalance in the Nigerian shipping trade for the purpose of implementing the provisions of UNCTAD Code of Conduct for Liner Conference, especially to observe the ration of 40:40:20 in respect of carriage of goods to Nigerian ports;
- Improve Nigeria's balance of payment position by enhancing the earring and conservation of foreign exchange from the shipping industry;
- Use the national shipping policy as instrument of promoting the export trade conservation of Nigeria and thus accelerate the rate of growth of the national economy;

- Ensure the greater participation of indigenous shipping lines in liner conferences thereby influencing the decision making processes of such liner conferences serving Nigerian international sea borne trade;
- Promote the acquisition of shipping technology by creating and diversifying employment opportunities in the shipping industry, through the stimulation and protection of indigenous shipping companies;
- Assist in the economic integration of the West African sub-region;
- Offer protection to Nigerian vessels flying the nation's flag on the high seas and world seaports;
- Increase the participation by indigenous Nigerian shipping lines in ocean shipping through the application of provisions of the UNCTAD Code On General cargo and entering into bilateral agreement, or other suitable arrangement;
- Encourage the increase of ownership of ships and the achievement of indigenous skills in maritime transport technology;
- Achieve a systemic control of the mechanics of sea transportation; and
- Promote the training of Nigerians maritime transport technology and as sea fare.

The functions of the Authority include:

i) To co-ordinate the implementation of the national policy on shipping as may be formulated from time to time by the Federal Government;

ii) To ensure that Nigerian nation carries exercise fully Nigeria's carrying rights of at least forty per cent of the freight in revenue and volume of the total trade to and from Nigeria;

iii) To grant national carrier status to indigenous shipping lines;

iv) To monitor the activities of vessels of the companies granted national carrier status;

v) To grant assistance to indigenous companies for fleet expansion and ship ownership;

vi) To regulate liner conferences and national carriers; and

vii) To perform such other functions as may be required to achieve the aims and objects of this Acts or the Federal Government pursuant to this Act may formulate nay-national shipping policy as may be formulated by the Federal Government pursuant to this Act.

The Acts further endows some special functions on the Authority, which includes that the Authority shall investigate, determine and keep current records of;

i) Ocean service, route and lines from Nigerian ports to Foreign markets as may be determined by the Minister to be essential for the promotion, development, expansion and maintenance of the foreign commerce of Nigeria;

ii) Bulk cargo carrying services for the purposes of promotion, development, expansion and maintenance of the foreign commerce of Nigeria, the national defense and other national requirements provided by Nigerian flag vessel whether or not operating on a particular ocean service, route or line;

iii) The type, size, speed, method of propulsion and other requirements of vessels which should be employed:
   - In such services or on such routes lines and the frequency and regularity of the sailings of such vessels, with a view to furnishing adequate regular, certain and permanent service, or
   - To provide the bulk cargo carrying services necessary for the promotion, maintenance and expansion of foreign commerce of the Federal Republic of

iv) Nigeria and its national defense or other national requirements whether or not such vessels operates on a particular service, route or line;

v) The relative cost of construction of comparable vessels in Nigeria and foreign countries;

vi) The relative cost of managing the commercial aspects of the shipping industry such as scheduling chartering in or chartering out of vessels, allotment of cargo space, cargo pricing and cargo soliciting, marine insurance, maintenance, repairs, wages and subsistence of officers and crew, and all other items of expense, in the operation of comparable vessels under the laws, rules and regulations of Nigeria and under those foreign countries whose vessels are substantially competitors of any such Nigerian vessels;

vii) The extent and character of aid and subsidies granted by foreign government to their merchant marine;

viii) The number, location and efficiency of shipyards existing on the date of the promulgation of this Act or thereafter built in Nigeria;

ix) New designs, methods of construction and types of equipment for vessels;

x) The possibilities of promoting the carrying of the foreign trade of Nigeria in Nigerian vessels; and

xi) Inland water transportation including their relation to the transportation by land and air.

1.5.1.13 National Inland Waterways Authority (NIWA) Decree No 13, 1997

This decree, which came into force on the 12th August, 1997, has the main objective of establishing the National Inland Waterways Authority (NIWA) and requires it to, among other things: improve develop and regulate Inland water ways for navigation and specify Navigable water Highlights of the provisions of the Decree, that have environmental bearings include:

- Established NIWA, to inter alia, provide regulation for inland navigation, grant permit and licenses for sand dredging, pipeline construction, dredging of slots and crossing of waterways by utility lines, water intake, rock blasting and removal – (Ss. 8,9).

- The Authority may, subject to the approval of the minister, make regulations generally for the regulation of users of navigable water ways and such other regulations as appear to him to be expedient for giving full effect to the provisions of the Decree – (s.29(10(2).
- The Rivers and their tributaries, distributaries, creeks, lakes, lagoons, and intra-coastal waterways specified in the 2nd schedule are declared Federal Navigable waterways. – (s. 10).

1.5.1.14 Nigerian Urban and Regional Planning Act 1992

Act 88 of 1992 established a Development Control Department (DCD) charged with the responsibility for matters relating to development control and implementation of physical development plans at Federal, State and Local Government levels within their respective jurisdiction.

1.5.1.15 Harmful Waste (Special Criminal Provisions) Act No 42 of 1988 (amended in 2004)

Activities relating to the purchase, sale, importation, transit, transportation, deposit and storage of harmful wastes are prohibited and declared unlawful under the Act. From the commencement of this Act, any person who, without lawful authority: (a) carries, deposits, dumps or causes to be carried, deposited or dumped, or is in possession for the purpose of carrying, depositing or dumping, any harmful waste on any land or in any territorial waters or contiguous zone or Exclusive Economic Zone of Nigeria or its inland waterways; or (b) transports or causes to be transported or is in possession for purpose of transporting any harmful waste; or (c) imports or causes to be imported or negotiates for the purpose of importing any harmful waste; or (d)sells, offers for sale, buys or otherwise deals in any harmful waste, shall be guilty of a crime under this Act. Remaining provisions deal with prosecution, crimes by body corporate and penalties.

1.5.1.16 Criminal Code Act, CAP C38, LFN, 2004

The Act contains the basic criminal law offences that relate to damage to the environment, public health and natural resources. Some environmental offences include: causing a public nuisance; fouling the water of any spring, stream, well or reservoir of a place; and violating the atmosphere in any place so as to make it noxious to the health of persons in general in the neighborhood.

1.5.1.17 Labour Act of 1990 (amended in 2004)

The Labour Act is the primary law protecting the employment rights of individual workers. The Act covers protection of wages, contracts, employment terms and conditions, and recruitment; and classifies types of workers and special workers.

1.5.1.18 Forestry Act, Cap F 36, LFN, 2004

This Act of 1958 provides for the preservation of forests and the setting up of forest reserves. It is an offense, punishable with up to 6 months of imprisonment, to cut down trees over 2ft in girth or to set fire to the forest except under special circumstances.

1.5.1.19 Trade Unions (Amendment) Act, 2005

This Act contains provisions with respect to the formation, registration and organization of trade unions. It includes stipulation of 'equal pay for equal workers without discrimination on account of sex, or any other ground whatsoever'.

1.5.1.20 Employees Compensation Act, 2010

This Act repeals the Workmen's Compensation Act W6 LFN 2004 and makes comprehensive provisions for payment of compensation to employees that suffer from occupational diseases or suffer injuries from accident at workplace or in the course of the employment.

1.5.1.21 Endangered Species Act, Cap E9, LFN, 2004

This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction as a result of overexploitation. These sections are noteworthy:

- **Section 1** prohibits, except under a valid Certificate, the hunting, capture or trade in animal species, either presently or likely to be in danger of extinction.
- **Section 5** defines the liability of any offender under this Act.
- **Section 7** provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.

1.5.1.22 Nigerian Content Act

The Nigerian Local Content law was created to enhance utilization of the country's human and material resources for the provision of goods and services to the petroleum industry.

- Nigerians shall be given first consideration in the award of oil blocks, oil field licenses, oil lifting license and shipping service as well as projects for which contracts are to be awarded in the industry;
- there shall be exclusive consideration for Nigerian indigenous services to the oil and gas industry subject to the fulfilment of specified conditions;
- every multinational oil company operating in Nigeria is to domicile a minimum of 10% of its annual profit in Nigerian banks;
- Nigerian insurance companies are to do all aspect of insurance in the oil and gas sector except where local capacity has been exhausted;
- one percent of every contract awarded in Nigeria's oil and gas sector to be set aside for capacity building;

- At least 50% of the asset of any company seeking to execute oil and gas contract in Nigeria must be domicile in Nigeria, among others.

1.5.1.23 Land Use Act CAP L5, LFN, 2004

The Land Use Act of 1978, revised 2004 under the Constitution of 1999 and the Public Lands Acquisition Laws of the relevant states constitute the governing policy for land acquisition in Nigeria. As it is the case with most National and State laws on acquisition of land in the public interest or for a public purpose, the legislation enables the state to acquire land. The Acts also specify the procedures the state must follow to clear the land, and define the compensatory measures the state must implement in order to compensate the affected people.

1.5.1.24 Public Health Law

In Nigeria, the Public Health Law provides justification for the execution of developmental projects under guidelines that promote health by protecting the environment and safeguarding the humans' health. Subsections 6 and 7 of the Public Health Laws empower Medical Officers of Health (operating at the local government council, under the supervision of the State and Federal Ministries) to ensure the promotion of good health.

1.5.1.25 National Policy on Occupational Safety and Health

Section 17(3c) of the constitution of the Federal Republic of Nigeria (1999) stipulates that the health, safety and welfare of all persons in employment must be safeguarded and not endangered or abused.

1.5.1.26 The Nigerian Cultural Policy

The national cultural policy (1996) is generally regarded as an instrument of promoting national identity and Nigerian unity and the protection of cultural heritages.

1.5.1.27 Public Participation and Disclosure

To a large extent, relevant regulatory authorities are required to inform the public of environment-related issues. Section 55 of the EIA Act provides for the maintenance of a Public Registry for the purpose of facilitating public access to records relating to environmental assessments. Public hearings to which interested members of the public are invited to provide comments on ESIA of a proposed project are a key part of the approval process by the FMEnv.

1.5.1.28 National Social Legislation

In the consideration of Nigerian social legislation, the following issues may be some of the important social aspects of the Project:

- Resettlement and displacement;
- Community health and safety;
- Labour, working conditions and employment;
- Cultural properties;
- Economic activities; and
- Access to fishing.

Table 1.2: Environmental Protection and Management Regulations

National Environmental (Wetlands, River Banks and Lake Shores) Regulations (No 29 of 2009)	Provides for the conservation and managed use of wetlands and their resources in Nigeria. It ensures the sustainable use of wetlands for ecological and tourism purposes and protects wetland habitats for associated species of fauna and flora.
National Environmental (Sanitation and Wastes Control) Regulations (No 28 of 2009)	Provides the legal framework for the adoption of sustainable and environment friendly practices in environmental sanitation and waste management activities in order to minimize environmental pollution.
National Environmental (Ozone Layer Protection) Regulations, (No 32 of 2009) National Environmental (Noise Standards and Control) Regulations (No 35 of 2009)	Seeks to prohibit the import, manufacture, sale and use of ozone-depleting substances. Regulates activities noise levels.
National Environmental (Surface and Groundwater Quality Control) Regulations (No 22 of 2010)	Includes provisions to restore, enhance and preserve the physical, chemical and biological integrity of the nation's surface waters, and to maintain existing water uses.

National Environmental (Soil Erosion and Flood Control) Regulations, 2010. S. I. No. 12	The overall objective of these Regulations is to check all earth-disturbing activities, practices or developments for non-agricultural, commercial, industrial and residential purposes.
National Environmental (Coastal and Marine Area Protection) Regulations, 2010. S. I. No 18	This Regulation provides for the regulatory framework for the application of preventive, precautionary and anticipatory approaches to avoid degradation of the coastal and marine environment

1.5.2 State and Local Government Regulations

Section 20 of the 1999 constitution of the Federal Republic of Nigeria, states that, "The State shall protect and improve the environment and safeguard the water, air and land, forest and wild life of Nigeria". Furthermore, the EIA Act No. 86 of 1992 recommends the setting up of state environmental agencies to support the efforts of the FMEnv in regulating the consequences of project development on their environment.

1.5.2.1 Rivers State Ministry of Environment

Since the inauguration of the present democratic administration, Rivers State Government has established a full-fledged Ministry of Environment (RSMENV) headed by a Commissioner. The Ministry was created from the Rivers State Environmental Protection Agency (RSEPA). RSMENV was empowered by the decree that set up the repealed FEPA (Decree 58 of 1988, as amended by Decree 59 of 1992), which encourages State governments to set up their own Environmental Protection Agencies.

Consequently, RSMENV is charged with the protection of the environment of Rivers State, and operates with Edict No. 2 of 1994.

In 2002, RSMENV published the Interim Guidelines and Standards on Environmental Pollution Control and Management in Rivers State. The guidelines seek to:

- Regulate the generation, handling, storage, disposal and management of all wastes of whatever origin in Rivers State
- Regulate physical development in compliance with the principle of sustainable development
- Enhance and where possible, restore the quality of the environment and protect the biodiversity of the flora and fauna of Rivers State.

1.5.2.2 Rivers State Environmental Sanitation Authority (RSESA)

The River State Environmental Sanitation Authority (RSESA), a parastatal under the Rivers state ministry of environment was established by an edict to manage the solid waste generated within the metropolis and its environments.

1.5.2.3 Bonny Local Government

Bye-Laws and other policies on the environment in place in Bonny Local Government Area (LGA) are in line with the Rivers State Ministry of Environment and Rivers State Environmental Sanitation Authority requirements.

Furthermore, the LGA is expressly empowered under section 33 of the Urban & Regional Planning Act to refuse an application by a developer which does not have a detailed environmental impact assessment attached to it where what is sought to develop, in respect of a residential land, is in excess of 2 hectares of land or in the case of an office building, is in excess of four floors or 5000 square meters of a lettable space. All these are in respect of the land in the areas within the jurisdiction of the Local Government.

1.5.3 International Regulations and Conventions

In addition to National laws/regulations, Nigeria is signatory or party to several International conventions and treaties that support the use of EIA as the key tool for achieving sustainable development. Some of these include:

- ***African Convention on Conservation of Nature and Natural Resources (1968)***

The contracting countries undertook to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due regard to the best interests of the people.

- ***Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention) (1979)***

The Bonn Convention concerns the promotion of measures for the conservation (including habitat conservation especially for endangered species listed in Bonn) and management of migratory species.

- ***Convention Concerning Protection of World Cultural and Natural Heritage Sites (1972)***

The convention sets aside areas of cultural and natural heritage for protection. The latter is defined as areas with outstanding universal value from the aesthetic, scientific and conservation points of view.

- ***Convention on Biological Diversity (1992)***

The objectives of the Convention include the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

- **Framework Convention on Climate Change (1992)**

To achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

- ***Convention on Wetland of International Importance, Especially as Water Fowl Habitat, Ramsar, Iran 1971***

This provision came into force in Nigeria on 2nd February, 2001 with the objective to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.

- ***Convention Creating the Niger Basin Authority and Protocol Relating to the Development Fund of the Niger Basin, Faranah, 1980***

This convention came into force in Nigeria on 3rd December, 1982. The objective is to transform the River Niger Commission into a Niger Basin Authority and to create a Development Fund to contribute to the development of the Niger Basin.

- ***World Bank OP/BP 4.01; Environmental Assessment (EA)***

This is one of the Environmental and Social Safeguard Policies of the World Bank. It is used in the Bank to examine the potential environmental risks and benefits associated with Bank lending operations. Under OP/BP 4.01, Bank lending operations are broadly defined to include investment lending, sector lending, rehabilitation lending through financial intermediaries, and investment components of hybrid lending. Prototype Carbon Fund (PCF) and Global Environmental Facility (GEF) co-financed projects are also subject to the provisions of OP/BP 4.01.

Under this guideline, The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The Bank favors preventive measures over migratory or compensatory measures, whenever feasible.

EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and trans-boundary and global environmental aspects. EA considers natural and social aspects in an integrated way. It also takes into account the variations in project and country conditions; the findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements.

The Bank does not finance project activities that would contravene such country obligations, as identified during the EA. EA is initiated as early as possible in project processing and is integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project. The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

Depending on the project, a range of instruments can be used to satisfy the Bank's EA requirement: environmental impact assessment (EIA), regional or sectoral EA, environmental audit, hazard or risk assessment, and environmental management plan (EMP). EA applies one or more of these instruments, or elements of them, as appropriate. When the project is likely to have sectoral or regional impacts, sectoral or regional EA is required. Other Banks guidelines and procedures that were considered in this study include the following:

- OP/BP 4.02, Environmental Action Plans;
- OP/BP 4.04, Natural Habitats;
- OP 4.07, Water Resources Management; and
- OP/BP 4.36, Forests;

- **International Finance Corporation (IFC) Performance Standards (PS)**

IFC is a member of the World Bank Group which provides investment assistance to private sectors in developing countries. IFC applies its PSs to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The PSs may also be applied by other financial institutions electing to apply them to projects in emerging markets. Out of the eight IFC's Performance Standards established to enable the clients ensure sustainability in projects throughout the life of an investment by IFC or other relevant financial institution, the following were considered in this EIA:

Performance Standard 1: Social and Environmental Assessment and Management System

This PS underscores the importance of managing social and environmental performance throughout the life of a project (or business activity that is subject to assessment and management). An effective social and environmental management system is a dynamic, continuous process initiated by management and involving communication between the client, its workers, and the local communities directly affected by the project. Drawing on the elements of the established business management process of "plan, implement, check, and act," the system entails the thorough assessment of potential social and environmental impacts and risks from the early stages of project development, and provides order and consistency for mitigating and managing these on an on-going basis. A good management system appropriate to the size and nature of a project promotes sound and sustainable social and environmental performance, and can lead to improved financial, social and environmental project outcomes. PS1 has the following objectives:

- To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence;
- To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities , and the environment;
- To ensure that affected communities are appropriately engaged on issues that could potentially affect them;
- To promote improved social and environment performance of companies through the effective use of management systems.

Performance Standard 2: Labour and Working Conditions

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient to the sustainability of the enterprise. Failure to establish and foster a sound worker management relationship can undermine worker commitment and retention, and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

Performance Standard 3: Pollution Prevention and Abatement

This PS recognizes that increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level. On the other hand, along with international trade, pollution prevention and control technologies and practices have become more accessible and achievable in virtually all parts of the world. This Performance Standard outlines a project approach to pollution prevention and abatement in line with these internationally disseminated technologies and practices. In addition, this Performance Standard promotes the private sector's ability to integrate such technologies and practices as far as their use is technically and financially feasible and cost-effective in the context of a project that relies on commercially available skills and resources. The PS3 has the following objectives;

- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities;
- To promote the reduction of emissions that contributes to climate change.

Performance Standard 4: Community Health, Safety and Security

This PS recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials. Communities may also be affected by impacts on their natural resources, exposure to diseases, and the use of security personnel. While acknowledging the public authorities' role in promoting the health, safety and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety and security that may arise from project activities. The level of risks and impacts described in this Performance Standard may be greater in projects located in conflict and post-conflict areas.

- To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances;

- To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security.

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that results in displacement. This occurs in cases of: (i) lawful expropriation or restrictions on land use based on eminent domain; and ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

The objectives of this standard are:

- To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs;
- To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected;
- To improve or at least restore the livelihoods and standards of living of displaced persons; and
- To improve living conditions among displaced persons through provision of adequate housing with security of tenure4 at resettlement sites.

Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management:

This performance Standard recognizes that protecting and conserving biodiversity - the variety of life in all its forms, including genetic, species and ecosystem diversity - and its ability to change and evolve is fundamental to sustainable development. The components of biodiversity, as defined in the Convention on Biological Diversity, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner. This Performance Standard addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources. PS6 has the following objectives:

- To protect and conserve biodiversity; and
- To promote the sustainable management and use of natural resources through the adoption of practices that integrates conservation needs and development priorities.

Performance Standard 8: Cultural Heritage

This Performance Standard recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to protect irreplaceable cultural heritage and to guide clients on protecting cultural heritage in the course of their business operations. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity. The objectives of this PS are as follows:

- To protect cultural heritage from the adverse impacts of project activities and support its preservation; and

- To promote the equitable sharing of benefits from the use of cultural heritage in business activities.

- **The Equator Principles**

Project financing, a method of funding in which the lender looks primarily to the revenues generated by a single project both as the source of repayment and as security for the exposure, plays an important role in financing development throughout the world. Project financiers may encounter social and environmental issues that are both complex and challenging, particularly with respect to projects in the emerging markets.

The Equator Principles Financial Institutions (EPFIs) have consequently adopted these Principles in order to ensure that the projects they finance are developed in a manner that is socially responsible and reflect sound environmental management practices. By doing so, negative impacts on project-affected ecosystems and communities should be avoided where possible, and if these impacts are unavoidable, they should be reduced, mitigated and/or compensated for appropriately. The EPFIs believe that adoption of and adherence to these principles offers significant benefits to financiers, borrowers and local stakeholders through borrowers' engagement with locally affected communities.

The Principles are intended to serve as a common baseline and framework for the implementation by each EPFI of its own internal social and environmental policies, procedures and standards related to its project financing activities. The EPFIs will not provide loans to projects where the borrower will not or is unable to comply with respective social and environmental policies and procedures that implement the Equator Principles.

The key components of the Equator Principles are:

- Principle 1: Review
- Principle 2: Environmental and Social
- Principle 3: Applicable Environmental and Social Standard

- Principle 4: Environmental and Social Management System and Equator Principles Action Plan
- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent
- Principle 8: Covenants
- Principle 9: Independent Monitoring
- Principle 10: Reporting and Transparency

- **China Export Import Bank (China Exim Bank)**

The Export-Import Bank of China is a state-funded and state-owned policy bank with the status of an independent legal entity. It is a bank directly under the leadership of the State Council and dedicated to supporting China's foreign trade, investment and international economic cooperation. With the Chinese government's credit support, the Bank plays a crucial role in promoting steady economic growth and structural adjustment, supporting foreign trade, and implementing the "going global" strategy. It is committed to reinforcing financial support to key sectors and weak links in the Chinese economy to ensure sustainable and healthy economic and social development. In China, the Bank has 32 branches on the mainland and one representative office in Hong Kong. Overseas, it has the Paris Branch, Representative Office for Southern and Eastern Africa, St. Petersburg Representative Office, Representative Office for Northern and Western Africa.

The Bank's main mandate is to facilitate China's national development strategies, and build a policy bank which has clear-cut market positioning, well-defined business portfolio, unique functions, sufficient capital, good governance, strict internal control, safe operation, high-quality service and sustainable development capability. Its financial support goes to foreign trade, cross-border investment, the Belt and Road Initiative, international industrial capacity and equipment manufacturing cooperation, science and technology, cultural industry, “going global” endeavors of small and medium enterprises, and the building of an open economy. The bank is a part of the Chinese foreign aid system and administers the Two Preferential Loan Program. The concessional loan and preferential export buyer's credit are the two main loan products under the preferential loan program.

For concessional loans the bank advances a no interest or very low interest rate loan to a developing country government or agency to build a project (e.g. power plant, road, water treatment facility). The term of the concession loan is up to 20 years and a maximum grace period of 7 years is given. The preferential export buyer's credit is provided to a foreign borrower to purchase Chinese goods or services (e.g. construction contractor building the project). Like the concessional loan, this type of loan is also subsidized by the Chinese government. Interest rates are below market rates at around 3 to 6%. However, the preferential export buyer's credit is generally classified as a commercial loan rather than foreign aid even if the interest rate is very low because the purpose is to promote Chinese exports. These two types of loans are a major part of the financing support for China's Belt and Road Initiative.

1.6 ESIA Procedure

This ESIA methodology is in line with the EIA procedure (**Figure 1.2**) as stipulated by the FMEnv (FEPA, 1995). The proposed Bonny Deep Sea Port project following screening level assessment (site verification visit and in-house assessment) was classified as a Category I project and as such is expected to follow the process shown in the EIA procedural flow chart.

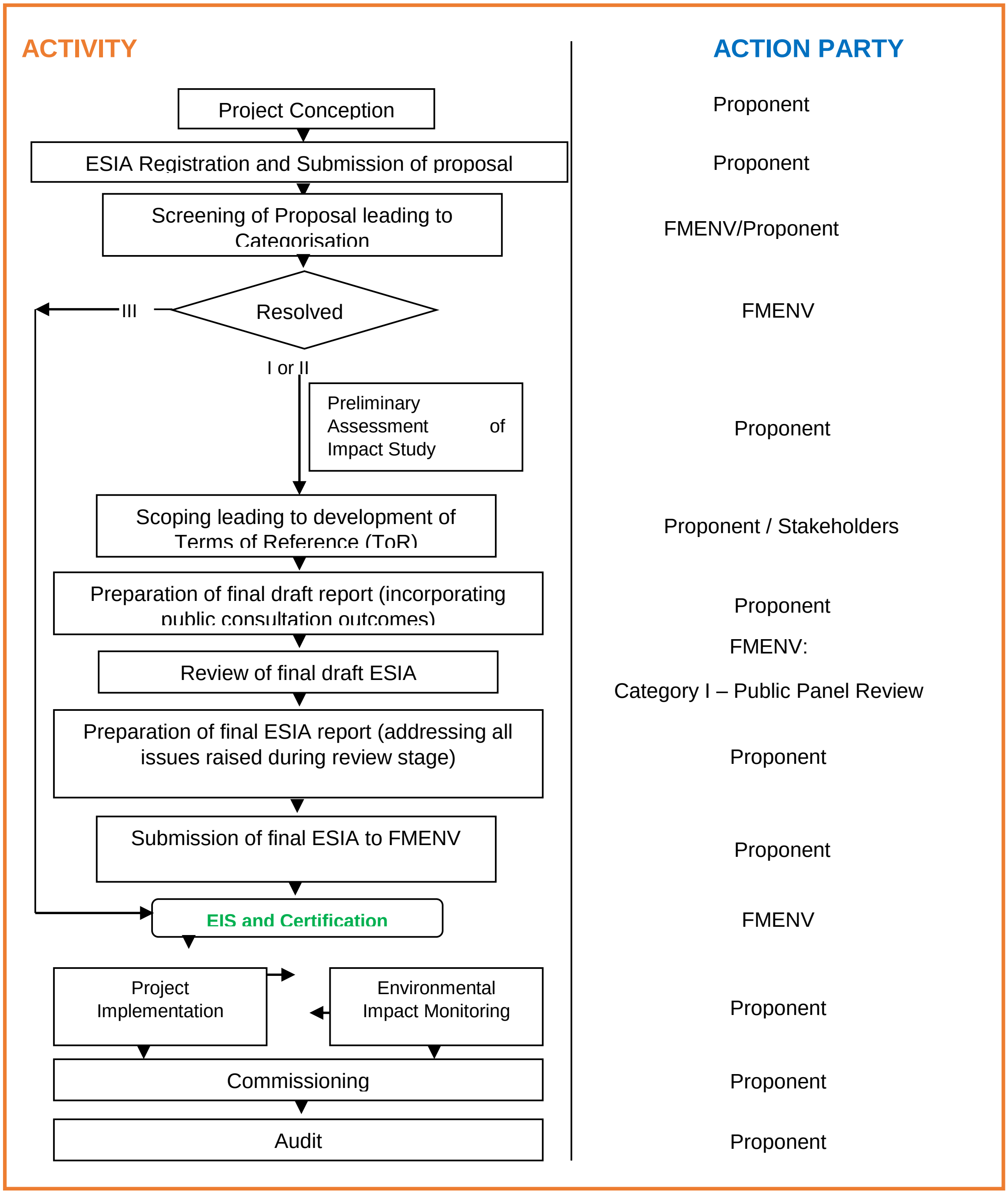


Figure 1.1: FMEnv EIA Procedure

Furthermore, the ESIA has been carried out in line with industry practice and regulatory guidelines on environmental assessment. The step by step methods employed in this process are described below.

Project Conceptualisation and Project Location Feasibility

This stage involved initiation of the project idea by the proponent and thereafter feasibility review of choice project location. Relevant environmental information on the proposed project location were identified using maps, charts, geographic coordinates, photographs, etc. Further preliminary activities defining the scope of project and environmental studies were also carried out in this stage.

ESIA Registration and Submission of Proposal

This stage involved development of proposal for ESIA permit to the FMEnv and payment of registration fees for same ESIA permit to the FMEnv.

Screening of Proposal Leading to ESIA Categorisation

After registration of the EIA with the FMEnv, a site verification visit comprising FMEnv, proponent, consultant and other necessary regulatory stakeholders was conducted to gain firsthand knowledge of the project area. Furthermore, in-house screening was carried out by the FMEnv to categorise the project on level of assessment required. Afterwards the project was placed in a category.

Development of Terms of Reference

The site verification visit and screening represents an initial step of the ESIA process. This step is followed by a scoping activity. A key outcome of this is the creation of Terms of Reference for a full EIA study. The ESIA study will then be carried out prior to approval and environmental licensing of the project.

Reporting and Review

This stage requires preparation of the full ESIA report for submission to regulatory authority for review and approval. As applicable to the category of the project the preparation of the ESIA report will involve in no particular order:

- Identification of applicable legal, regulatory and administrative frameworks guiding the project;
- Field data gathering, literature review and existing baseline condition documentation;
- Results of stakeholders disclosure and consultation programmes;
- Impact assessment, mitigation and environmental management plans for the project; and
- Summary, conclusion and appropriate recommendations.

The next stage after reporting and submission is the review stage. It is required that internal stakeholders (client and consultant) make appropriate reviews prior to submission to regulators. Technical and or public panel review for approval follows depending on category of project.

1.7 Structure of the Report

The ESIA is structured into nine (9) chapters, viz:

Chapter One: Introduction - Presents the background information, study objectives, ESIA terms of reference, ESIA consultation program and fieldwork activities/research. It also provides information on the legal and administrative framework for the ESIA in Nigeria as applicable to the proposed project.

Chapter Two: Project Justification - Examines the justification for the project and its alternatives.

Chapter Three: Project Description - Describes the technical details of the project. This includes the project location, facility layout, human and material input, project output, operation processes and project schedule.

Chapter Four: Description of the Environment/Baseline Condition - Describes the methods adopted in environmental data acquisition, description of the physical, chemical, biological as well as socio-economic aspect of the proposed project site.

Chapter Five: Associated and Potential Impacts - Highlights the impact assessment approach and presents the associated and associated positive and negative impacts of proposed development.

Chapter Six: Mitigation Measures - Presents the mitigation measures to be applied in addressing the potential and associated negative impacts.

Chapter Seven: Environmental Management Plan - Provides the Environmental Management plan (EMP) that shall be adopted throughout the project lifecycle. This includes environmental monitoring programme.

Chapter Eight: Remediation Plans after Decommissioning /Closure - Outlines the decommissioning and abandonment plans of the project.

Chapter Nine: Conclusions and Recommendations - Highlights the key findings of the study and the conclusions.

The list of the references and appendices are included thereafter.

CHAPTER TWO

PROJECT JUSTIFICATION

2.1 Need for the Project

Maritime transportation is one of the key sectors of the Nigerian economy. According to the Nigerian Ports Authority cargo throughput data of 2007 – 2019, the cargo throughput handled in the Nigerian ports increased from 66,908,322 metric tonnes in 2009 to 74,910,284 metric tonnes in 2010 indicating a 12% increase. According to global trends in port development, out of a total of 100 plus seaport developments being executed the world over, approximately 60 to 75 percent of these are deep sea ports or terminals. The balance is mostly inland water way ports and Jetties. Nigeria needs new better designed port facilities in line with increased cargo traffic nationally and globally, new and bigger marine vessels that need deeper harbour drafts and global logistics trends and practices have made the need for deep sea port more imperative.

Presently, Lagos ports alone handle 90 per cent of the cargo in and out of Nigeria. With the expected growth in container volumes, the combined capacity of Apapa Port fully-developed and Tin Can Island Port and all the Inland Container Depots (ICDs) in the Lagos area is expected to be inadequate within the next five years. The same situation also applies to general cargo terminals.

From the foregoing, it goes without saying that a viable deep seaport project is needed to keep up with the demand for capacity, as the existing ports in the country which have been overwhelmed are either surrounded by urban developmental facilities, they cannot be further expanded (like the case with the ports in Lagos) or have insufficient draft to allow for large vessels (such as the case with the existing Calabar port).

The Federal Ministry of Transportation has therefore decided to develop a sea port and to situate it in Rivers State, by virtue of the location in the Southern border, being washed by the Atlantic Ocean the State is clearly the most strategic in Nigeria were a deep sea port will serve the entire Northern States in the country and also feed into the proposed Eastern Railway line.

2.2 Value of the Project

The total estimated project cost for the proposed Bonny Deep Sea Port project is Four Hundred and Sixty-One Million, Nine Hundred Thousand ($461,900,000.00) only. The project would be funded through a Public – Private Partnership arraignment.

2.3 Envisaged Sustainability

The envisaged sustainability of the proposed Bonny Deep Sea Port will be discussed under Environmental, Technical, Economic, and Social basis.

2.3.1 Environmental Sustainability

The project's activities shall be followed through as guided by National and International environmental regulatory guidelines and standards. Also, the Environmental and Social Management Plan (ESMP) as drawn up and contained in this ESIA document shall be implemented from the construction to the operation phase of the deep seaport project so as to guarantee its environmental sustainability. Finally, a project specific waste management plan shall be put in place. The plan shall evaluate the waste streams and prescribe specific sustainable waste management approaches.

2.3.2 Technical Sustainability

The technical sustainability of the proposed project stems from the application of best available technology (BAT). Also, strict adherence to International and National Sea port engineering design, construction standards and codes of practices which shall be adopted at all stages of the proposed project development. This shall ensure the technical viability of the deep sea port project. Federal Ministry of Transportation as well as the Engineering Procurement Construction (EPC) contractors (CCECC Nigeria Limited) will in addition develop operating manuals and appropriate documentation regarding the operation and maintenance of the facilities. All the projects facility designs and construction shall be handled by properly trained and experienced personnel and competent contractors.

The Best Available Technology and Design not entailing excessive cost shall be adopted to increase the Lifespan of the Project.

2.3.3 Economic Sustainability

The proposed Bonny Deep Sea Port project shall promote business opportunities and enhance the Nation's economic development thus increasing the country's foreign reserves and gross domestic product (GDP). Importation of Oil and Gas facilities and materials will also be facilitated by this project with increasing activities in the industrial sector. By these, the proposed project is deemed to be economically sustainable.

The Project shall also stimulate and promote the proposed Port Harcourt Industrial Park project there by boosting its Economic Viability.

In addition, the project has local and national economic values in terms of employment opportunities for various categories of Nigerian professionals, skilled and semi-skilled craftsmen, business opportunities and additional revenue for the government.

2.3.4 Social Sustainability

The Federal Government of Nigeria through The Federal Ministry of Transportation shall also put up robust and implementable Memorandum of Understanding detailing issues about Corporate Social Responsibilities, employment, compensation for land, affected farms among other to the Project Host Community. Furthermore, the project will bring about huge infrastructural benefits to the host community(ies) such as good roads, electricity, water, modern healthcare facilities, just to mention a few. All these will engender the social sustainability of this project.

There shall be Grievance Redress Mechanism in place in line with Global Best Practice and Consultation with Host Communities and Relevant Regulators shall be throughout the project's lifespan.

2.3.5 Technical Sustainability

The design, construction and operation of the proposed Project will be handled by properly trained and experienced personnel according to the pre-established standards and procedures. Stringent safety measures would be built into the design and fabrication of facilities also the company's management is committed to continuous development and motivation of its human resource base through effective training or re-training, and an attractive remuneration and reward system.

2.3.6 Environmental Sustainability

This project would have some potential negative impacts on the environment. The ESIA will identify all potential impacts associated with the proposed project and proffer appropriate mitigation measures that will ensure that all the impacts are minimized or completely avoided. However, incorporating the findings and recommendation of this ESIA, and implementing an effective Environmental Management Plan, at the planning, design, construction, operation and abandonment/decommissioning stages of the proposed project, will ensure its environmental sustainability. The project's activities shall be followed through as guided by National and International environmental regulatory guidelines and standards.

2.4 Project Options

2.4.1 No Project Option

The non-implementation of this project implies that the area may be free from impacts associated with the project operations and at the same time benefits to be derived would be lost. This option is rejected for this project as there exist environmental, technical, economic, and social sustainable plans for implementing the project.

2.4.2 Delayed Project Option

This option is considered when all determining factors for the operation of the project have not been fully explored to ascertain effects on the project. In view of Corona Virus Pandemic, Covid-19 protocols as stipulated by Nigerian Centre for Disease Control (NCDC) shall be observed. Delayed Project option does not apply to this proposed Bonny Deep Sea Port project as all the necessary environmental, technical, economic and social factors have all been aptly explored and found to be majorly favourable for the proposed project.

2.4.3 Go Ahead Project Option

This option allows for full implementation of the project after all considerations of the concerned environmental, technical, economic and social factors. Based on the availability of sufficient natural draft for large vessels to sail, requisite land availability, adequate geo-technically wholesome soil, the Eastern Railway System linked directly to the deep sea port for cargo evacuation among other climatic, environmental and social factors etc., this option is recommended for the project to be carried out with strict compliance with the recommendations of the ESIA study as approved by the Federal Ministry of Environment.

2.5 Site Selection

2.5.1 Alternative Site Options

Several site options within the southern coastal areas of River State were considered for the proposed Deep Sea Port project taking into consideration dredging to attain requisite draft for large vessels to conveniently sail and berth, nearness to fairway bouy, nearness to the deep sea, sufficient requisite land area, available evacuation route for cargoes, and adequate geo-technical characteristic of the soil to withstand the nature/type of civil construction works to be carried out. These sites include other coastline States such as Delta, Bayelsa and Akwa Ibom. However, the Alternatives were found to be deficient in either one or more of the aforementioned criteria.

2.5.2 Proposed Project Site Selected

Very short dredging distance to attain sufficient draft for large vessels to sail, nearness to the deep Atlantic Ocean, land availability, adequate geo-technical nature of the soil/ground, proximity to the extended portion of the Eastern Railway Line for cargo evacuation among other climatic, environmental and social factors make Oluma in Bonny LGA of Rivers State (the proposed project site) apt for the project.

CHAPTER THREE

PROJECT AND PROCESS DESCRIPTION

3.1 GENERAL

This Chapter highlights in details the features of the Project basic activities, location layout plan and implementation schedule.

3.2 PROJECT OVERVIEW

The project Intent is to construct a 100,000DWT Container Vessel and 50,000 DWT Bulk Vessel capacity Deep Sea Port on a land take of 275.22Ha at Bonny Island, Bonny Local Government Area of Rivers State with components such as Dredging of basin, dredging of channel, reclamation for land area, pilling works, fabrication of beams, installation of superstructures of berth, construction of revetments and buildings of terminals.

A viable Deep-Sea port project is needed to keep up with the demand for capacity, as the existing ports in the country have been overwhelmed or have been surrounded by urban developmental facilities which has made expansion impossible

3.3 Project Size and Location

The project site for the proposed Bonny Deep Sea Port is located on the shore of the Atlantic Ocean on a landtake of 275.22Ha at Bonny Island, Bonny Local Government Area, Rivers State Nigeria. The Bonny Deep Sea Port project will be located at the southwest tip of the Bonny Island in Rivers State of Nigeria, approximately 1.4km on the existing vertical coastline before NLNG. Bonny Island is an island at the mouth of the Niger delta, in the southeast of Nigeria. According to the Encyclopedia Britannica, Bonny lies about 10km along the Bonny River an eastern distributary of the Niger River upstream from the Bight of Biafra (also known as the Bight of Bonny). The town is bounded by the states of Anambra and Imo on the north, Abia and Akwa Ibom on the east, with Bayelsa and Delta on the west. Rivers state contains mangrove swamps, tropical rainforest, and many rivers.

Geographical Coordinate of the project location is captured below: -

Table 3.1: Geographical Coordinate of the project location

	North	East
A.	7.200805^0	4.469988^0
B	7.209146^0	4.482962^0
C	7.198157^0	4.490024^0
D	7.188687^0	4.475289^0
E	7.192164^0	4.471195^0
F	7.197437^0	4.472150^0

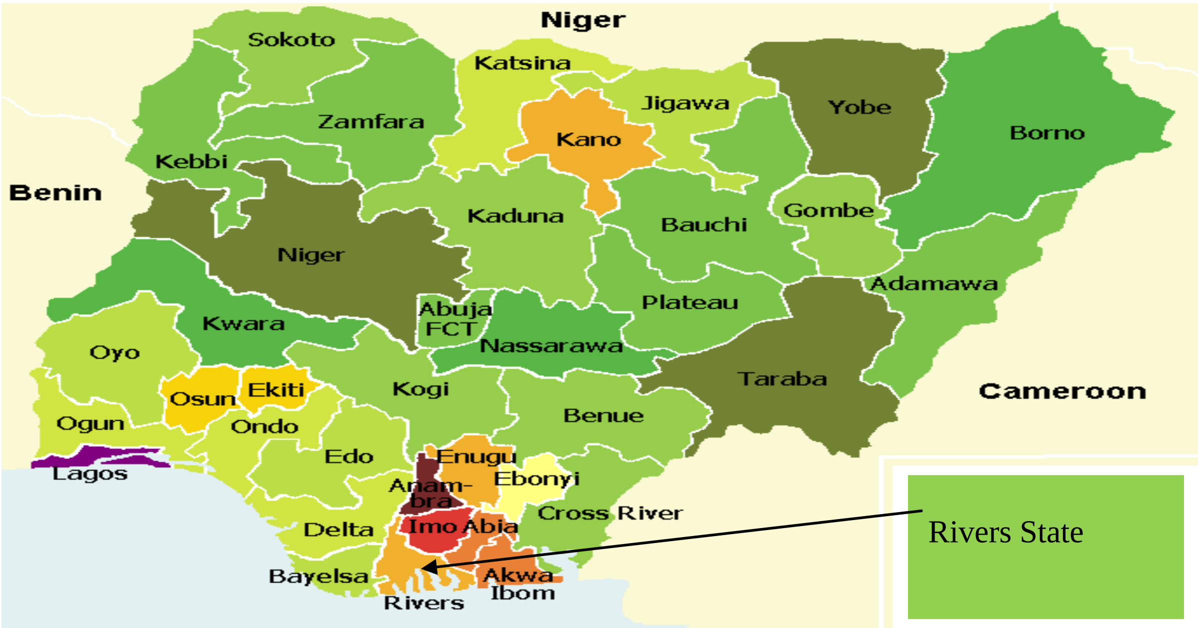


Figure 3.1: Map of Nigeria. Arrow points to Project Location Rivers State

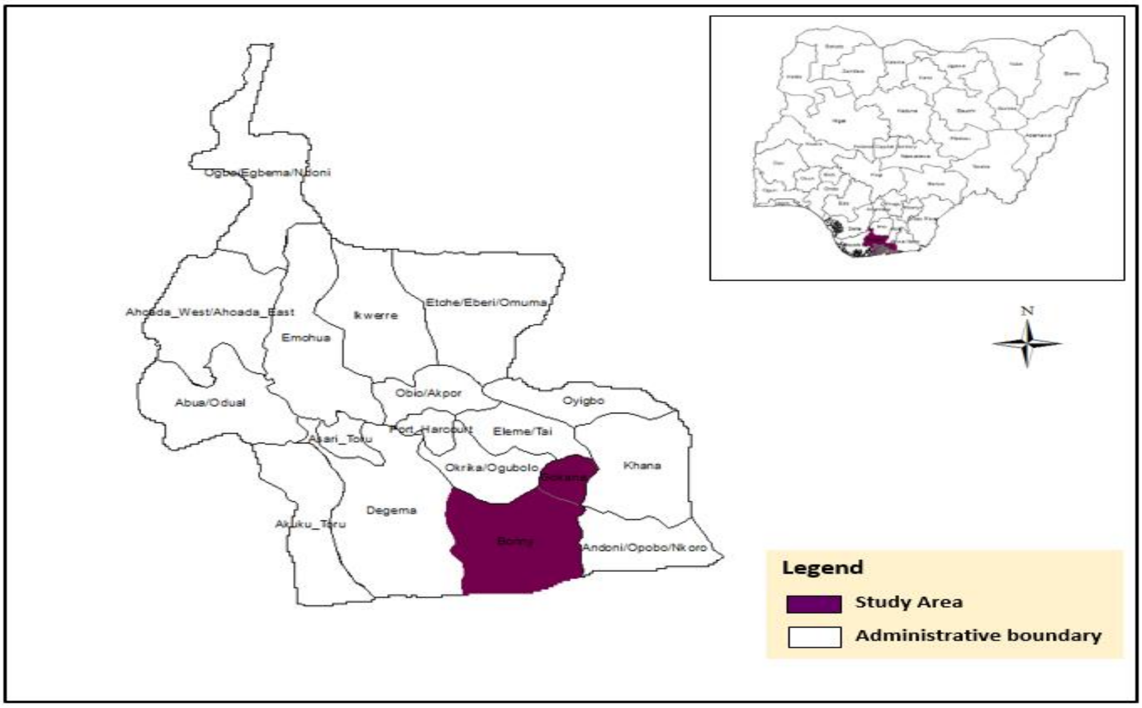


Figure 3.2: Map of Rivers State showing Bonny Local Government Area

Figure 3.3: Proposed Bonny Deep Sea Port location on Google Earth satellite imagery

3.4 DESIGN ENGINEERING CODES AND STANDARDS

The installation and construction of the Deep-Sea Port project would be in accordance with the recognized and generally acceptable engineering practices, Statutory Codes and Standards. Thus, the Technical Specifications shall be in accordance with approved design. The Bonny Deep Sea Port project shall follow applicable National legislation and regulations and International codes (Table 3.2), standards and specific technical requirements for Sea Port construction projects.

Table 3.2: Chinese Codes and Standards

No.	Code Name	Code No.
1	Design Code of General Layout for Sea Ports	JTS 165-2013
2	Code of Design and Construction of Port and Waterway Revetment Engineering	JTJ300-2000
3	The Technical Code of Dredging Engineering	JTS 181-5-2012
4	Code of Design and Construction of Breakwaters	JTS154-1-2011
5	Code for Geotechnical Investigation on Port and Waterway Engineering	JTS133-1-2010
6	Load Code of Harbour Engineering	JTS144-1-2010
7	Code of Hydrology for Sea Harbour	JTS 145-2015
8	Design Code for Wharf Structures	JTS167-2018
9	Code for Design and Construction of Port and Waterway Revetment Engineering	JTJ300-2000
10	Code for Pile Foundation of Harbour Engineering	JTS 167-4-2012
11	Code for Soil Foundations of Port Engineering	JTS147-1-2010
12	Code of Earthquake Resistant Design for Water Transport Engineering	JTS 146-2012

British Standards Institution - BSI (Civil Works)

- Structural Use of Concrete (Parts 1 to 3) BS 8 110
- Code of Practice for Foundations BS 12
- Specification for Aggregates from Natural Resources for Concrete BS 882
- Specification for Carbon Steel Bars for the Reinforcement of Concrete BS 4449
- Methods for Test for Soils for Civil Engineering Purpose BS 1377
- Chapter V – Wind Loads (Part 2) BS CP 3

- Structural Steel Sections Part 1 –Specification for Hot Rolled Sections BS 4
- Specifications for the use of Structural Steel in Buildings (Part 2) BS 449
- Specifications for Hot Dip galvanized Coating on Iron & Steel BS 729
- Specifications for Hot Rolled Non-Alloy Structural Steel BS EN 10025
- Fences – Specification for Anti-Intruder Fences BS 1722
- In chain and Welded Mesh (Part 10).
- Code of Practice for Earth Works BS 6031

Quality Assurance Design

In order to ensure that the objectives of the project are realized, CCECC Nigeria Limited has specified the following quality objectives for design:

- Compliance with statutory requirements;
- Performance requirements;
- Production availability;
- Environmental conditions and safety;
- Operability and maintainability;
- Life expectancy;
- Extendibility
- Use of innovative technology

To ensure that the above quality objectives are met, CCECC Nigeria Limited intends to adopt time-tested designs, employing new technology where safety and economics dictate.

3.5 Design Criteria

3.5.1 Design Vessel

Table 3.3/ 3.4 shows the parameter of design vessel as reference.

Table 3.3: Design Vessel

Type/Tonnage	Gross Deadweight（t）	L（m）	B（m）	Load Draught（m）
Container Vessel	30,000	241	32.3	12.0
Container Vessel	100,000	346	45.6	14.5
Bulk Vessel	50,000	223	32.3	12.8

3.5.2 Design Life

Table 3.4: Design Life

Item	Design Life
Marine Structure	50 years
Revetment	50 years
Buildings	50 years
Other equipment and services	As per manufacturer's requirements

3.6 Pre-Construction and Construction Phase

Construction Conditions

Traffic Accessibility: There is no existing access road to the site, so temporary road to be constructed at beginning of construction. The efficiency of transportation shall be carefully considered.

Water and Power Supply: As the local power supply is not reliable, diesel power generators and standby generations should be provided for both construction and living areas. Boreholes will be drilled by contractor to supply water.

Construction Materials: Most construction materials are considered to be imported except for cement, reinforcement, rock and aggregates.

Equipment: Construction vessels are considered to be mobilized from China, while major onshore equipment, such as excavator, wheel loader, mobile crane, is considered to be mobilized from other Projects in Nigeria.

Temporary Facilities: Temporary access road, precast yard, site office, workshop and temporary jetty will be constructed as soon as the first mobilization completes. The precast yard will be planned to be completed within 6 months

General Construction Arrangement

In general arrangement, the works will be performed as planned with the following steps:

- Step 1: Temporary access road, precast yard, site office and accommodation, workshop and temporary jetty will be constructed as soon as the mobilization of personnel and equipment, and ensure relevant management and operation personnel enter the site as planned;
- Step 2: Carry out the earth work of terminal backyard;
- Step 3: Carry out dredging of basin, dredging of channel, reclamation for land area;
- Step 4: Carry out pilling works and fabrication of beams and slabs, ground improvement of terminal backyard;
- Step 5: Carry out the installation of superstructures of berth and the construction of revetments;
- Step 6: Carry out ancillary buildings of terminals and furniture installation.

3.6.1 Raw Material Supply

Construction materials required for the Deep-Sea Port project are highlighted under five (5) broad areas which include: Civil works, Electrical works, Plumbing works, Metallurgical works and Wood works.

- Civil works: - This will require the following materials; cement, granite, stone dust, sharp sand, water, interlocking stones, marble tiles, roofing sheets, wooden planks, asphalt, iron rods, paints and POPS/PVC, glass sheets among others.
- Electrical works: - This will require the following materials as so listed; transformer, feeder pillar, electric cables, bulbs, street lighting poles, cable clips, sockets, chandelier, electric plugs, electrical distribution boxes, and change over switches just to mention a few.
- Plumbing works: - Will require these materials as listed and more; water tanks, toilet seats, washing hand basins, shower kits, bath tubs, water heaters, pvc pipes and water tap heads.

- Metallurgical Works: - Requires electric welding machines, oxy-acetylene welding equipment, filing machines, metallic sheets, metallic rods, fabricated metallic gates and doors as well as window frames among others.
- Wood Works: - This will require planks, boards, nails, adhesive, formica, screws etc.

According to Clause 4.1.4, 4.1.5 and 4.1.6 of Design Code for Concrete Structures of Port and Waterway Engineering (JTS 151-2011), the properties of concrete used in the design are listed in the following table:

Table 3.5: Concrete Properties

Class	f_c (MPa)	f_t (MPa)	E_c (MPa)	μ
C40	19.1	1.71	3.25×10^4	0.2

Where:

f c -- characteristic compressive cylinder strength of concrete at 28 days

E c -- Secant modulus of elasticity of concrete

μ -- Poisson's ratio of concrete

The properties of rock materials to be adopted for marine works are listed in following table.

Table 3.6: Rock Material Properties

Item	Density (kN/m^3)	Submerged Density (kN/m^3)	Internal Friction Angle
Individual stone unit	26.50	-	-
Armour rock	17	10	45°
Underlayer rock			
Rock fill			
Rubble stone	17	11	38°
Mixed filter stone			

The rock shall meet the following requirements:

- The primary compression strength shall not be less than 50MPa and shall not be less than 30MPa for secondary rock;
- It is not weathered, free from flaky or severe crack.

Durability

Concrete structure

- Limitation on crack width: According to Clause 3.3.4 of Design Code for Concrete Structures of Port and Waterway Engineering (JTS 151-2011), crack width under quasi-permanent combination shall be limited to 0.2mm.

According to Clause 7.2.1 of Design Code for Concrete Structures of Port and Waterway Engineering (JTS 151-2011), the minimum concrete cover is as following:

- Marine Structure: not less than 70mm
- Column, beam and wall: not less than 35mm.
- Slab: not less than 25mm.
- Member under ground level: not less than 40mm.

Anti-Corrosion Measures

All steel surfaces shall be protected against corrosion with paint systems or galvanising as appropriate. All steel piles are provided with an appropriate marine paint coating proprietary system, cathodic protection.

The coating system is applied for exposed steel. For splash area and water level fluctuation area with the coating thickness no less than 1000 microns. For under water area with the coating thickness no less than 450 microns.

The sacrificial cathodic protection is applied for under water area.

The allowance corrosion is applied all steel, the thickness can be calculated according to 6.3.6, JTS 167-4-2012.

Note that all construction materials shall be sourced locally and transported to site by CCECC Nigeria Limited (Engineering, Procurement and Construction) contractors to Federal Ministry of Transportation.

3.7 Site Layout

The layout of the Bonny Deep Sea Port includes the port and relative facilities such as; container berth, multipurpose terminals, stacking area (yard), warehouse, administrative building and cranes.

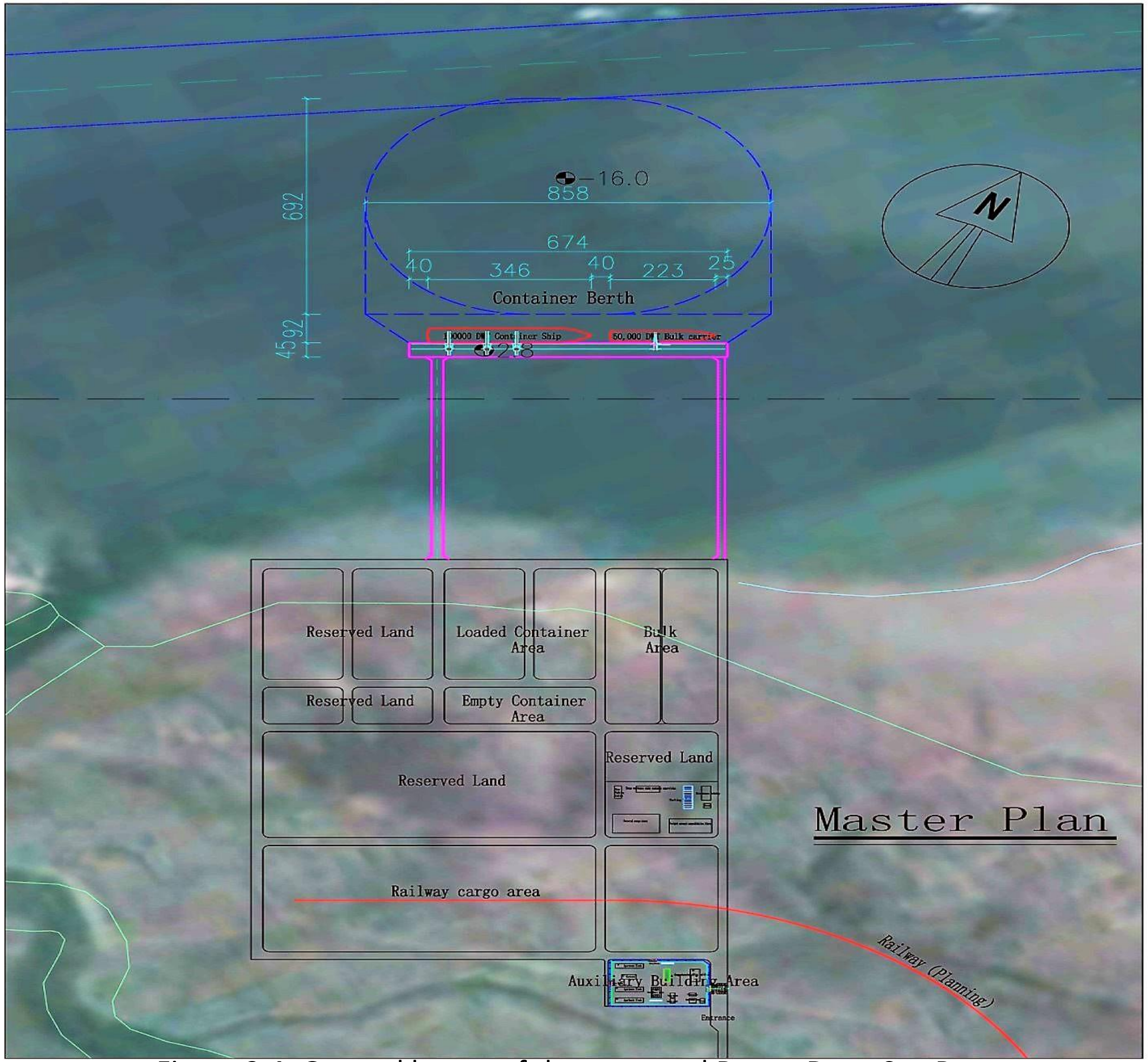


Figure 3.4: General layout of the proposed Bonny Deep Sea Port

3.8 DREDGING

Dredging Slope

A minimum dredging side slope of 1:5 shall be adopted for the parts of Approach Channel, Turning Circle Area and Harbor Basin.

Disposal of the Dredged Materials

The surplus unsuitable dredged materials shall be disposed at the designated disposal area. For the suitable dredged materials, they can be used as fill material for terminal reclamation.

Dredging Method

As mentioned previously, and due to the type of soil conditions varying from soft or maybe dense materials, different type of dredgers can be mobilized for the reclamation and dredging works but mainly TSHD‟s and CSD‟s will operate the dredging and reclamation works. At this stage the following vessels can be foreseen:

- Trailing Suction Hopper Dredger (TSHD) for dredging soft materials and some of hard materials from about all the dredged zones.
- Cutter Suction dredger (CSD) for dredging soft materials and hard materials from the unexposed dredged zones (protected zones from waves).
- Backhoe dredgers (BHD) for typically small pits of hard materials from unexposed dredged zones located near reclaimed land.
- Split Barges
- Auxiliary equipment will also be mobilized.

Figure 3.5: Trailing Suction Hopper Dredger (TSHD)

Figure 3.6: Cutter Suction dredger (CSD).

Figure 3.7: Back Hole Dredger (BHD)

3.8.1 Possible Reclamation Work Method

The reclamation works will start by building containment bunds (dykes) for enclosing the designated reclamation areas by temporary or permanent slope (rock) protections. No hydraulic filling will occur prior containment bunds are built.

Reclamation of project yard might be mainly done by means of a THSD and CSD. In both cases, dredgers can pump sand or loosened soil as a hydraulic mixture through a series of pipelines to reclamation area. If sand is borrowed offshore by a THSD, the loaded ship sails from borrow area to a connection pipeline in project area

The hydraulic fill may however be initiated at different locations depending on the type and number of dredgers mobilized. The layout of the total pipeline trajectory will depend on the location of the connection, the exact layout and geometry of the reclamation area, the type and the quantity of the terrestrial means and equipment and the type and number of dredgers.

In a general way, land-based equipment will manage and control the reclamation works. In order to control the outflow of transport water the reclamation area into the sea, weir boxes (or water boxes) shall be installed along the containment bunds of the reclamation area.

3.9 Marine Components

3.9.1 Piling

For purpose of reducing anchor dropping times of pile driving barge, the principle for pile sinking sequence is confirmed as followed in accordance with the reality of this Project and in coordination with the construction arrangement: implementation from inside to outside and from shore to sea.

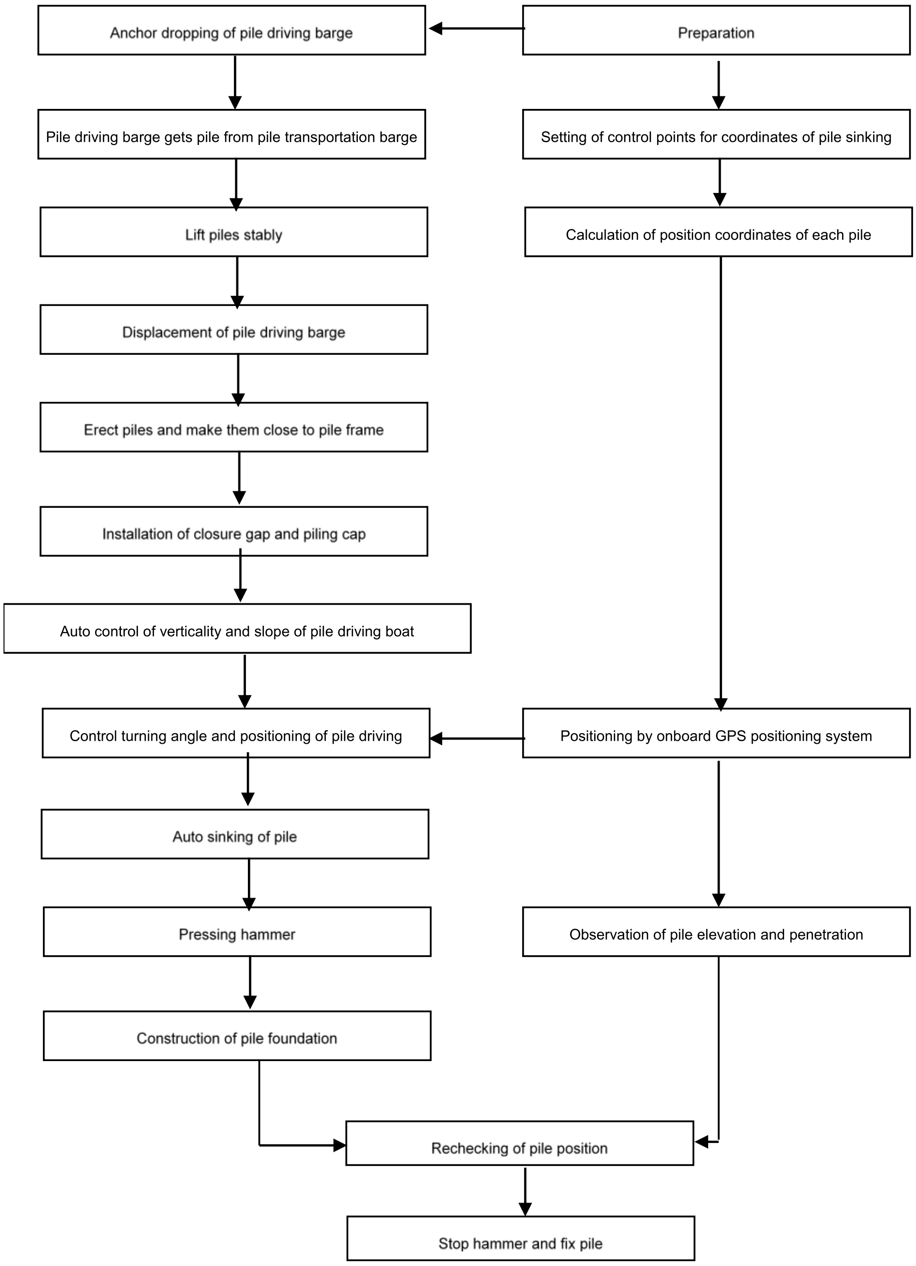


Figure 3.8: Flow Diagram for Construction of Piling

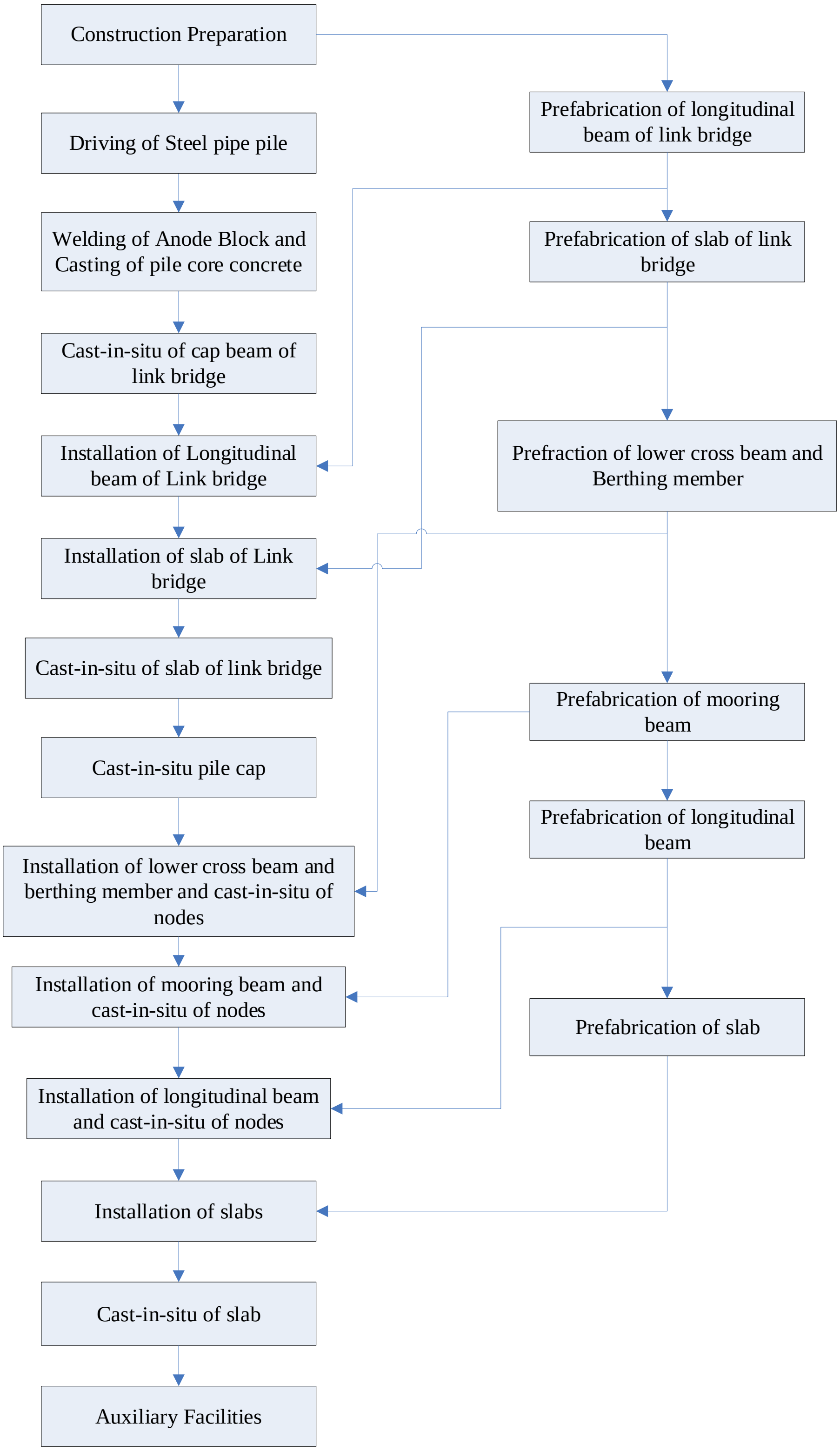


Figure 3.9: Flow diagram for the construction of Berth

Table 3.7: Dimensions of Main Structures

S.N	Structure	Item	Value
1	Container and Bulk Berth	Length	674m
		Top elevation	2.8m
		Bottom Level	-14.8m
2	Approach Bridge	Length	650m
		Width	15m
		Top elevation	2.8m
3	Revetment	Length	500
		Top elevation	2.8m

3.9.2 Design Scheme of Container Berth

A Berth is a designated location where a vessel may be moored, usually for the purposes of loading and unloading. The size of the berths varies from 5-10m for a small boat in a marina to over 400m for the largest tankers.

The Berth structure is designed as a pile-supported structure with bottom level -14.8mCD for berthing of maximum 100,000 DWT Container Vessel and 50,000 DWT Bulk Vessel. The whole berth is 426m long and 45m wide with the top elevation of 2.8m. The berth is connected to the rear yard with approach bridge.

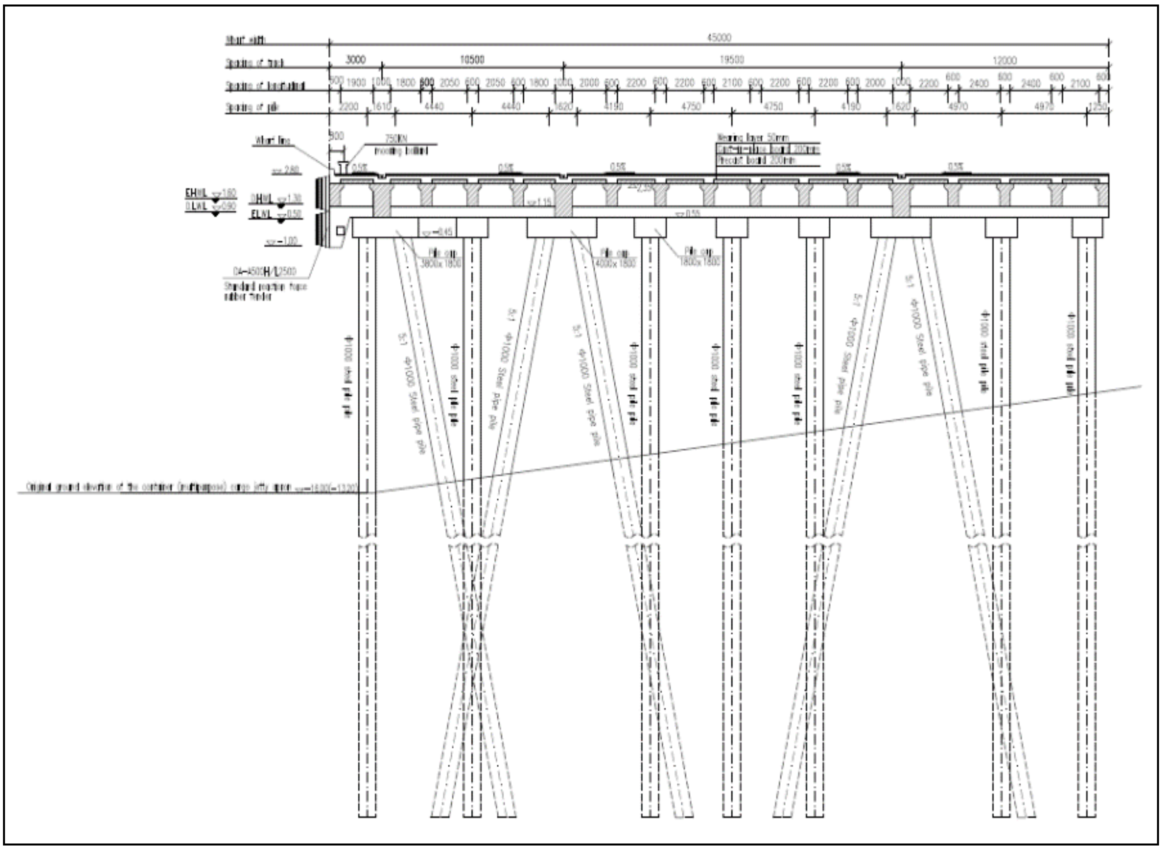
The diameter 1.0m steel tubular piles are applied to undertake the load from the ship, container handling and other superimposed live loads. Six vertical piles are located under the transverse beam. Two raked piles are arranged under leeside crane beam. One vertical and one raked pile are arranged in the front line.

All beams and slabs are reinforced concrete. The transverse beam is cast-in-situ of not less than C35/45 concrete. The slab is composite and intercrossed with the transversal beam.

For mooring and berthing convenience, DA-A500H×2500L rubber fenders and 750KN bollard will be installed.

Figure 3.10: A typical container berth

Typical Section of Container Berth



3.9.3 Design Scheme of Approach Bridge

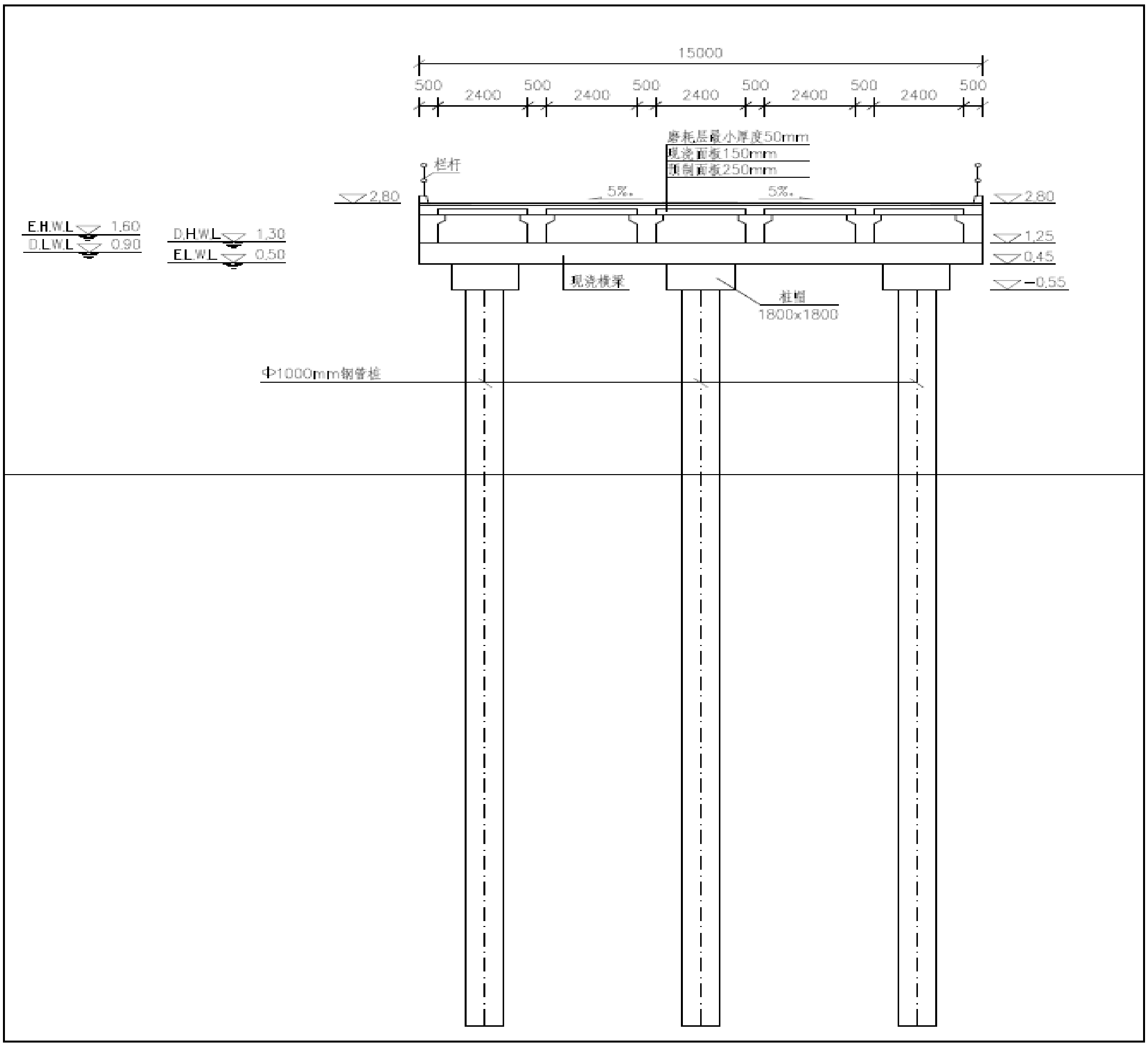
The approach bridge is 650m long and 15/25m wide with the top elevation of 2.8m.

The berth is designed as pile-supported structure, which the diameter 1.0m steel tubular piles are applied to support. Three vertical piles are located under the transverse beam.

All beams and slabs are reinforced concrete. The transverse beam is cast-in-situ of not less than C35/45 concrete. The slab is composite and intercrossed with the transversal beam.

Guard curbs and Handrails are constructed by both sides of the approach bridge.

Typical Section of Approach Bridge



3.9.4 Design Scheme of Revetment

The revetment is of slope structure, and the top elevation of the revetment is 2.80m. The revetment body material is 0~500kg rock and the slope ratio on both sides of the revetment is 1:1.5.

3.9.5 Revetment Construction

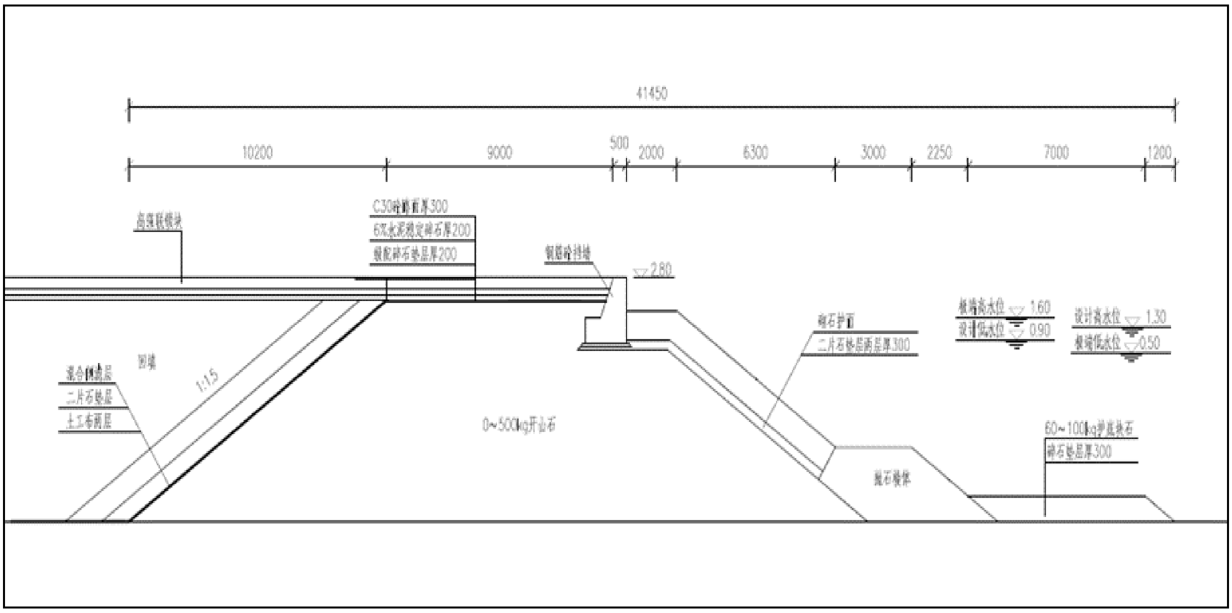
Flat top barge, excavators, crawler crane, etc. will be used for the construction of the revetment. The construction will be started after the dredging inspection is completed.

Rock fill shall not be dropped or tipped into position, but shall be placed piece by piece onto the structure to achieve a minimum standard of "three-point support" and to meet the specified requirement of lines and levels.

Bulk placement of rock by dumping vessel may only be permitted, provided that layers will be stable to the specified profiles and no substantial disturbance or damage to already placed structures will occur. No segregation of a specified grading shall be accepted. Rock will be placed by an excavator on barge.

Core transportation and placing (left), Slope trimming (right)

Typical Section of Revetment



3.9.6 Prefabrication

Concrete members: The production rate of concrete members relies on the quantity of bottom formwork for pre-casting and its turnover. A gantry crane may be used for the formwork erection and removal while a concrete pump will be used for concrete pouring.

Figure 3.11: Gantry Crane in Fabrication Yard

Interlocked paving blocks and other prefabricated units: A production line will be prepared for interlocked paving blocks, and the production area for other minor prefabricated units will be arranged within the precast yard according to the overall production progress. A mobile crane will be used for the formwork erection and removal and concrete pouring.

3.9.7 Auxiliary Facilities

The auxiliary facility works include rubber fender, bollard, ladder stand and handrail. If the design drawing for embedded parts is prepared, such parts should be supplied by professional manufacturer.

Construction Method

- The bollard should be embedded during the casting of upper cross beam concrete. The handrails should be installed after continuous beam casting is done. The embedded steel plate should be used as pedestal before installation, be installed manually and be provided with dedusting and rust prevention on surface after installation.
- The berthing member components of rubber fender and casting of upper and lower cross beam concrete should be completed at the same time. The rubber fender should be lifted and installed using truck crane.
- The ladder stands, before being installed, should be provided with embedded steel plate as the pedestal. After the ladder stands and handrails are prepared at site, they can be immediately installed on the pedestal. For other requirements, please refer

to the relevant introduction in this design drawing.

3.9.8 Equipment Installation

All equipment for this Project is planned to be purchased from professional manufacturers and sent to construction site for installation after inspection. It should be guided by manufacturer's professional personnel during installation to make sure the installation quality is satisfying the design requirements.

3.9.9 Multipurpose terminal

A multipurpose terminal is a complex of infrastructure, equipment and services which offers a combined and flexible response to the servicing demand of certain types of vessel and cargo, permitting the optimum utilisation of manpower and equipment. The use of the adjective 'multipurpose' is not odd with the fact that the terminals are specialised in flexibility. The terminals' response is to be combined and flexible because the flexibility is provided within a specific spectrum of trades having identical generic characteristics. This implies two requirements which are proposed for the Bonny Deep Sea Port project:

- The terminals shall be planned to accommodate heterogeneous cargoes, from general cargo in small consignments to containers, which does not mean that the terminals shall accommodate every type of cargo.
- The specific sub-groups of the cargo to be combined shall not be so large as to call for a specific terminal or demand special handling within the multipurpose terminal in which they are grouped.

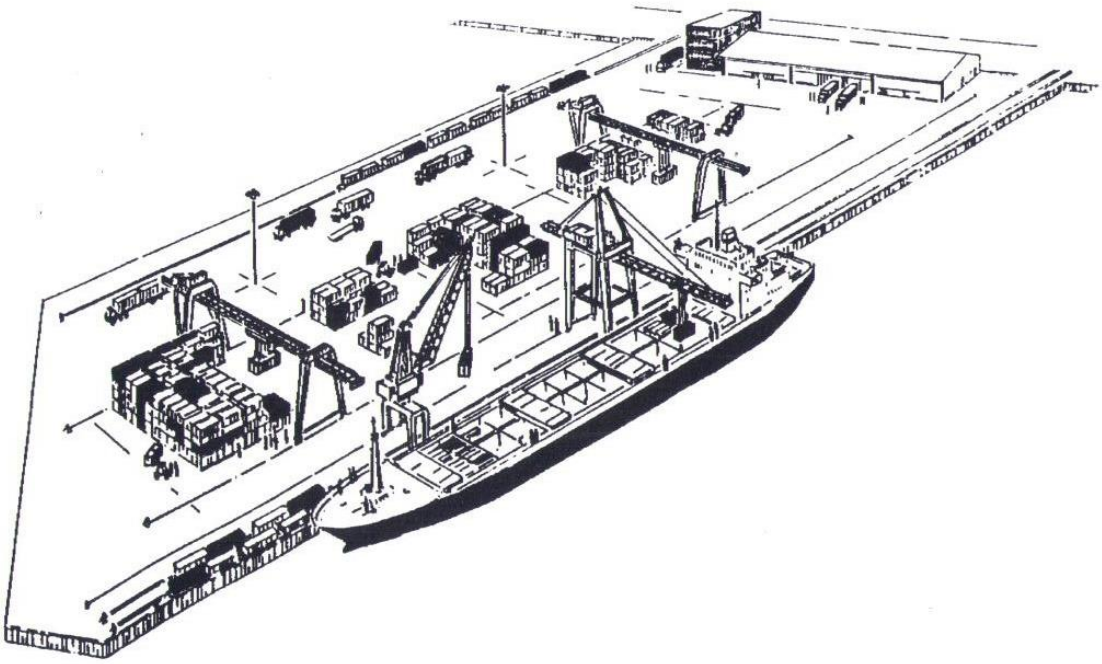


Figure 3.12: Multipurpose terminal with heavy container traffic

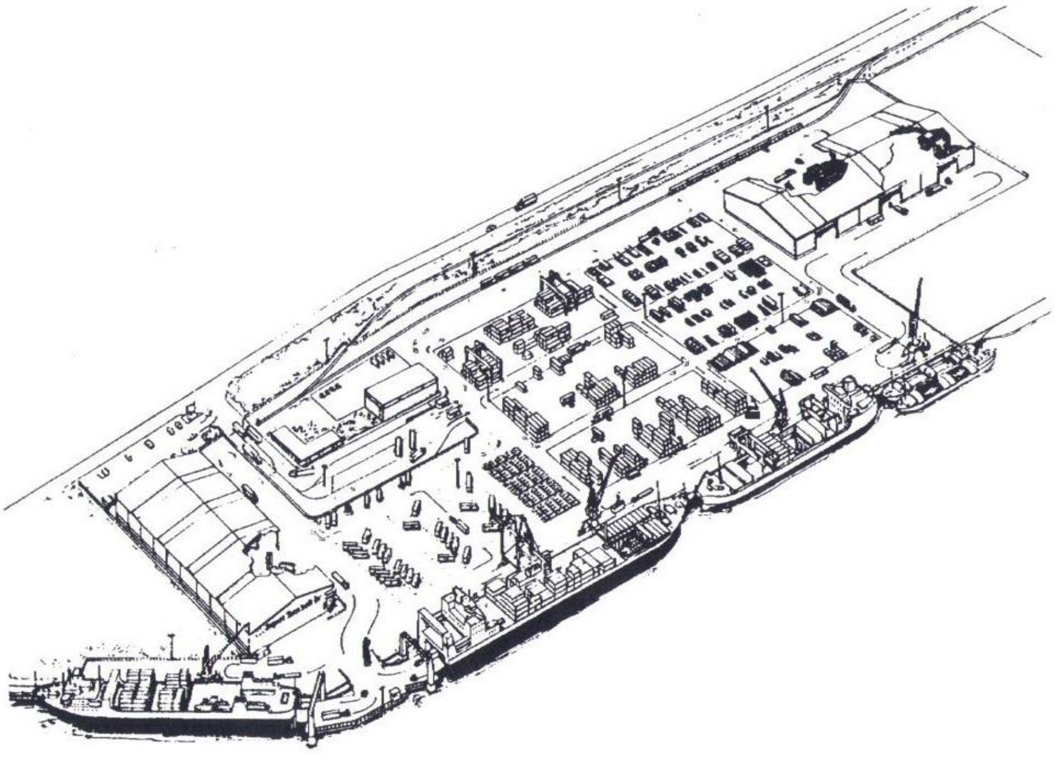


Figure 3.13: A two berth multipurpose terminal

3.9.10 Stacking Area/Yard

The yard is an intermediate stacking area, holding boxes until they are transported to their next destination. Stacking boxes takes up one of the terminal's most valuable resources: yard space. A yard management system will position a container in a slot where, ideally, it does not need to be re-handled before leaving the terminal. After all, reshuffling containers is a very costly activity, both in time and resources, which is (usually) not billable to a customer.

Figure 3.14: A typical stacking area/yard

3.9.11 Warehouse

A warehouse is a commercial building for storage of goods. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, etc. They are usually large plain buildings and usually have loading docks to load and unload goods from trucks. Sometimes warehouses are designed for the loading and unloading of goods directly from railways, airports, or seaports.

Figure 3.15: A typical warehouse

3.10 Administrative Building

This is the centre of control of all business and management operational activities. The administrative building will contain the port director's office, deputy port director's office as well as the offices of other management staff.

3.10.1 Technological Layout

A range of port operating equipment (including those proposed for this project) are highlighted and discussed below with information on its most significant operating capabilities.

3.10.2 Cranes

A crane is a type of machine, generally equipped with a hoist rope, wire ropes or chains, and sheaves, that can be used both to lift and lower materials and to move them horizontally. It is mainly used for lifting heavy things and transporting them to other places. It uses one or more simple machines to create mechanical advantage and thus move loads beyond the normal capability of a human. Cranes are commonly employed in the transport industry for the loading and unloading of freight, in the construction industry for the movement of materials and in the manufacturing industry for the assembling of heavy equipment.

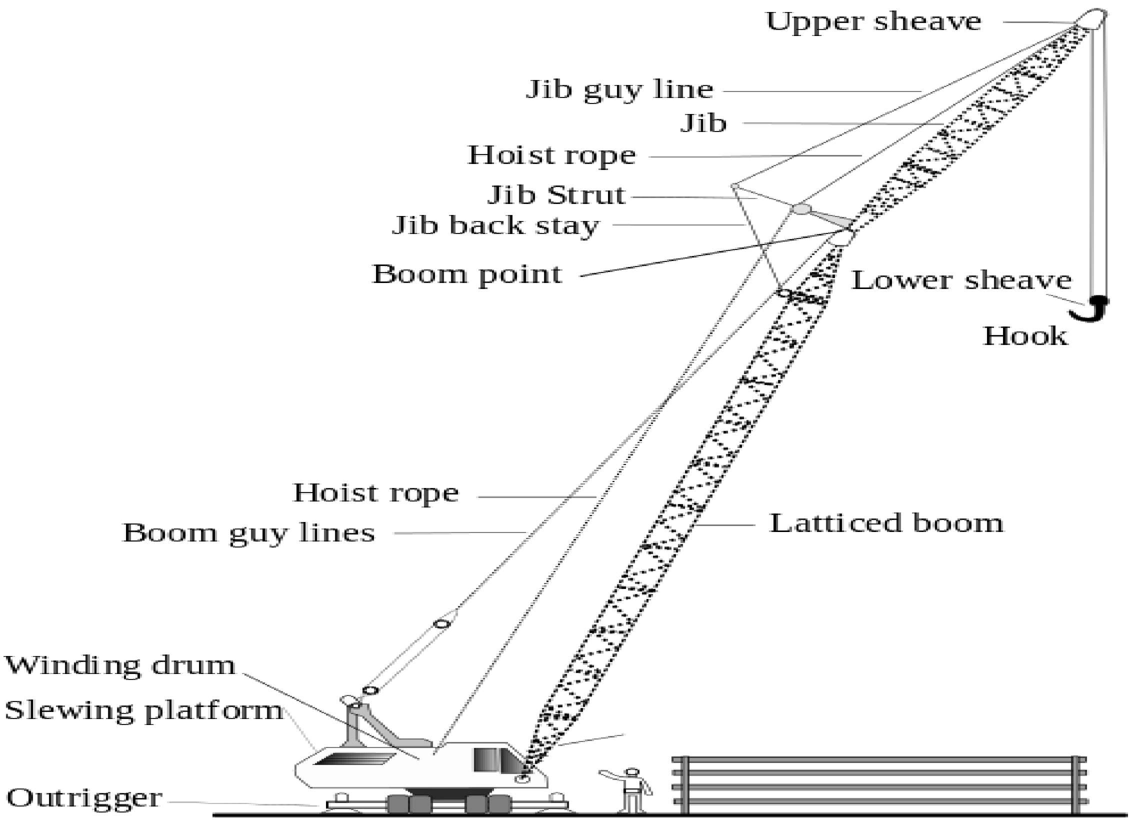


Figure 3.16: An annotated illustration of a crane

3.10.3 Trailer

There are Three (3) types of trailer used to move cargo and containers within the terminal. They are:

3.10.4 Low Platform Trailers

These are best suited to Ro-Ro operations. Over long distances the low speed due to the small wheels is a handicap, as is the need to secure the gooseneck coupling with chains. They are the advantage of being able to be stacked when empty.

Figure 3.17: Low Platform trailer

3.10.5 Normal Height Trailers

These are similar to trailers for road use but are simpler and sturdier, with no suspension or extra connections.

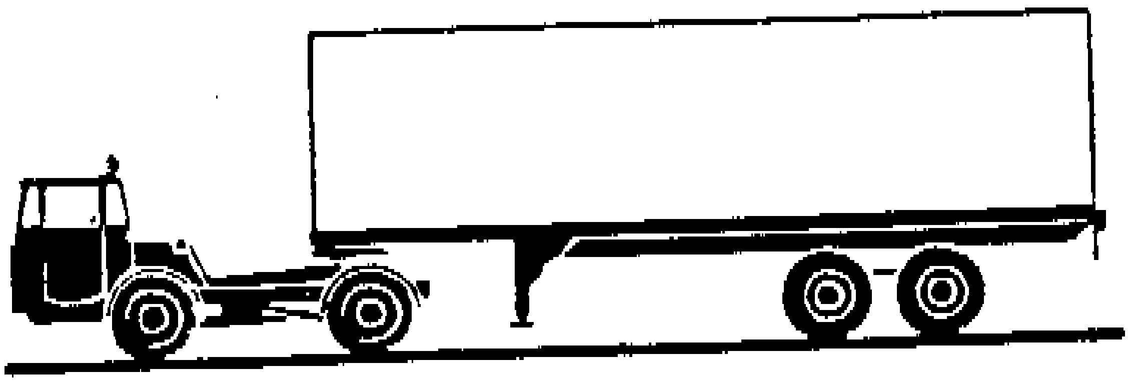
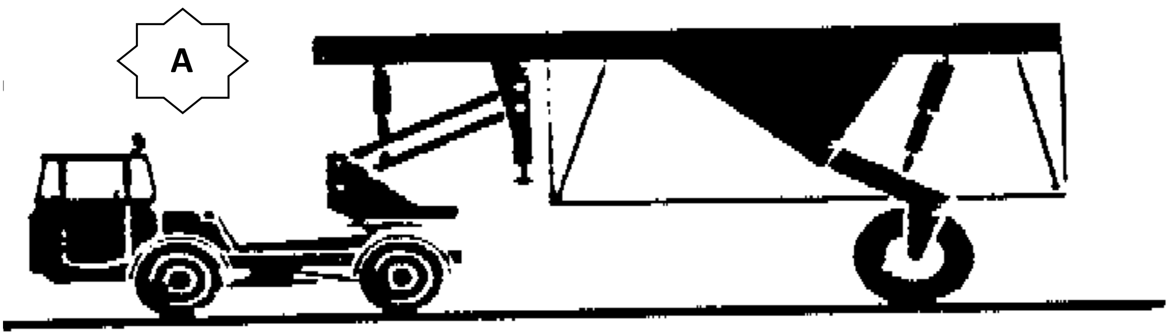


Figure 3.18: Normal height trailer

3.10.6 Hydraulic Lift Trailers

These have advantage of the first two types in not needing a machine to load them. A hydraulic lift raises the cargo but cannot be used for stacking.



B

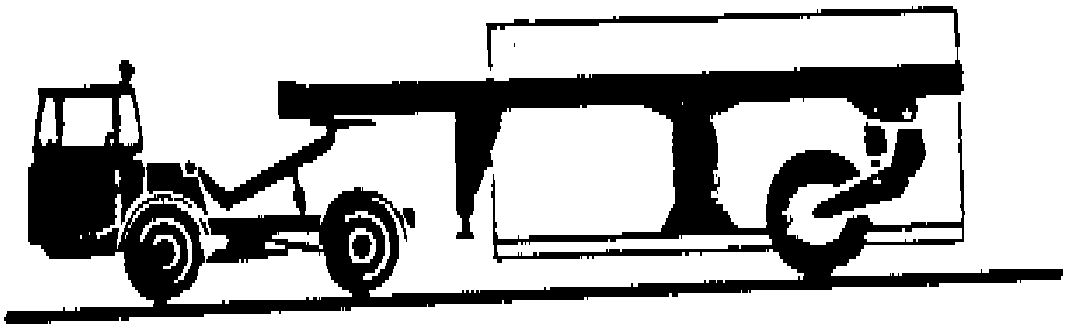


Figure 3.19: Trailers (A and B) with hydraulic lift

The three types of trailer are towed by tug masters fitted with coupling devices. For Ro-Ro work tug masters with low cabs are used (minimum overall height).

From all the three truck options explored above, the **Normal height trailers** and the **Hydraulic lift trailers** are the ones to be used during the operation of the Bonny Deep Sea Port project.

3.10.7 Reach Stacker Crane (RSC)

RSC performs the functions similar to those of the side and front loaders and can stack containers in blocks of four rows four containers high. This doubles the efficiency of use of the storage area in comparison with the blocks of two containers high that could be stacked by earlier machines. At the same time the load imposed by the machine on the pavement is reduced and the spreader’s 90 degree turning capability permits a further reduction in the width of the corridors between stacks and as such shall be procured for the operation of the Bonny Deep Sea Port.

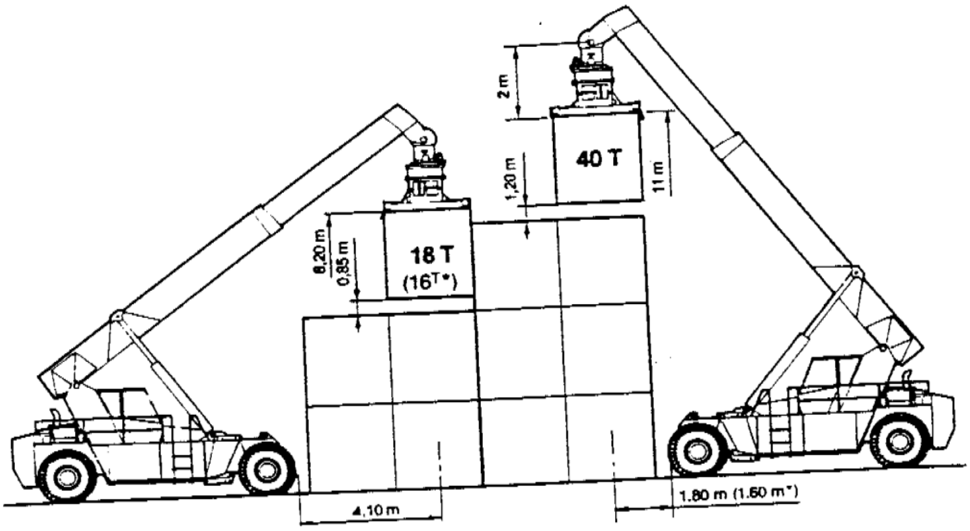


Figure 3.20: Reach stacker crane

3.10.8 Mobile Portal Crane

The mobile crane which is one of the equipment to be used in the operation of the proposed project performs the functions of the front lift truck, the reach stacker crane and the straddle carrier, offering the flexibility necessary even in highly specialised terminals at a purchase price and maintenance costs intermediate between those of an FLT and the STC.

1. Turning a fully loaded 40’ container.
2. Stacking two containers high in third row.
3. Carrying container, jibs retracted.
4. Working as ‘straddle carrier’.
5. Stacking sideways in first row.
6. Stacking first container in third row.
7. Spreader vertical extension (1.35m).

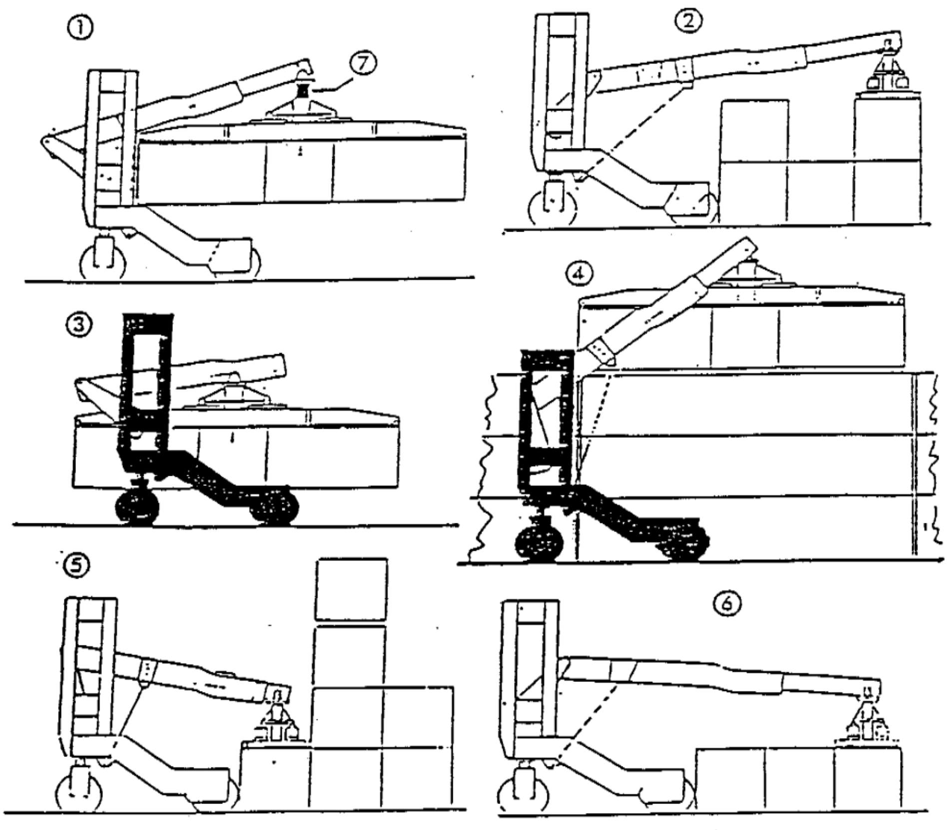


Figure 3.21: Mobile portal crane

3.10.9 Straddle Carrier (SC)

The SC is ubiquitous in container terminals. It offers high flexibility, but the purchase price and maintenance cost are also high and the load imposed on the pavement is heavy. Its stacking capability varies from one to one on three, one on two being the most common. This equipment shall be procured for use by the Bonny Deep Sea Port.

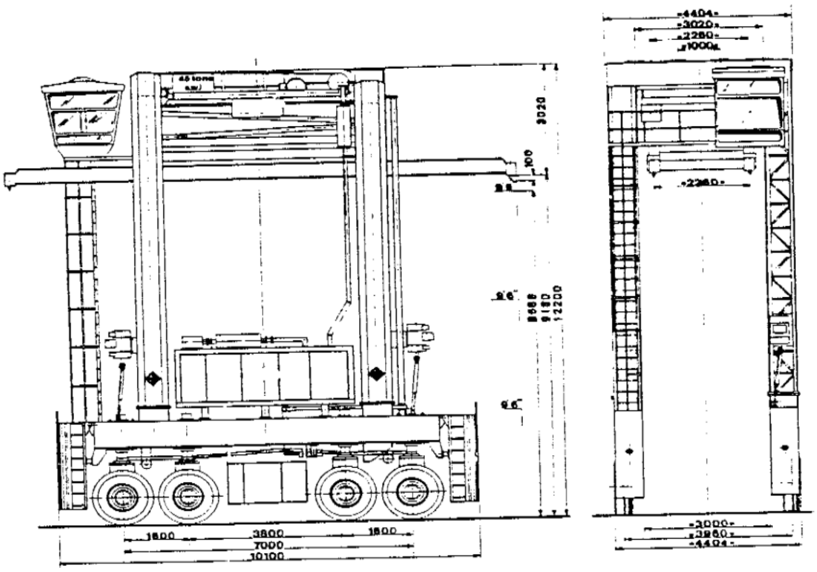


Figure 3.22: Straddle carrier

3.10.10 Rubber Tired and Rail Mounted Gantries (RTG and RMG)

The RTG and RMG are highly specialised pieces of equipment with stacking capability well adapted to highly organised operation. They are rarely seen in multipurpose terminals but shall be employed in the proposed project.

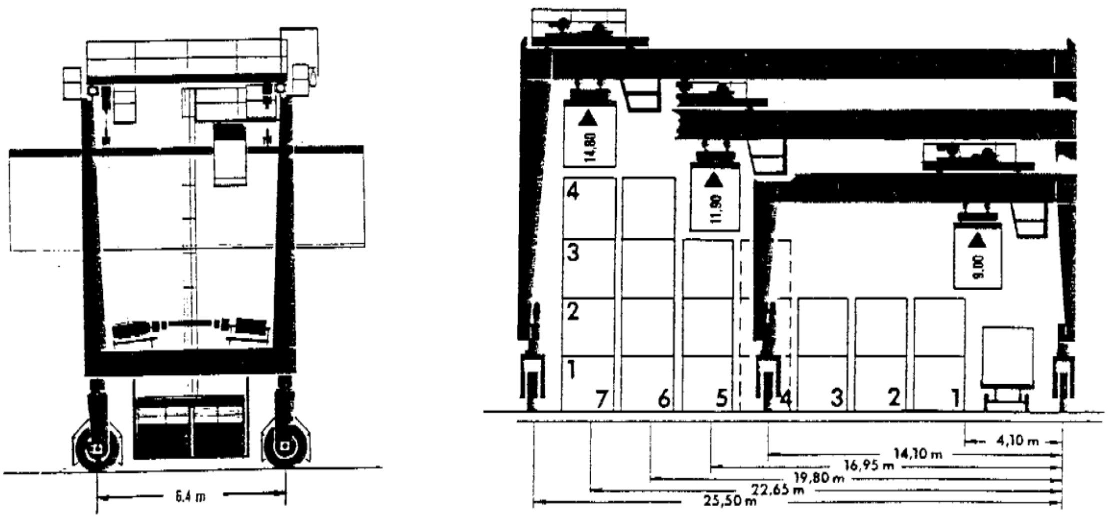


Figure 3.23: Rubber tired and rail mounted gantries

3.10.11 Ramps

There are three types of ramps for Roll-On Roll-Off Operations. These include the fixed ramp, mechanically operated bridge and the floating ramp.

3.10.12 Fixed Masonry Ramp

This consists of a simple masonry platform where there is no tide, or a masonry ramp of the type in tidal waters. See figure below

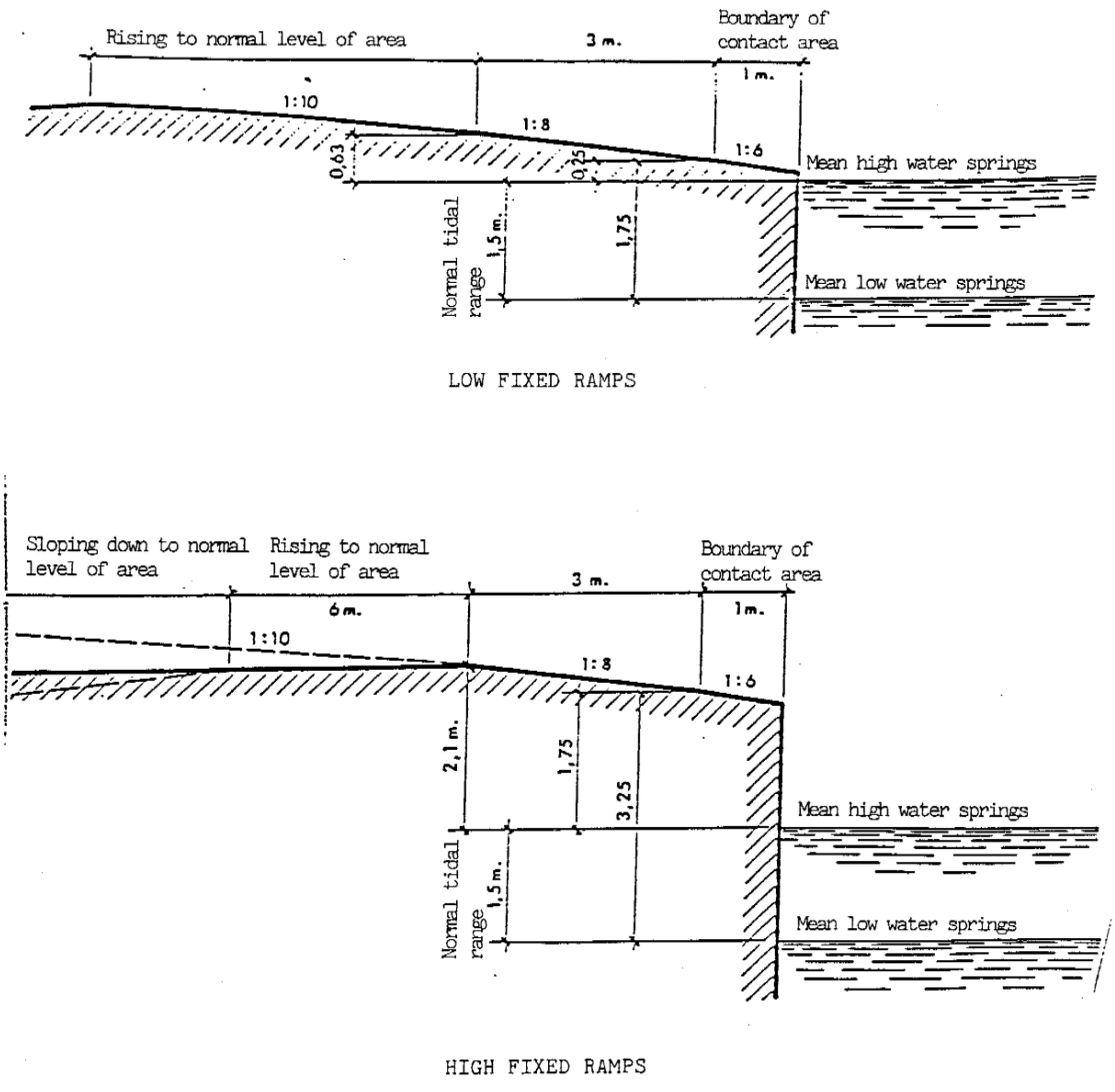


Figure 3.24: Low and high fixed ramps

3.10.13 Personnel

A clear list of personnel is yet to be determined. However, as a minimum, there will be the following:

i) General Manager;
ii) Personnel Manager;
iii) HSE Manager;
iv) Accountant;
v) Legal Officer;
vi) Clerical Staff;
vii) Gatekeepers (running shifts)
viii) Weigh bridge operator and record keeper;
ix) Maintenance mechanics at the workshop;
x) Drivers and operators of loaders, excavators, among others.

In all, a minimum of about over 300 full time personnel will be engaged at the operation stage of this project. Local recruitment will be emphasized, unless the requisite experience and qualification cannot be obtained locally.

3.11 Waste Management

Typically, wastes will be generated in the course of the project's construction and operational activities. The key wastes anticipated include sanitary and domestic wastes on dredgers, gaseous emissions from equipment and machineries, including barges and the dredgers as well as the dredge spoils expected from the dredging of the navigational channel. Hazardous wastes will include spent lube oils, servicing parts (filters, plugs, etc.), paint containers, etc. Dredge spoil will be disposed of within the channel. The process for this is referred to as side-casting. Dredge spoils will be disposed of by dumping them close to the channel being dredged, within the water body. Results of sediment analyses along the water bodies do not indicate any inherent pollution in the sediment. Thus, disposal of dredge spoil in-channel is not expected to lead to release of pollutants into the water column. Also, no alteration of sediment properties (mostly texture and particle size) is expected to occur, as spoils will have very similar characteristics as that of the area where they are to be disposed.

For other waste types, the management of the Bonny Deep Sea Port shall commit to sound and sustainable environmental management and liaise with State environmental protection agencies like the Rivers State Ministry of Environment and Rivers State Environmental Protection Agency for effective waste management during construction and operation. CCECC Nigeria Limited (EPC contractor engaged to work on this project) shall submit a detailed waste inventory and management plan, which shall be approved before the commencement of site activities.

Generally, hazardous wastes will be carefully stockpiled on the dredgers and will be evacuated by certified waste management contractors. Hazardous wastes at jetty sites (spent lube oils, spent batteries, toner cartridges, lighting bulbs and tubes, paint containers, etc.) will be stockpiled at designated areas within the jetty locations. Sanitary wastes shall be treated to meet International standards before being discharged. Other solid wastes will also be handled by certified waste contractors. All machinery and equipment to be used for project activities will be regularly maintained to ensure that they comply with international emission standards.

3.12 Project Schedule

The proposed Bonny Deep Sea Port project is scheduled to take three years to set up to an operational level. Details of the project schedule are tabulated below.

Table 3.8: Project schedule for the proposed Bonny Deep Sea Port project

No.	Month / Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	Investigation & Design																																				
2	Preparation & Mobilization																																				
3	Dredging																																				
4	Land Reclamation																																				
5	Ground Treatment																																				
6	Construction of Berth																																				
7	Construction of Revetment																																				
8	Construction of Backyard																																				
9	Construction of Road																																				
10	Construction of Buildings																																				
11	Auxiliary Facility																																				
12	Installation of Equipment																																				
13	Trail Operation & Handover																																				

CHAPTER FOUR

DESCRIPTION OF THE ENVIRONMENT

4.1 Background Information

This section provides a description of the current environmental conditions against which the potential impacts of the proposed construction and operation of the can be assessed, and future changes monitored. The section presents an overview of the aspects of the environment relating to the surrounding area in which the project will take place and which may be directly or indirectly affected by the proposed project.

The baseline environmental and social conditions were established using available literatures and a one-season field exercise carried in the study area.

4.2 Study Methodology

A one season data gathering exercise was approved by the Ministry which took place within 22nd to 24th November, 2020 (Wet Season) witnessed by Representatives from Federal Ministry of Environment, Rivers State Ministry of Environment as well as Staff of Federal Ministry of Transportation. The wet season field data collected was augmented with dry season secondary data sourced from the Final EIA Report for Bonny Oloma Fabrication Yard Study 2018.

4.2.1 Sampling Design

The sampling was carried out in accordance with the requirements of FMEnv EIA Cap E12 LF 2004. Thirty (30) geo-referenced sampling stations and additional two (2) control points were established for Soil, air Quality and noise sampling within 2km spatial boundary. The samples location distribution map is given in **Figures 4.1** show.

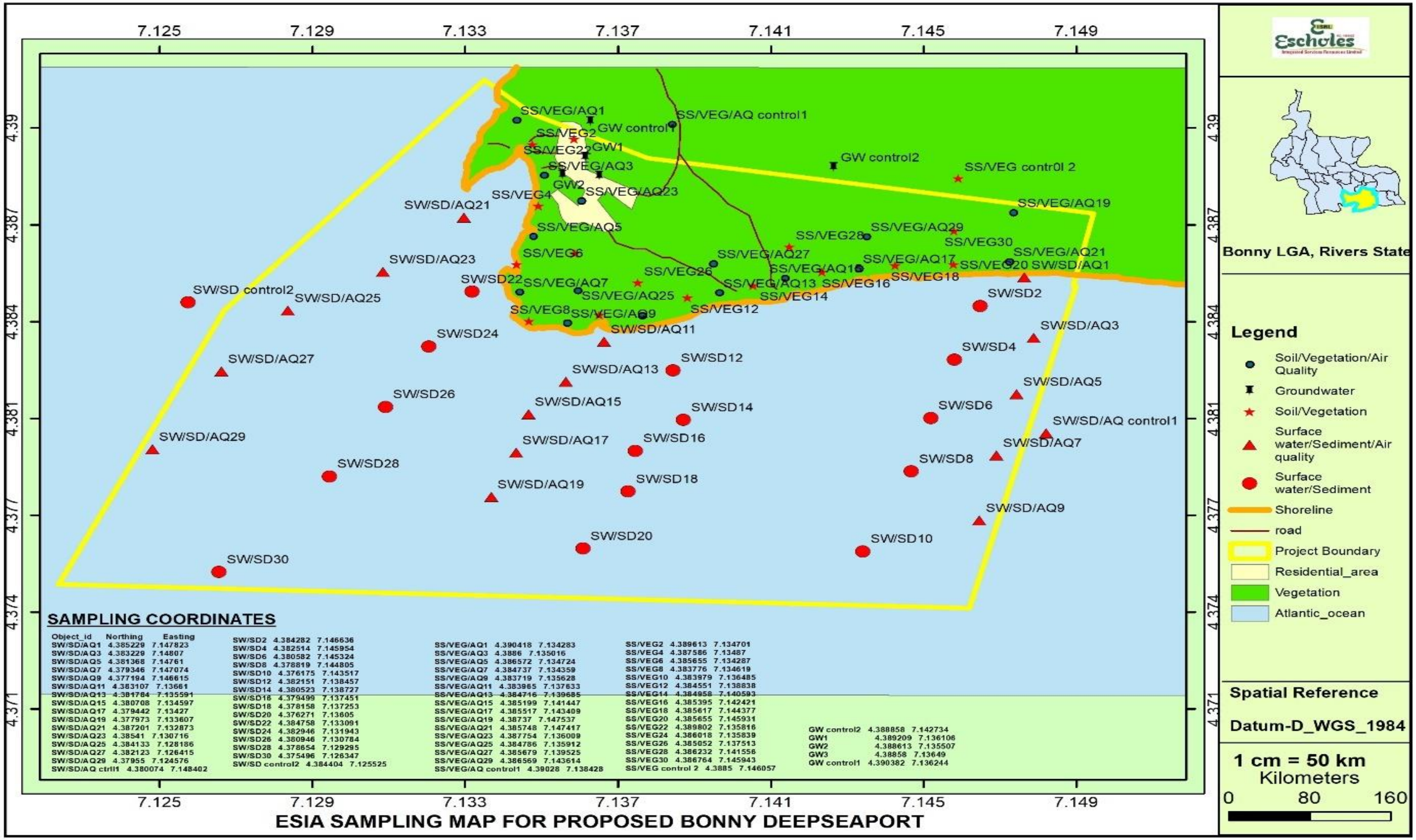


Figure 4.1: Map ***showing sampling stations for air quality, soil and Groundwater. Source: Fieldwork, 2020***

4.2.2 Sampling Equipment and Laboratory Technique

Sample collection, handling, storage, transfer, data coding and documentation followed methods approved by FMEnv and international best practices. All the samples collected on the field were preserved with ice chests and immediately taken to Tudaka Environmental Consultants Limited laboratory which is accredited by FMEnv.

The samples were then stored adequately in designated freezers at <4^{o}C prior to analysis. Laboratory analysis was timely carried out in line with the samples' respective analytical times as recommended in FEPA (1991) ***(Table 4.1)*** and APHA and US EPA,

Table 4.1: Sampling and Laboratory Technique

Parameter	Symbol	Unit	Test method
Physico-chemistry			
pH	pH		in situ
Temperature	T	ºC	in situ
Conductivity	EC	S/cm	in situ
Dissolved oxygen	DO	mg/l	in situ
Salinity	S	‰	in situ
Turbidity	Turb	NTU	in situ
Total suspended solids	TSS	mg/l	APHA 2540D
Total dissolved solids	TDS	mg/l	APHA 2540C
Heavy metals			
Arsenic	As	mg/l	AAS
Cadmium	Cd	mg/l	AAS
Arsenic	As	mg/l	AAS
Chromium	Cr	mg/l	AAS
Copper	Cu	mg/l	AAS
Mercury	Hg	Mg/l	AAS
Ferric iron	Fe^{3+}	mg/l	AAS
Ferro iron	Fe^{2+}	mg/l	AAS
Lead	Pb	mg/l	AAS
Nickel	Ni	Mg/l	AAS
Manganese	Mn	Mg/l	AAS
Cations			
Magnesium	Mg	mg/l	AAS
Potassium	K	mg/l	AAS
Sodium	Na	mg/l	AAS
Zinc	Zn	mg/l	AAS

Parameter	Symbol	Unit	Test method
Aluminium	Al	mg/l	AAS
Anions			
Carbon dioxide	CO2	mg/l	APHA 4500-CO2
Carbonate and bicarbonate	HCO3	mg/l	APHA 2320B
Fluoride	F	mg/l	APHA 4500
Nitrate	NO3	mg/l	APHA 4500
Nitrite	NO2	mg/l	APHA 4500
Phosphorus total	P	mg/l	APHA 4500
Sulphate	SO4	mg/l	APHA 4500
Sulphide	S^{2-}	mg/l	APHA 4500
Organics			
Total Organic Carbon (TOC)	TOC	mg/l	APHA 5310
Dissolved organic carbon	DOC	mg/l	APHA 5310
Total mineral oil		mg/l	EPA 8015
BTEX	BTEX	mg/l	EPA 8260
Phenol		mg/l	APHA 5330C
Chemical oxygen demand	COD	mg O2/l	APHA 5220B
Biological oxygen demand	BOD	mg O2/l	APHA 5210B
Polycyclic aromatic	PAH	mg/l	EPA8260
Macro and Micro-biology			
Chlorophyll		mg/l	UV
Bacteria count		(cfu/100ml	APHA 9215C

4.2.3 Sampled Parameters

Abiotic and biotic components were studied; they include climate/meteorology, air quality and noise, soil, vegetation, animal ecology, geology, hydrogeology, socio-economics and health status. During sampling, in situ measurements were conducted for parameters with short holding analytical time, samples were also collected for laboratory analysis.

4.2.4 Abiotic Component

a) Climate and meteorological studies

The purpose of the climatic and meteorological study is to establish meteorological conditions in-and-around the study area. The climatic characteristics of the study area relating to the following were extracted from historical and field sampling data. The following data were collected:

a) Temperature

b) Relative humidity

c) Wind speed

d) Wind direction

A hand-held battery powered high precision Skymaster (SM 28) pocket Weather Tracker, made in the USA was used for data collection for wind speed, humidity, temperature and wind direction (i.e. microclimatic data). Although the microclimatic data was acquired via field measurement, macroclimatic data (long term data) was acquired from the database of the Nigerian Meteorological Agency (NiMet) and World Meteorological Organization (WMO).

A weather station was set up at the same sampling stations for soil sampling during the field survey. Sampling was allowed to run for a minimum of 30 minutes in order to establish a microclimatic data of that particular station. All precautions taken when setting up a weather station and during measurements were observed for the onsite measurements according to the World Meteorological Organization (WMO) standard. These include setting up the weather station away from obstacles like buildings and tall vegetation, using an instrument shelter to display all temperature sensitive instruments, orienting the instrument shelter so that the sun's radiation does not fall directly on the instrument during reading and setting up the weather station in an area representative of the study area's totality. **Table 4.2** below presents weather data acquisition techniques.

Table 4.2: Weather Study Equipment

Climatic Variable	Instrumentation/Method
Air temperature	Dry bulb thermometer
Relative humidity	Psychrometer/hygrometer
Wind speed	Anemometer
Wind direction	Wind vane
Cloud Cover	Direct observation

b) Ambient air quality and air borne noise level investigations

Gases that are of environmental importance such as toxic gases, greenhouses gases and ozone depleting gases were examined. Portable AEROQUAL Air Quality Monitor (Series 300 Model) was used for air quality determination. Pollutant gases such as NOx, SOx, NH3, H2S, CO and VOC were determined. The analyser contains sensor for each gas and each sensor analyse the quality of the respective gases in the ambient air. It is a digital meter, which reads parameters at a time weighted average. An EXTECH instrument (USA), model 407730 Sound level meter with high sensitivity was used, the instrument can measure as low as 30 dB (A) and as high as 150 dB (A). **Plate 4.1** below shows in situ sampling.

Plate 4.1: Air quality sampling station in the proposed Project location - 1: Particle Counter (SPM), 2: GPS, Test kits, etc., 3: Multi Gas Meter and 4: Noise Meter and Weather Tracker

c) Water quality investigations (groundwater water)

Groundwater samples were collected from 5 boreholes within the proposed project area and immediately analysed for parameters with short holding analytical time such as pH, dissolved oxygen (DO), temperature, and turbidity. However, there was no surface water within the 2 km spatial boundary of the proposed project area. All sampling was carried out in line with standard quality control/quality assurance procedures. ***Plate 4.2*** below shows in situ measurement of groundwater pH using a hand held Hanna pH meter during the field sampling.

Plate 4.2: pH meter being used for in situ measurement of water quality

d) Water Sampling (Surface water)

Seawater samples were collected at the surface of the water column at the sampling stations with the use of a water sampler. Some parameters (pH, temperature, dissolved oxygen, salinity, turbidity and conductivity) were measured in-situ using a Hanna Multi-parameter meter and measurements for dissolved oxygen (DO) were double checked with dissolved oxygen test kit. Samples for microbiology analysis were aseptically collected into sterile universal plastic bottles and stored below 4^oC for transportation to the laboratory. Water samples were also collected for other measurements that could not be made in situ (e.g., heavy metals, nutrients, hydrocarbons and others).

e) Seabed Sampling

Sediments were sampled at the stations using a Van-Veen grab sampler with a sampling surface area of 0.12m2. At each of the sampling stations, two grab samples were collected. The top 2cm of the sample was sub-sampled for microbiology, metals, hydrocarbons and nutrients, all of which were stored in appropriate containers. The remaining sediment in the grab was carefully scooped into a bowl and washed through a sieve of mesh size 0.5mm with seawater. Sieving was carried out with great care with the salt water. The residues were washed into 1L wide mouthed plastic bottle appropriately labelled and fixed with 10% buffered formalin for later analysis in the laboratory.

Plate 4.3: Grab deployment

f) Plankton Sampling

Samples were collected using standard plankton net of 55µm mesh size. Both qualitative and quantitative samples were collected. The qualitative samples were collected by towing the net at about 3knots for 5 minutes at every station. The concentrated samples collected were preserved separately in buffered 4% formalin in appropriately labelled plankton bottles.

Plate 4.4: Planktons Sampling

e) Soil quality investigation

To ensure a representative sampling, soil samples were collected from 3 cores from each sampling point at depths of 0-15cm and 15-30cm for top soil and sub soil respectively ***(Plate 4.3).*** Samples were collected with stainless screw type soil auger into plastic bags for physicochemical and microorganism analysis. Separate samples were also collected into aluminium foil hydrocarbon content determination

Plate 4.5: Soil sampling showing 3 cores where representative samples collected

4.2.5 Biotic Components

f) Vegetation and Wildlife Studies

- ***Sampling Technique for Floristic and Faunal Data Collection***

Floristic data were collected using systematic sampling technique with 6 quadrats of one square meter each at each sampling location for assessment of herbaceous flora. Sampling for faunal species followed point sampling design, and walking along foot paths was used (Walsh and White, 1999). Data collected on faunal species included species composition of each sampling location.

- ***Species Identification***

Identification of species was done in situ and all identification were done using available literatures like Akobundu and Agyakwa (1998); Johnson (1997) for herbaceous flora; and Dalziel and Hutchinson (1979) and Keay *et al.* (1967) for woody flora. Identification of faunal species was done using Adeyanju *et al.* (2012)

- ***Data Analyses***

All quantitative data were subjected to Relative Importance Values analysis following; Kent and Coker (1992) and Olubode *et al* (2009). Multivariate analyses for ordination and phytosociology of species and stands describing the ecology of the sampling stations followed Hammer *et al.* (2001) using Paleontological Statistics (PAST) 2.14 version software for detrended correspondence and cluster analyses. Two-Way Indicator Species Analyses (TWINSPAN), 2012 version software was used for determination of phytosociology of the flora (Hill, 1994, 2012).

g) Fish and Fisheries Studies

Fish and fisheries studies were carried out based on an extensive review of relevant available literature of fish landing sites in the Coastal Communities of the project area. Information obtained from the literature and field studies included but was not limited to:

- Fishing grounds
- Fishery types
- Fish species and seasonality
- Fish economics

Fisheries studies investigated fish species composition, diversity, economic importance, harvest methodology, fishing activities and fish sales. These were carried out through inspection of catches by local fishermen at the landing sites, administration of questionnaires, interviews of fishermen in the communities regarding catch composition and market survey including interview with middlemen about the source of the fishes and income regime.

g) Microbiology

Soil and groundwater samples were collected into sterile plastic bottles and polythene bags, kept at 2 - 6^{o}C and analyzed for microbial contents.

- ***Heterotrophic Bacterial Counts***

The total heterotrophic bacteria in the groundwater samples were enumerated using modified yeast extract agar (Cruickshank *et al*, 1975). Bacteria isolates were identified according to the scheme for Buchanan and Gibbons (1974).

- ***Determination of Fungal Content***

The total fungal counts in the groundwater samples were determined using Emmons, Binford and Utz's modified Sabouraud Dextrose Agar. Isolated fungi were identified based on the associated spores and mycelia and their growth characteristic on the isolation medium.

- ***Determination of Percentage Petroleum Degrading Bacteria and Fungi***

The petroleum degrading bacteria were enumerated on petroleum agar medium, while chloramphenicol was added to this medium for the selective isolation and enumeration of petroleum degrading fungi. Any bacteria or fungi growing on these media were regarded as petroleum utilizers or degraders. The percentage of these counts on the total heterotrophic bacteria or fungal counts were then calculated to obtain the percentage petroleum degrading bacteria and fungi respectively in each sample.

4.2.6 Quality Control/Quality Assurance (QA/QC) Procedures

QA/QC procedures cover all aspects of the study, including sample collection and handling, laboratory analyses, generation of data and coding, data storage and treatment and report preparation.

- ***Sample Collection and Handling***

In preparation for fieldwork, glassware to be used were washed with detergent solutions, rinsed with tap water, then soaked in 1:3 nitric acid solutions for 24 hours to remove organic materials, washed again with tap water and rinsed with distilled water. Plastic containers were washed with detergents, rinsed with tap water, followed by distilled water. After drying, all the containers were rinsed with acetone to remove organic materials, and rinsed with distilled water. Aluminium foils were obtained for soil and sediment samples. Sampling equipment was rinsed with portions of the water to be sampled. Samples per sampling point were taken with thoroughly cleansed containers. Sterile wide-mouth polypropylene and Pyrex glass sample bottles were used. Samples for oil and grease were collected in clean and dry glass-stoppered bottles and were usually not completely filled to avoid losing oil when the stopper was inserted.

- ***Sample Identification***

Specific details on sample identification were entered on a permanent label to reflect node, date, sample matrix, sampling point, sample number, depth etc.

- ***Laboratory Analysis and Generation of Data***

Possible sources of error in laboratory analysis include contamination of reagents and materials, lack of sensitivity of equipment, lack of calibrations, poor data entry and interpretation. Glassware and other containers used for each analysis were thoroughly cleansed as appropriate for each parameter. All glassware used for oil and grease determination was pre-rinsed with Analar grade xylene. Glassware for determination of metals were pre-soaked in dilute nitric acid and then rinsed well with distilled water. All reagents and chemicals of high purity (mostly Analar grade) were used. Freshly distilled water prepared in our laboratory was used for all dilutions.

The various instruments and equipment for measuring physico-chemical parameters used were in good working condition. Periodic control checks were usually carried out on such instruments/equipment and the performance record maintained. The pH meters were calibrated using HACH commercial buffer standards. Appropriate colour standards of diluted potassium dichromate or potassium permanganate solutions are frequently used to check the wavelength settings and sensitivities of the absorption spectrophotometer. For analytical determination requiring the use of calibration curves, such curves were plotted using standard solutions prepared from analytical grade reagents. Records of such calibration curves were maintained and frequent re-calibration checks were carried out. Analytical blanks were incorporated per specific batches of samples to compensate for the sample preparation and determination steps. All the analyses were replicated and the means reported. The samples were analysed at Tudaka Environmental Consultants Limited laboratory.

- ***Storage/Preservation***

Samples were stored in ice-chest as a cooling device and transported to the laboratory where they were refrigerated at 4°C or kept in a freezer as appropriate. Samples for heavy metal analyses were preserved with 1:1 nitric acid and oil and grease with 1 ml of 1:1 H_2SO_4 as soon as they were collected. Adherence to good preservation procedures ensured that errors were not introduced into the analytical process.

- ***Chain of Samples Custody Procedure***

There is a Master Register for all samples brought into the laboratory. Following registration of the sample, a sample data sheet containing pertinent information on the sample was opened for each sample. The information includes:

a) Sample reference number;
b) Nature or type of sample;
c) Site of collection;
d) Date and time of collection; and
e) Mode of preservation (depends on nature of material) and analytical data from the field and results of laboratory analyses of representative samples.

Appropriate methods were used in storing the remaining stock materials and sub samples. Samples for storage were kept in labelled compartments on shelves in a storage room. Samples sent to co-operating laboratories were recorded in the Master Register and accompanied by essential data pertaining to the sample material.

- ***Evaluation of Results***

Raw data obtained from the instrumental measurements were used in calculating the concentrations of the various parameters, using standardized formulae. All such calculations were crosschecked. Outlying values were deleted from the replicate data before calculation of mean concentrations. A quick identification of results, which deviate from the normal trend, was usually done. The sum of the anion concentration in meq/l should be equal to the sum of the cations concentration also in meq/l. Differences within 5% are acceptable.

$$\% \text{ Difference} = \frac{\text{(Cations) minus (anions)}}{\text{(Cations) plus (anions)}}$$

Also, calculated and observed conductivity measurements and IDS data were compared, to check reliability and accuracy of data. The laboratory analytical methods used were those recommended by FEPA, 1991.

4.3 Socio economics

4.3.1 Socioeconomics and health data collection

The socio-economic data gathering involved the use of some techniques like interview schedule, survey question administration, key informant interview and focus group discussion (FGD). These techniques are found to be useful in participatory rural and learning appraisal techniques. Firstly, the conduct of preliminary investigations during which the extent of the intended area to be surveyed (within 5km radius to the proposed project site) while other major community more than 5km away was also consulted with to ensure good rapport is established with the resident of the Bonny Kingdom.

Consultation was carried out to solicit stakeholders' views on the proposed actions and their input on issues relating to the potential environmental, ecological and socio-economic impacts of the Proposed Bonny Deep Sea Port Project. Consultations would be sustained throughout the phases of the project implementation with the authorities of the Rivers State Government, the Bonny King (Amanyanabo) and the Bonny Council of Chiefs, the leaders of the Bonny Local Government Area, and representatives of the neighboring communities (Oloma, Ayaminima, Bonny, Finima, communities etc.).

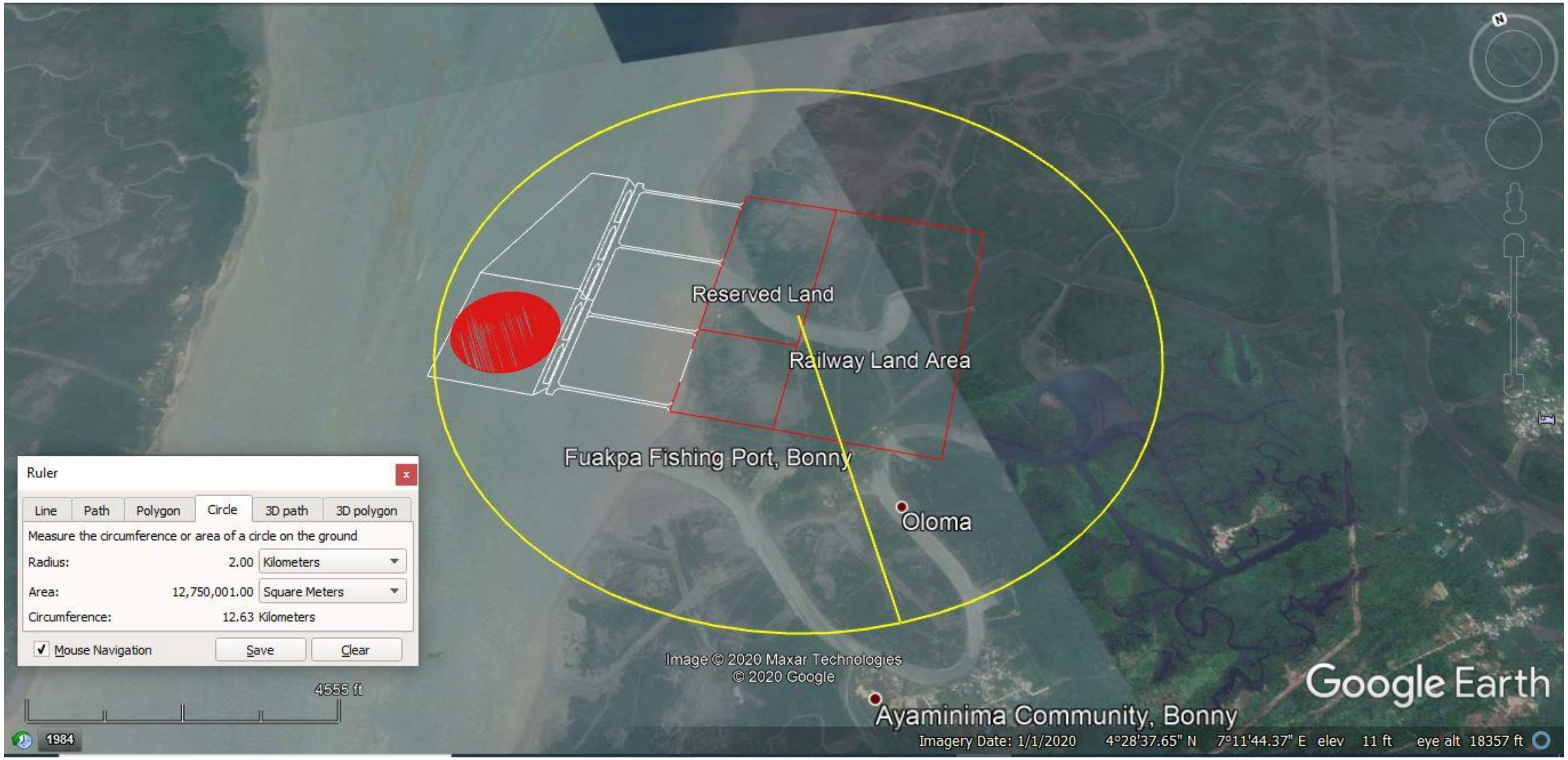


Figure 4.2 Google Earth Imagery showing closest community to the Project Area

4.3.2 Public Health Assessment

Ethnographic research design was adopted for the study through stratified random sampling technique. The choice of stratified random sampling technique was informed by the observed dispersed settlements in the area of project influence. The adoption of stratified random sampling, therefore, was inevitable in order to gauge the health status of the people as well as their disparities in opinions and attitudes regarding the impact of the proposed thermal plant on the health of the people that are likely to benefit from the project. Secondary data were collected from the following institutions: Department of Health, Bonny Local Government Area, Model Primary Health Centre and a private health centre both located in Bonny.

The health status of the communities in the project area was carried out and determined by means of baseline health data collected from below:

(i) Local health statistics from the health centres and clinics.

(ii) Consultation process with major stakeholders.

(iii) Field data in relation to:

- Water Supply.
- Waste Disposal.
- Refuse Disposal.
- Health Institutions
- Immunization status

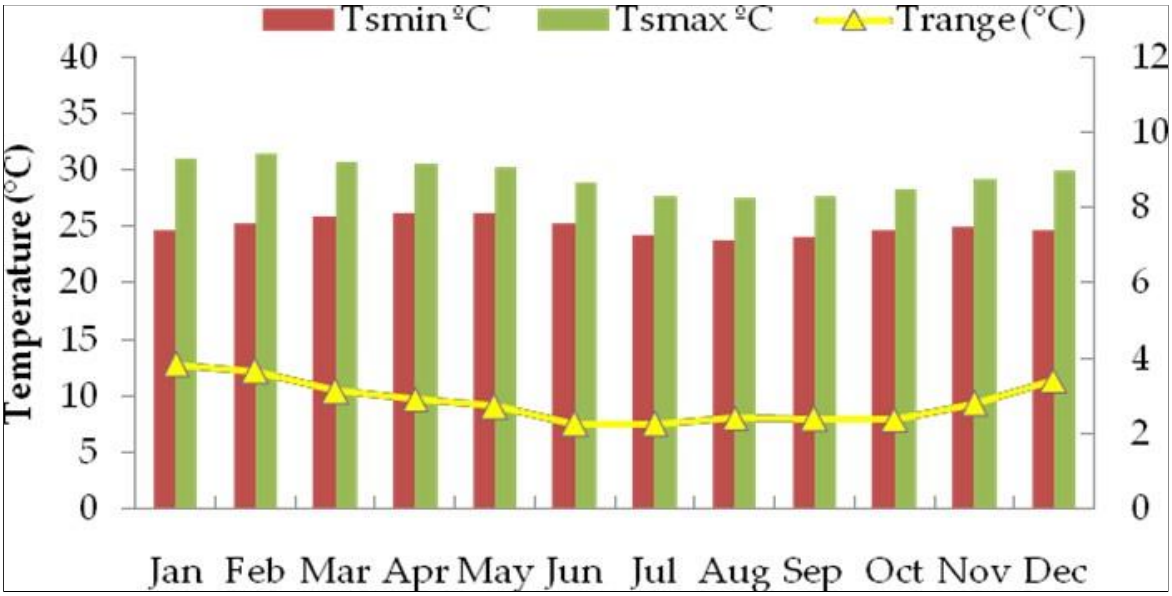
4.4 Baseline Environmental Conditions

4.4.1 Climate and Meteorology

The study area is located in the humid tropical Niger Delta region of Nigeria, characterized by distinct wet and dry seasons. The dry season occur between November and March while the wet season is from April to October. The climatic information for the project area is based on the analysis of the climatic data of the study area collected from NIMET Port Harcourt, for Port Harcourt and Bonny. The climatic data spanned from 1983 to 2018. Meteorological data were also collected at thirty-two locations within the study area during the field data gathering process.

Temperature

Latitude is the main determinant of temperature. Other determinants like atmosphere, ocean currents, and altitude also influence temperature. The type and density of clouds influence the amount of solar radiation that reaches the Earth's surface. Some parts of Nigeria often experience overcast skies during the wet season. One of such areas is Port Harcourt in the southern part of the country. The amount of solar energy received, and the extent of energy losses drives a climatic system. Warm tropical ocean currents hardly affect Nigeria's temperature regime so also altitude does not alter the temperature regimes in Nigeria. Nigeria experiences consistent high temperatures all year round between 25-31ºC. The extreme coastal areas recorded temperatures in the range of 30.0 – 32.0°C according to Nigeria Climate review 2010 (NIMET, 2018). Furthermore, the southern region recorded minimum temperatures ranging from 20.0 to 24.1ºC.



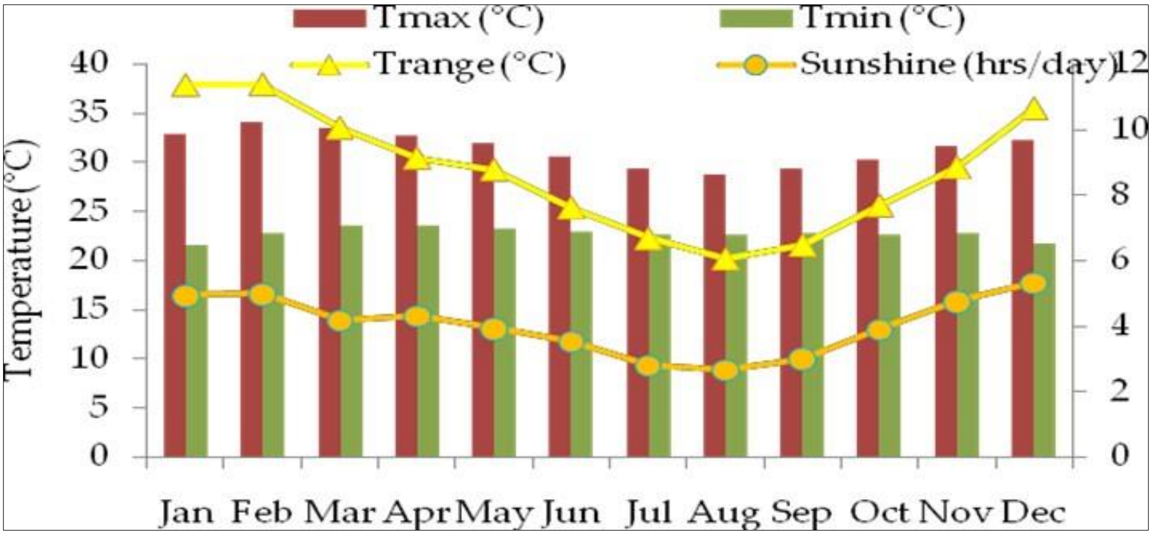


Figure 4.3: Monthly Average Minimum and Maximum Temperatures, Temperature Range and Sunshine Hours for Port Harcourt/Onne/Bonny Axis (a) 10m above the Earth (NASA) (b) Temperatures on the Earth's surface (NIMET)

Climate change is a change in the state of the climate that can be identified (eg. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period typically decades or longer" IPCC (2007). Climate fluctuations or climatic variability occurs on shorter temporal scale. The most crucial things about the concept of climate change is not only the time periods involved but also the degree of variability that the change is subjected to as well as the duration and impact of such variability on man and the ecosystem. In the tropics, the lowest temperature during each day described as minimum temperature is experienced during the night while maximum temperatures are recorded during day time. In the Port Harcourt/Onne/Bonny axis and in Nigeria as a whole, the highest maximum temperatures are recorded in February, while the lowest maximum temperatures are recorded during the month of August. The 22 year average monthly temperatures for the period 1983 – 2018 from NiMET is shown in **Figure 4.2a** while that of the period 1993 – 2001 including sunshine hours from NIMET is shown in **Figure 4.2b** . The annual temperature pattern in the two figures is essentially the same as described in the preceding paragraph for Port Harcourt/Onne/Bonny axis and in Nigeria as a whole. The only difference between them is the daily temperature range which is about 4°C for the dry season and drops to a low of 2.2°C in the wet season as compared with the respective 11°C and 6°C for the NIMET data.

Rainfall

Rainfall distribution both spatial and temporal is the single most important factor in differentiating seasons in the tropics. Rainfall occurrence and distribution in Nigeria are however dependent on the two air masses that prevail over the country. The Nigeria Climate Review 2010 noted that the southern part of the country experienced rainfall between 3000 – 4500mm. Some areas recorded higher than normal rainfall conditions and included some areas in the southwest and Ogoja, Calabar and Eket in the southeast. In 2018, the highest daily rainfalls of 199.5mm, 184.6mm and 183.8mm were recorded at Uyo (June), Benin (September) and Umuahia (June) respectively (NIMET, 2018).

Table 4.3 shows the pattern of rainfall during the dry season (November - February) and wet season (March - October) which is typical of tropical rain forest covering Port Harcourt, Onne and Bonny areas. The Table indicates the mean annual rainfall for Port Harcourt to be 2370.5mm and that of Onne/Bonny to be 2438.4mm. Warri has the highest annual rainfall of 2907.8mm in the Niger Delta followed by Calabar (2903.8mm) and Onne

Table 4.3: Summary of Rainfall Statistics for Selected Stations in the Niger Delta

S/N	Station	Mean Annual rainfall(mm)	Nov-Feb rainfall(mm) (% of Annual)	Mar - Oct rainfall (mm) (% of Annual)
1	Benin	2087.2	145.8 (7.05%)	1939.9 (92.95%)
2	Sapele	2391.5	167.5 (7.03%)	2223.4 (92.97%)
3	Warri	2907.8	228.7 (8.18%)	2578.0 (91.82%)
4	Port Harcourt	2370.5	237.9 (9.77%)	2138.9 (90.23%)
5	Onne/Bonny	2438.4	222.4 (8.74%)	2225.3 (91.26%)
6	Opobo	3816.8	370.4 (9.44%)	3456.4 (90.56%)
7	Calabar	2903.8	304.1(10.75%)	2591.5 (89.25%)
8	Uyo	2142.2	142.1 (5.48%)	2007.7 (94.52%)

Source: Adapted from Ologunorisa and Adejuwon, 2010

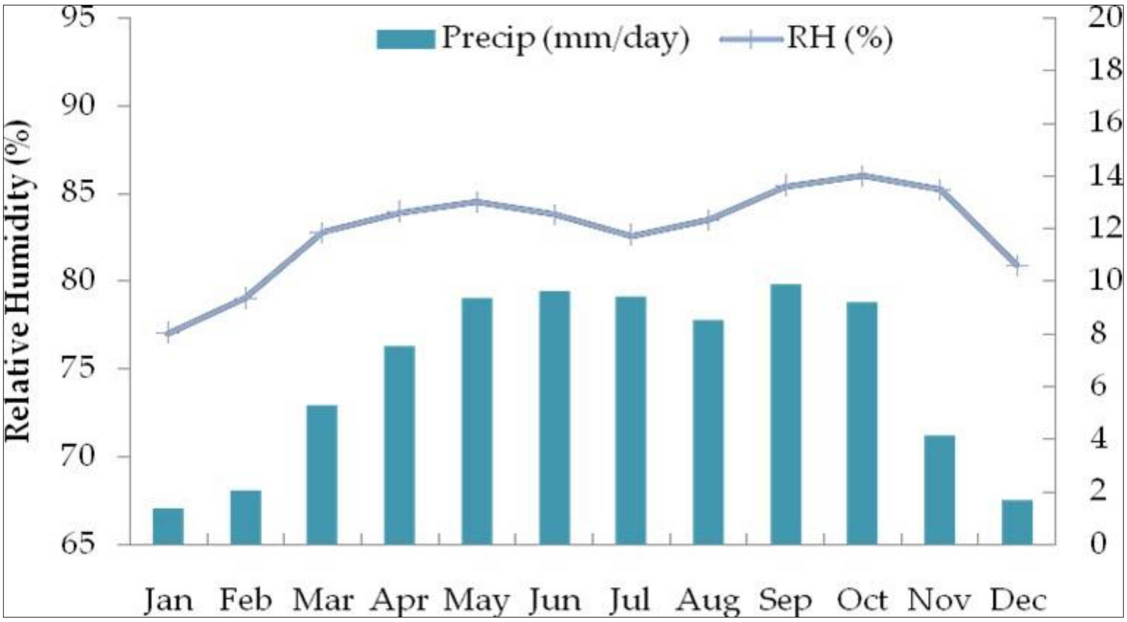
Table 4.4: Mean Monthly Rainfall and Number of Rainy Days in Port Harcourt (1993-2018)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall(mm)	15.8	40.7	105.8	165.8	217.0	310.3	365.2	232.0	351.8	275.4	104.7	31.7	2216.2
Rainy days	2	4	8	10	14	19	22	19	21	19	8	3	149

Source: NIMET

Relative Humidity

The composite relative humidity curves in **Figure 4.3 (a and b**) show that mean monthly relative humidity is consistently high in the eighties with no month experiencing values greater than 88%. As expected, mean monthly relative humidity values are slightly high for the wet season months (approximately March to November) with the highest values occurring within the months of July to August. This is when the influence of the moisture-laden South- westerlies is greatest. In the dry season relative humidity drops to the high seventies



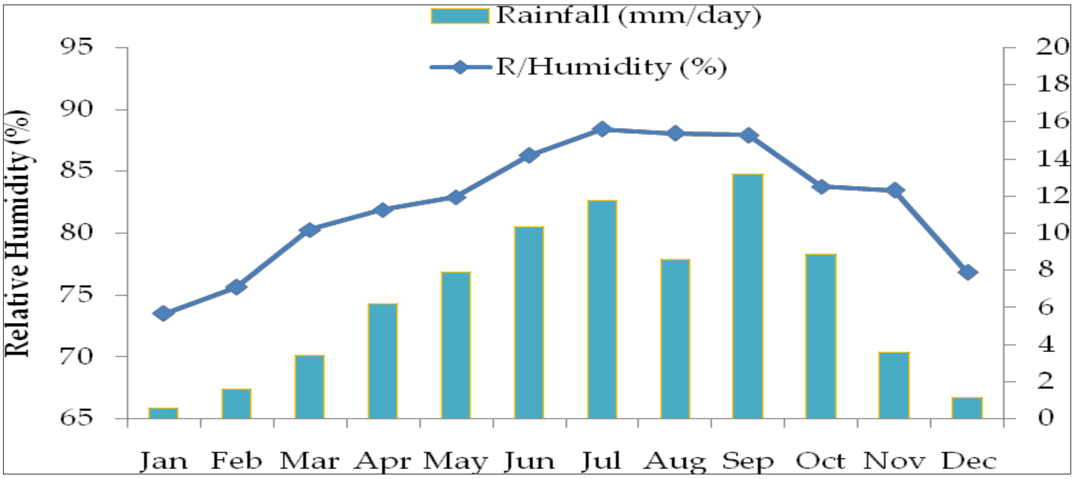


Figure 4.4: Daily Average Rainfall and Relative Humidity, for Port Harcourt/ Onne/Bonny Axis (a) 10m Above the Earth (NASA) (b) Earth's Surface (NIMET)

Wind Pattern

The wind pattern also follows the migratory Inter Tropical Discontinuity (ITD). Thus, it is mainly southwesterly during the rainy season and the northeasterly during the dry season. In general, a long low southwesterly swell is prevalent. During the wet season, this swell together with the characteristic rough sea becomes high, especially during heavy squalls. The wind speed varies between 1.5 and 3.9 m/sec. around the coast for most of the year with an average speed of 2.3m/sec. Incidences of severe windstorms are now more frequent with some rare occasions being as high as 8 - 10 m/sec. These are often associated with thunder and lightning especially during the changing season (**Figure 4.5**).

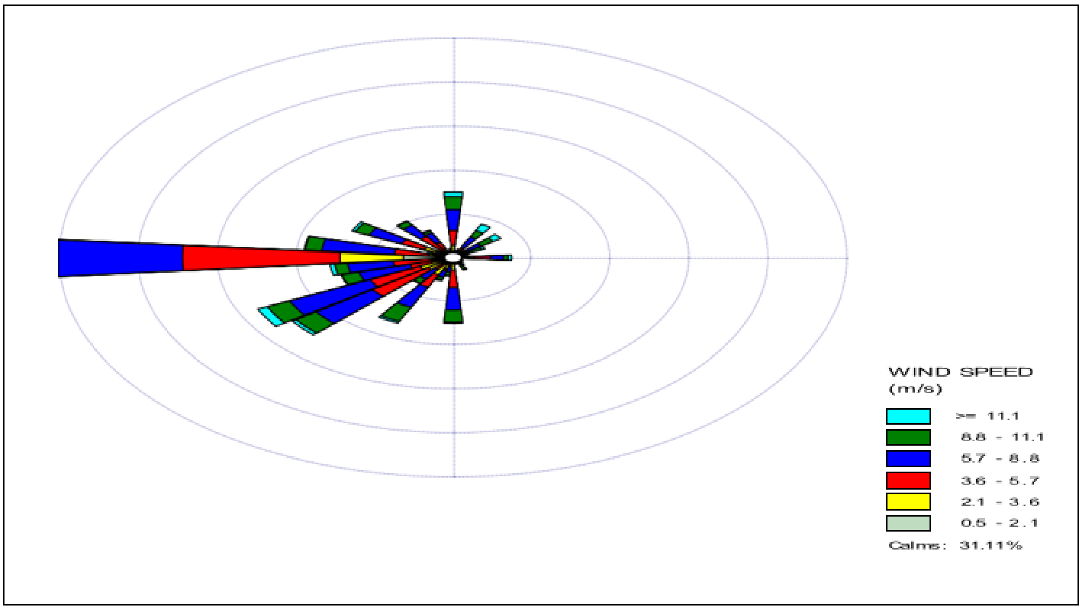


Figure 4.5: Wind Rose of Port Harcourt for the Period of 1983 – 2018 (Source: NIMET 2018)

a) Site-Specific Micro Climate

The measured daily averages of relative humidity, temperature and wind speed within the project site during the field data gathering of are presented in **Table 4.5**. Temperatures were moderate in the study area during the field data gathering and ranged from 31.9-35.4^{o}C with a mean value of 33.4 ^{o}C. However, these values were relatively higher when compared with the historical data (**Table 4.5**) for the period study.

Table 4.5: Summary of Microclimatic Conditions of Bonny Deep Study Area

Parameter	BONNY DSP ESIA (WET)			Bonny Oloma EIA (Dry) (2018)	Historical Data
	Min	Max	Mean	Mean	NIMET/NASA
Relative Humidity (%)	65	83	75.469	69.8	>65 in (Dec.)
Wind Speed (m/s)	2.9	7.1	4.813	1.5	1.5 - 3.9 m/sec. most and as high as 8 – 10 m/sec.
Temperature (oC)	31.9	35.4	33.369	33.1	25-32ºC (Dec)
Wind Direction	SW	SW	SW	SW	SW, SSW, NE

Source: Bonny, ESIA Field Work, 2020

The table indicates that the average relative humidity ranged from 65. - 83 % during the period of measurement and gives a reflection of the historical data obtained for the study area. Wind velocities recorded during the study varied from 2.9-7.1m/s with a mean value of 4.81m/s. These values compared favourably with the historical data obtained for the study area as strong south-westerly wind predominates during this study, especially at the near shore.

4.4.2 Air Quality

A summary of the air quality measurement in Bonny is presented in **Table 4.6** while the detailed results are in the Appendices. The sampling map is as shown in **Figure 4.5.**

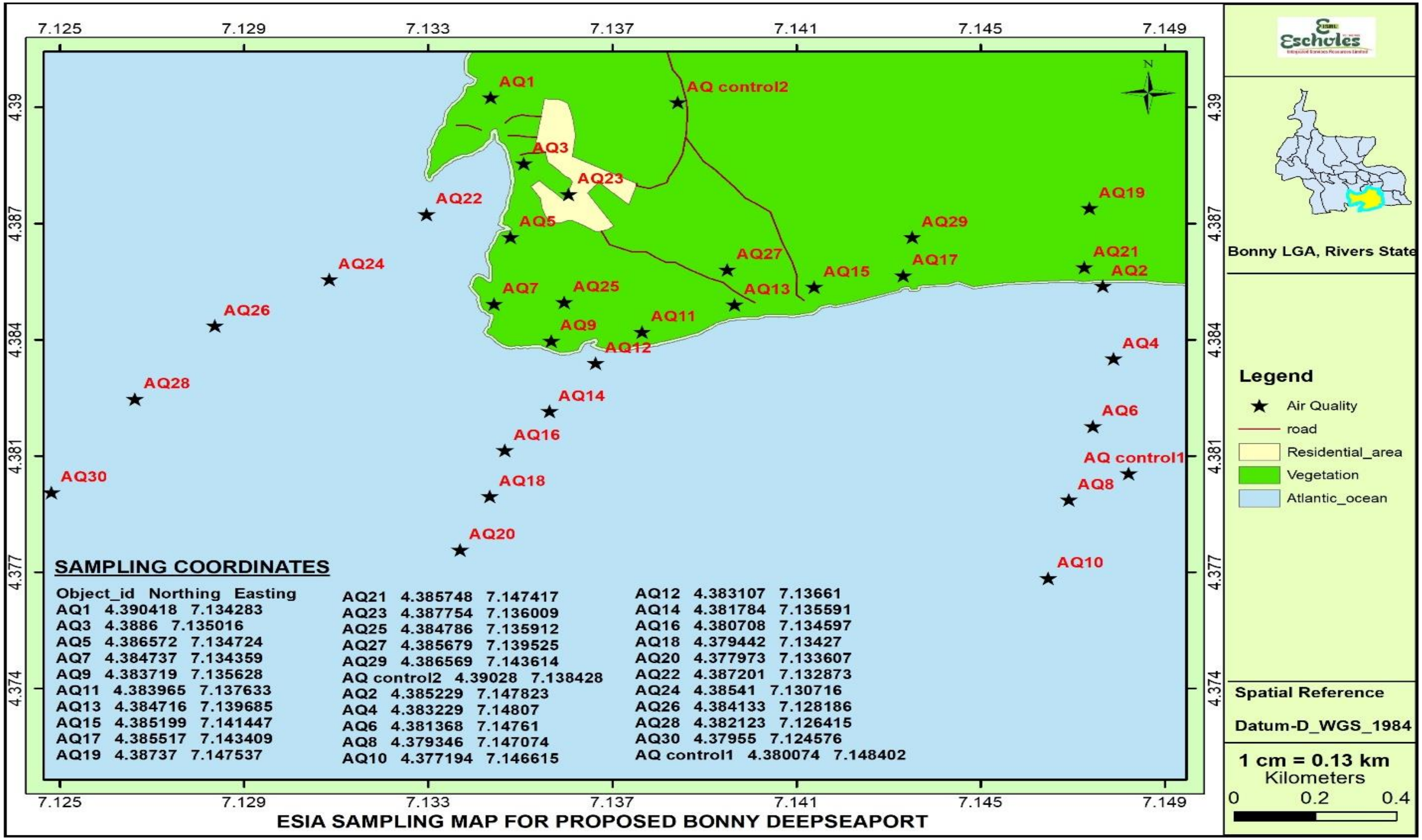


Figure 4.5: Air Quality Sampling Map

Volatile Organic Compounds (VOC)

VOC is an aggregate parameter defining volatile hydrocarbon species. These are airborne and are usually composed of low and intermediate molecular weight hydrocarbons. The concentration of volatile organic compounds in the air was very low and had a mean value of 0.341ppm (0.1-0.8ppm). The concentrations were below the FMEnv limit of 160ppm.

Total Suspended Particulate (TSP)

This is the term for a mixture of solid particles and liquid droplets found in the air such as dust, dirt, soot, smoke. These are grouped as 'inhalable coarse particles' with diameters ranging between 2.5 pm and 10 pm; and 'fine particles' having diameters less than 2.5pm. They can also deface cultural and traditional artefacts, monuments and buildings. On a macro-scale, particulate matter affects the earths-atmospheric heat balance by disturbing the evaporation-condensation cycle (Pope *et al,* 1999). TSP determination yielded results within the range of 5.8ppm to 20.7ppm (mean=10.26) while the $PM_{2.5}$ and PM_{10} yielded results within the range of 0.3ppm to 4.9ppm (mean=2.17ppm) and 3.7ppm to 14.8ppm (mean=7.56ppm) respectively. The $PM_{2.5}$, PM_{10} and TSP concentrations determined were far below the World bank limit of 25ppm for PM2.5 and 80ppm for PM10. TSP levels were also lower than FMEnv limit of 250ppm.

Oxides of Nitrogen (NOx)

Nitrogen dioxide (NO_2) is a suffocating brownish gas that belongs to a family of highly reactive gases called nitrogen oxides (NOx). It results from high temperature combustion of fuel and occurs mainly from motor exhaust and stationary sources such as electric utilities and industrial boilers. It is a strong oxidizing agent that reacts with air in the presence of water to form corrosive nitric acid, as well as toxic organic nitrates. It plays a major role in the atmospheric reactions that produce ground level ozone or smog. Exposure to NO_2 concentrations higher than regulatory limits could alter pulmonary immunologic responses and may increase susceptibility to bacterial infection such as influenza. Levels of NO_2 above 563g/m^3 may cause pulmonary diseases in man and animals. The NOx detected from all the sampling locations ranged from 0.01ppm to 0.04ppm and were all below the FMEnv limit which is 113 ppm.

Oxides of Sulphur (SOx)

SOx is the group formula for oxides of sulphur such as SO and SO_2 which usually occur as both primary and secondary air pollutants. Power plants and other equipment that burn fossil emit these species as primary pollutants. In addition, biological decay processes and some industrial sources emit H_2S which is oxidized to form the secondary pollutant, SO_2. The combustion of fossil fuels containing sulphur yields SO_2 in direct proportion to the sulphur content of the fuel.

The primary threat of SO_2 to urban atmosphere may arise not from SO2 itself but from the changes it undergoes in the atmosphere such as the formation of sulphuric acid (H_2SO_4), a reaction which is catalysed by particulate matter; and the formation of sulphate aerosols. SO_2 can also be absorbed on small particles such as the salts of iron, manganese and vanadium present in the atmosphere and thus enter the alveoli of the lungs. SOx concentration (0.01-0.05ppm) were detected below the FMEnv limit of 260ppm.

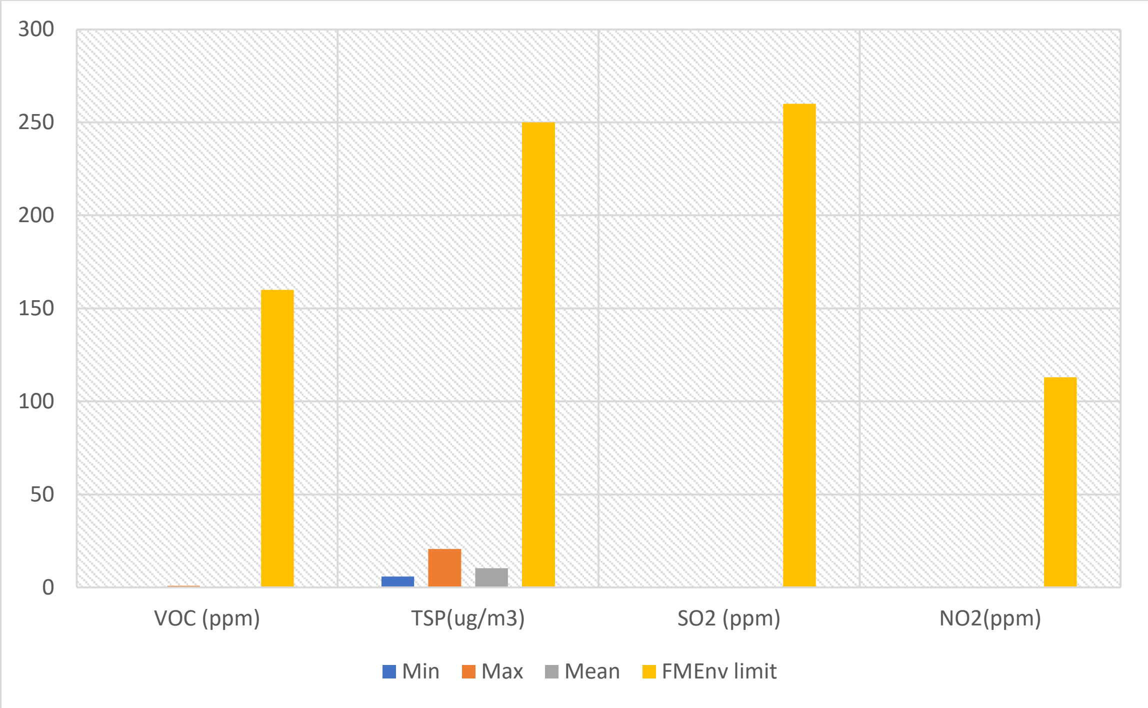


Figure 4.6: VOC, TSP levels, SO_2 and NO_2. Source: Fieldwork, 2020

Carbon monoxide (CO)

CO is a colorless, odorless gas emitted from combustion processes of fossil fuel. In urban areas, the majority of CO emissions to ambient air come from mobile sources. At extremely high levels, CO can cause death (Kao, 1994). In the study area, CO concentration obtained ranged from 0.1ppm–1.4ppm (mean=0.631) The CO concentrations detected were far below the FMEnv limit of 22.8ppm.

Hydrogen Sulphide (H_2S)

H_2S is known to be immediately dangerous to life and health (IDLH). It has a pungent smell when in low concentration, but at a high concentration, the odour will no longer be detected by human nose. Hydrogen sulphide has both natural and man-made sources (such as biodegradable waste sites). Hydrogen sulphide does not have regulatory limits, because it is a “non-criteria” pollutant. H_2S concentrations were above FMenv limit (0.008ppm) in the some locations sampled as values ranged between <0.01ppmto 0.03ppm.

Ammonia (NH_3)

Ammonia or azane is a compound of nitrogen and hydrogen with the formula NH_3. It is a colourless gas with a characteristic pungent smell. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to food and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals and is used in many commercial cleaning products. Although common in nature and in wide use, ammonia is both caustic and hazardous in its concentrated form. The NH_3 values detected from all the sampling locations ranged from values below equipment detection limit (<0.01ppm) to 0.02ppm which are all below the FMEnv limit of 0.28ppm.

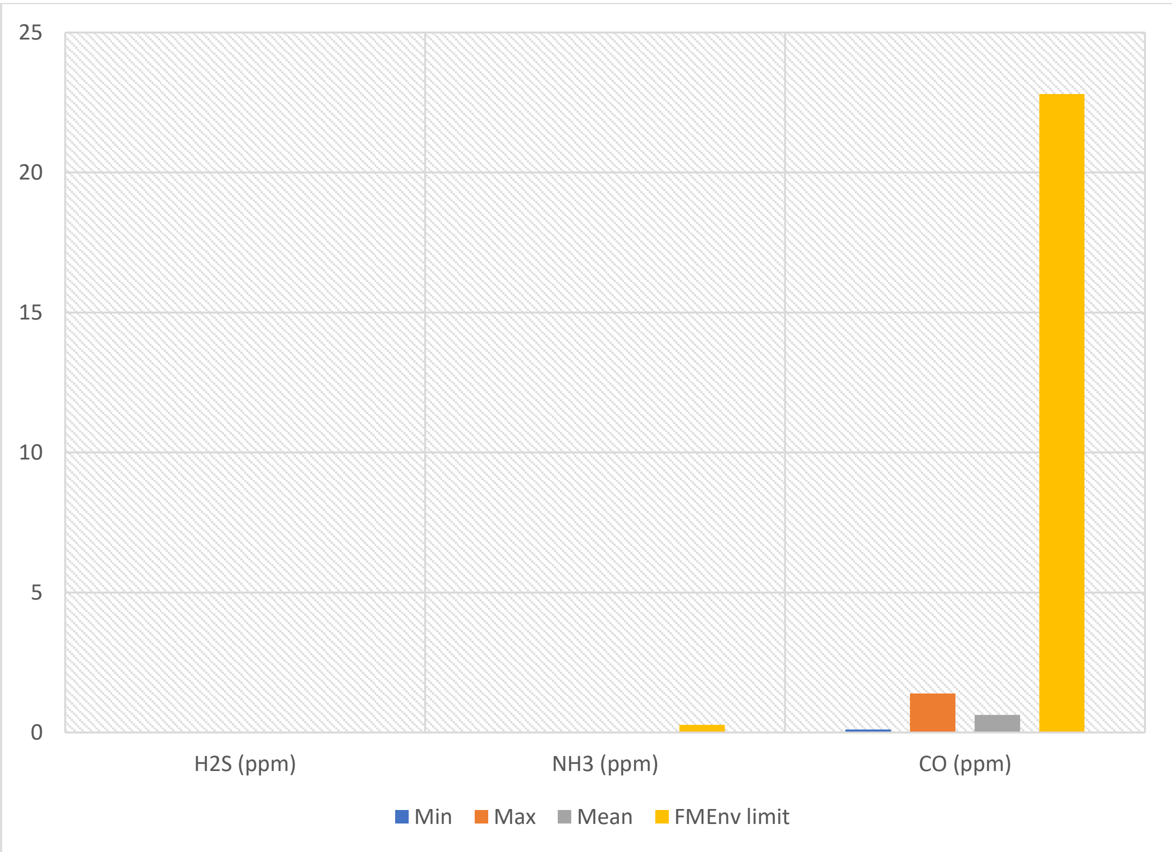


Figure 4.7: H_2S, NH_3 and CO Levels. Source: Fieldwork, 2020

Table 4.6: Summary of Air Quality and Noise Values of Bonny Study Area

Parameters	Bonny Study			Bonny Oloma EIA (Dry Season) (2018)	Regulatory Limits	
	Min	Max	Mean	Mean	FMEnv	DPR
CO (ppm)	0.1	1.4	0.631	2.15	22.8	NS
CO_2 (µg/m$^{3)}$	264	298	281.719	-	-	-
O_3 (ppm)	0.01	0.04	0.020	0	-	-
SO_2 (ppm)	0.01	0.05	0.022	<0.001	260	100-150
NO_2(ppm)	0.01	0.04	0.021	<0.001	75-113	150
H_2S (ppm)	0	0.03	0.009	<0.001	0.008	NS
VOC (ppm)	0.1	0.8	0.341	6.23	160	NS
NH_3 (ppm)	0	0.02	0.005	2	0.28	-
CH_4 (ppm)	0.01	0.04	0.018	-	-	-
PM2.5(ug/m3)	0.3	4.9	2.169	-	-	-
PM10(ug/m3)	3.7	14.8	7.556	-	-	-
TSP(ug/m3)	5.8	20.7	10.256	21.3	250	60-90
Noise Level (dB(A))	41.9	63.8	53.578	82.4	90	80-100

ii. Noise Level:

The minimum mean value of noise level at the proposed site was 41.9dB (A) with the highest Noise level of 63.8dB(A) which was as a result of the tide on the shoreline. Despite the differences in the values obtained, the values were relatively low compared with the 90.0 dB (A) limit provided by Federal Ministry of Environment for occupational Noise for 8-hour exposure **Figure 4.8**.

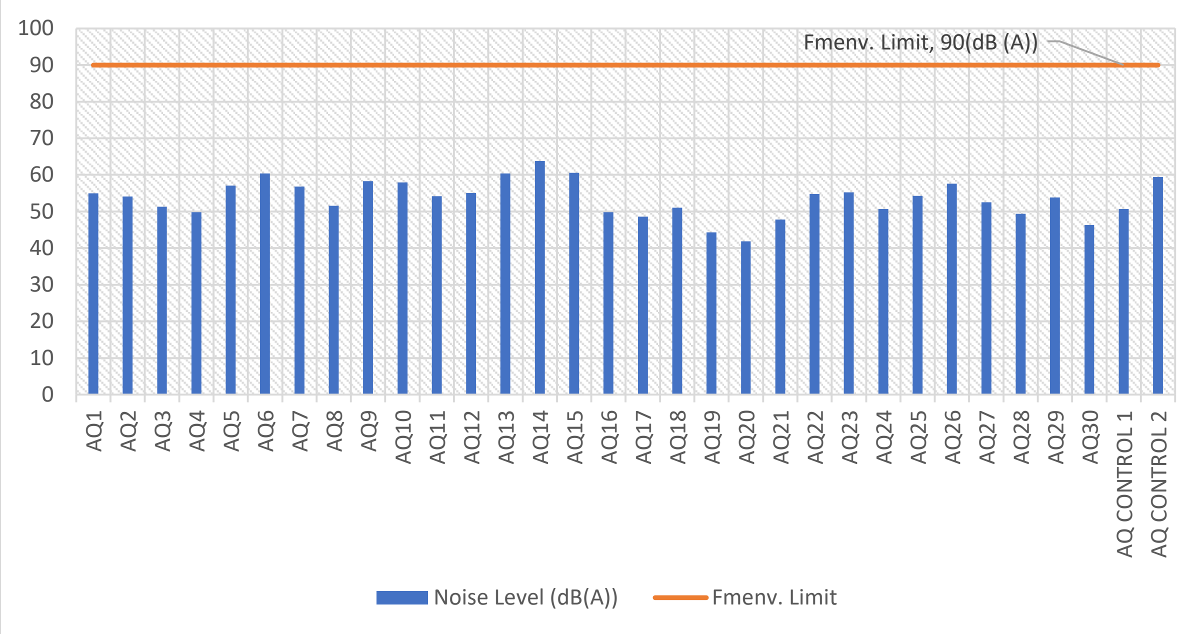


Figure 4.8: Noise level in the study area

4.4.3 Surface water

The present condition of surface water quality within the catchment area of the proposed Bonny deep sea port project is presented. Water quality assessment is a means of determining the level of environmental pollution and possible environmental contaminants. Periodic environmental assessment will help in early detection of pollution and the source of the pollutant. Therefore, in order to evaluate the possible impact of a proposed project to the environment, the present conditions of the environment within the catchment area of the proposed project need to be ascertained. For this reason, 30 surface water samples were collected with 2 control samples. The sampling locations are presented in **Figure 4.9**. The results of the analyzed parameters are presented in Appendix 3 and its summary was presented in **Table 4.7**. The implications of these results to the environment are therefore summarized as follows:

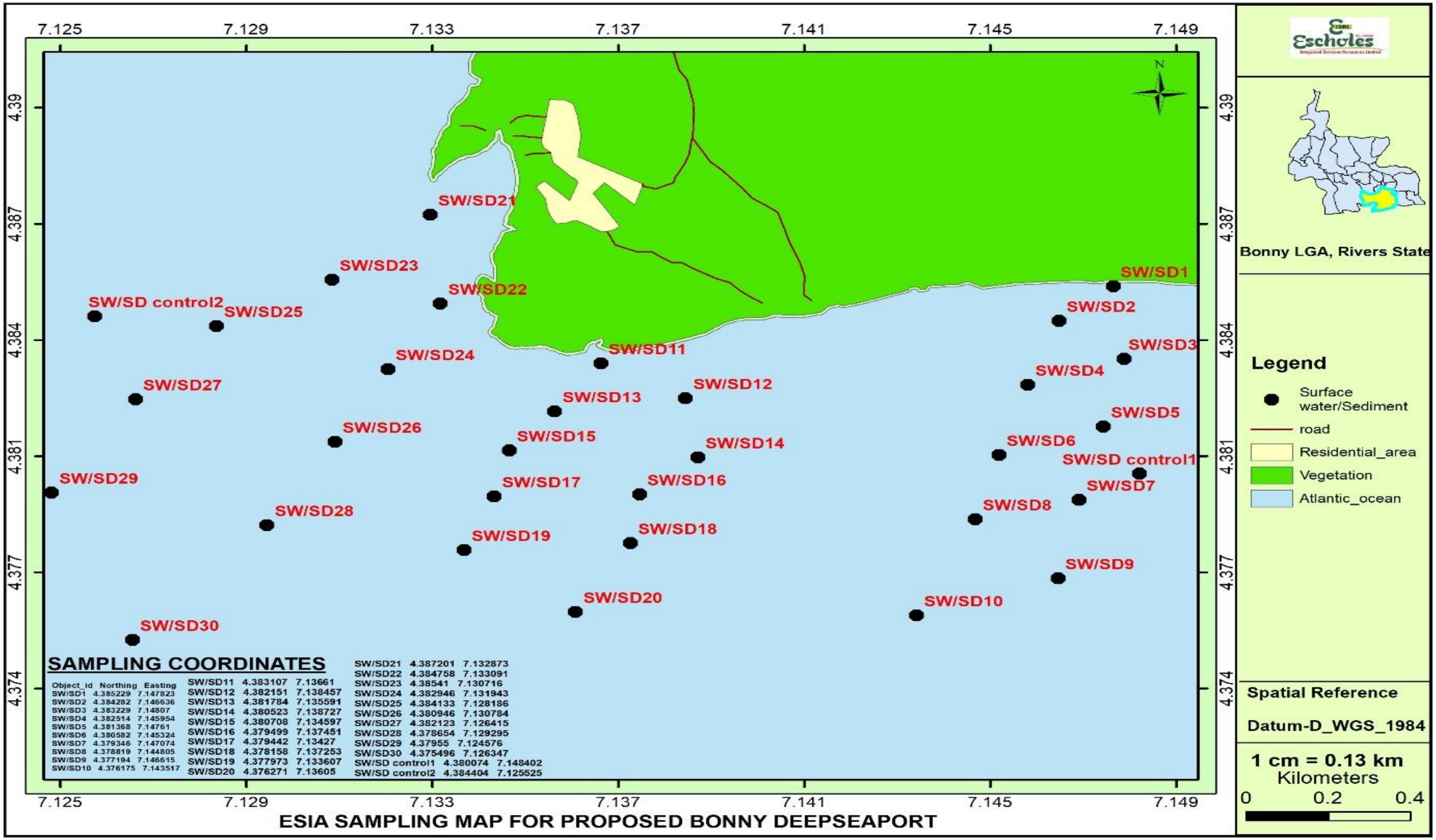


Figure 4.9: Surface water Sampling Map

pH, Salinity, EC, TDS, and TSS and Turbidity

The average value of the pH of the surface water within the study area is 8.52 with a maximum value of 8.90 and a minimum value of 7.00. These values though slightly alkaline are common with coastal waters such as lagoons and embayments.

The average values of 5156.15mg/L, 35303.13 µS/cm, and 17650.94mg/L with ranges of 4302.07 – 6113.42mg/L, 29700-46000 µS/cm, and 14840-20200 mg/L were recorded for the salinity, EC, and TDS respectively in the surface waters within the proposed well locations. The value of salinity falls within the EPA permissible limit of ≤40000, the EC value is above the EPA permissible limit of 1000µS/cm, while there is no limit set for the TDS of surface waters by EPA. However, the average TDS value of 17650mg/L is above the permissible limit of 1000ml/L set by world health organization (WHO) for drinking water; hence the water is not fit for direct consumption. These relatively high values in the salinity, EC, and TDS are common with waters within the mangrove forest region of the Niger delta and are attributed to the influx of sea water and effluents from anthropogenic activities.

The average concentration values of the total suspended solids (TSS) and turbidity were 3.66mg/L and 0.17 NTU in the surface water samples collected within the study area. However, it is important to note that these parameters (TSS and turbidity) can frequently vary due to fluctuations in ocean tides and sediment load.

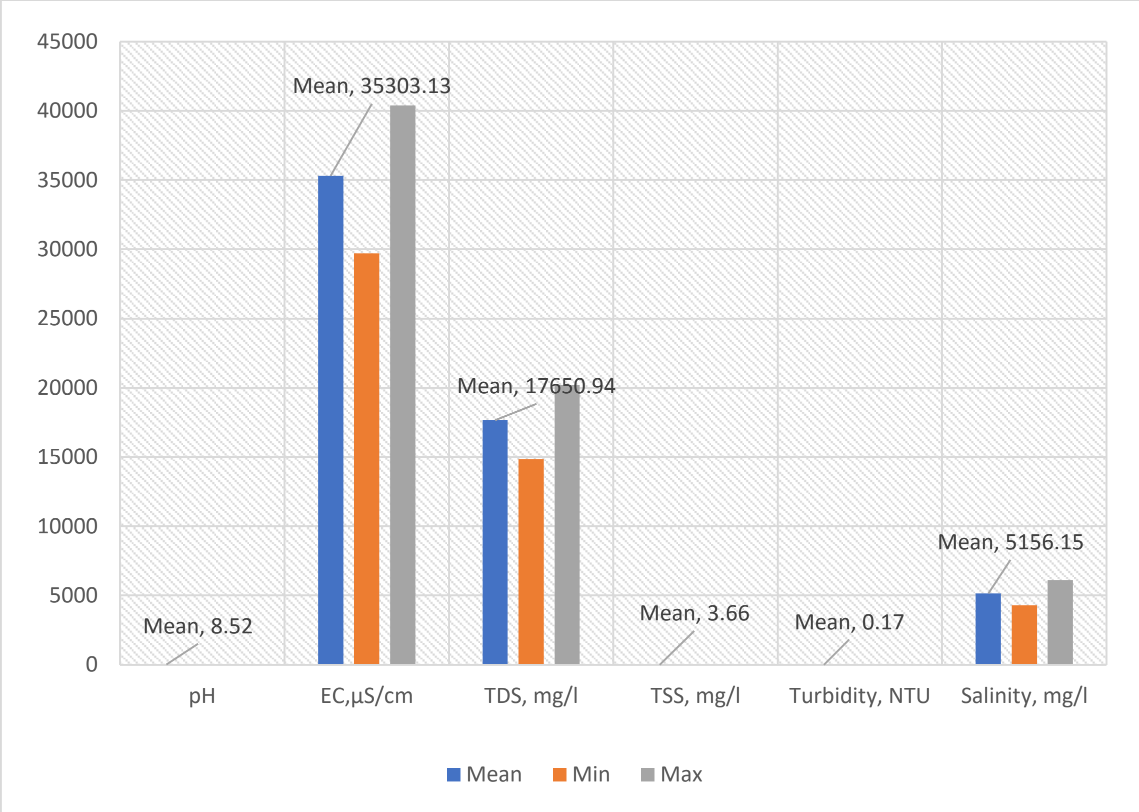


Figure 4.10: Average values of pH, EC, TDS, TSS, Turbidity and Salinity in the study area

Dissolved Oxygen, Chemical Oxygen Demand, and Biochemical Oxygen Demand: Biochemical oxygen demand (BOD) is a measure of the amount of oxygen consumed in five days by biological processes breaking down organic waste and therefore is an indirect measure of the concentration of organic waste. Low dissolved oxygen (DO) can be detrimental to fish and other organisms living in the water. Higher BOD values indicate a greater degree of pollution from excess organic material. The BOD of the surface water samples collected within the proposed well locations gave an average value of 1.97mg/L, with a range of 1.20-2.70mg/L. These values are within the permissible limit of most environmental protection agency which is normally set at ≤ 5mg/L. Also, the average DO value of 6.37mg/L was recorded for the samples collected within the radius with a range of 6.00-6.90mg/L. These values of the DO are slightly lower than the EPA standard of ≥ 7mg/L and may be as a result of relatively high temperature of the surface water (28.25^{o}C); noting that the solubility of oxygen decreases with increase in temperature (Ibanez et al., 2008; Wetzel and Likens, 2000). However, **Figure 4.11**. revealed that the values are in the order of DO > COD > BOD. COD was 11.18 mg/l in the Bonny Oloma study, 2018 but was 4.29 mg/l during this study.

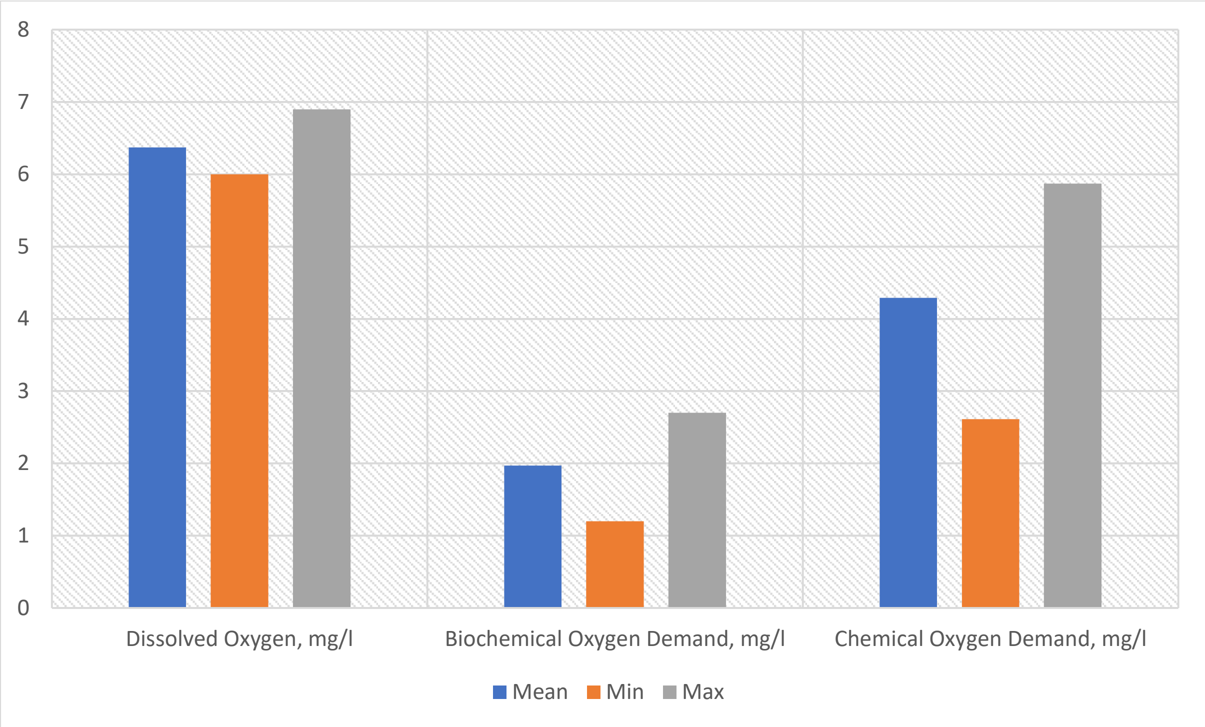


Figure 4.11: Concentration values of BOD, COD, and DO in the main and control surface water sample

Nutrients:

The major compounds affecting the availability of nutrients in surface waters are nitrates, phosphates and sulphates. Reduction in the amount of sulphate may lead to increased decomposition of organic matter (Boomer and Bedford, 2008), while increase in the amount of phosphates and nitrates usually leads to eutrophication (Jaynes and Carpenter, 1986). These processes typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. The average values of the nitrate and phosphate composition of the surface water collected within the proposed well locations are 14.12mg/L and 0.18mg/L respectively, with ranges of 11.87-16.16mg/L and 0.15-0.20mg/l respectively (Figure. 4.). These values fall within the EPA standard of < 0.7mg/L and < 50mg/L for nitrates and phosphates respectively.

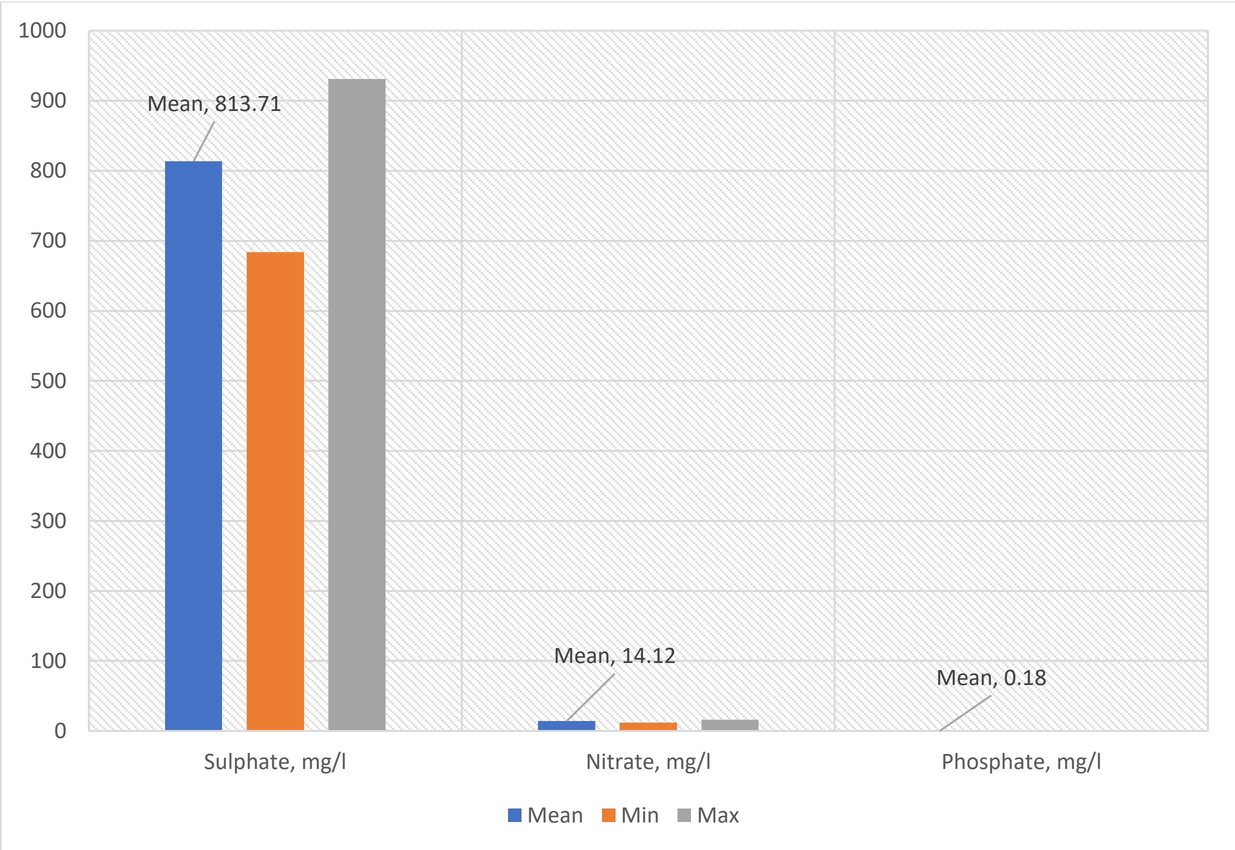


Figure 4.12: Concentration values of sulphate, phosphate, nitrate and ammonia in the main and control surface water sample

However, the average value of 813.73mg/L with a range of 684.12-931.22mg/L for the sulphate composition of the surface water collected within the study area is above the EPA permissible limit of < 250mg/L for surface water. The relative high amount of sulphate in this surface water sample maybe attributed to the geology of the underlying sediments. Iron sulphides are present in sedimentary rocks from which they can be oxidized to sulphate in humid climates (EPA, 2001).

Heavy metals and Trace elements:

These are element which at a very low concentration can be toxic to but human and animals, but their degree of toxicity vary greatly from metal to metal. They are easily accumulable in fish and other tissue and hence liable to enter food chain. The analyzed metals include; Copper, Lead, Cadmium, Iron, Barium, Vanadium and Zinc. Apart from Fe, Zn and Cu all other elements were not at detectable concentration in the surface water samples collected within the study area. The average values of the detectable elements are 0.22mg/l, 0.02mg/l and 0.01mg/l for Fe, Zn and Cu respectively. These values compared well with values from previous studies in the area.

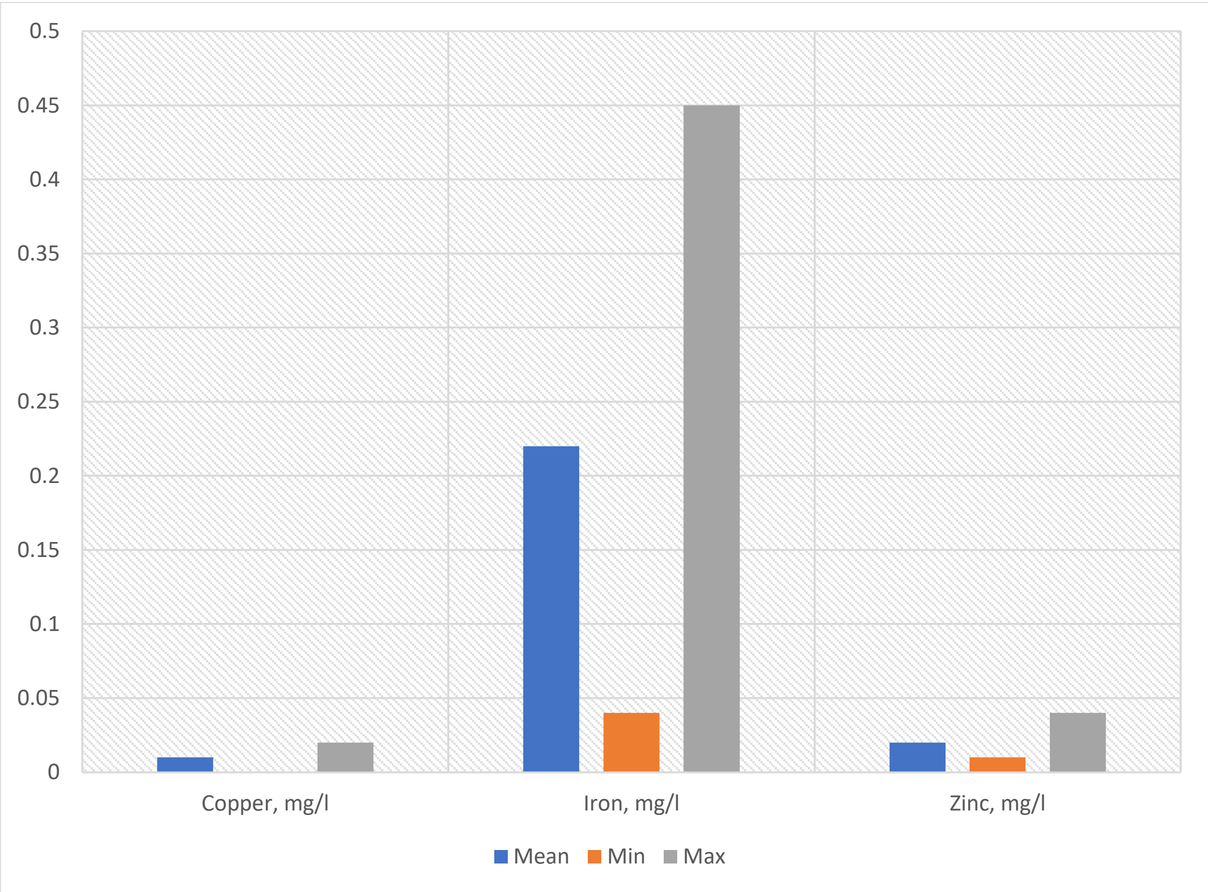


Figure 4.13: Concentration values of Fe, Zn and Cu in the study area

Hydrocarbons:

Problems associated with hydrocarbons include; interference with such vital processes as the mass transfer of oxygen from air to water (essential in reaeration of water bodies), blockage of pipes, odour and taste problems, cancers, etc. However, organoleptic and total aliphatic hydrocarbon (THC) was detected in the range of 0.05-0.29mg/l (mean=0.15mg/l) in the samples collected within the study area.

Microorganisms

Microbial activities in surface water can be a measure of the general quality of the environment. The total count of these organisms in surface water can be used to determine the nutrient load of the water body, the oxygen demands, and the level of contamination by toxic substances such as hydrocarbons. Therefore, it is important to periodically assess the microbial count of surface waters in order to detect any abnormal change in the immediate environment. For this reason, the microbial count in surface water samples was analyzed in order to determine the present condition of the surface waters within the catchment area.

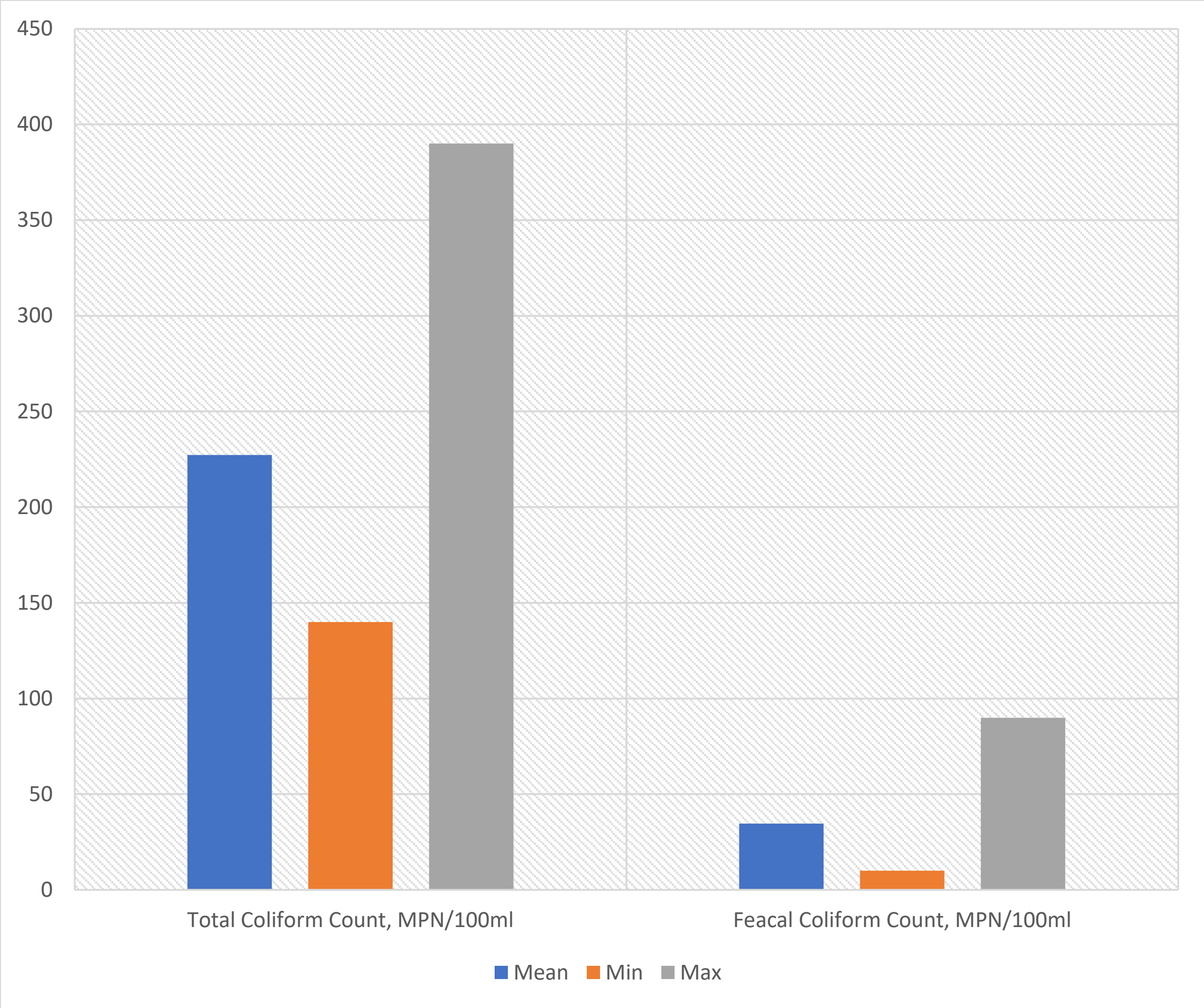


Figure 4.14: Total coliform count and feacal coliform count in surface water within the study area

The result (Figure.4.14) revealed that the average count value for the total coliform and Feacal coliform is 227.19 MPN/100ml and 34.62MPN.19 respectively within the study area.

Table 4.7: Summary of Surface water Values of Bonny Study Area

Parameters	BONNY DSP ESIA (WET)			Bonny Oloma EIA (Dry Season) (2018)	FMEnv Limit
	Mean	Min	Max	Mean	
pH	8.52	7.00	8.90	7.63	6.5-8
Temperature, °C	28.25	27.20	28.90	29.77	-
Total Dissolved Solid, mg/l	17650.94	14840.00	20200.00	6910	-
Electrical Conductivity, µS/cm	35303.13	29700.00	40400.00	11272.00	1000
Colour, TCU	1.41	1.00	3.00	20.67	-
Turbidity, NTU	0.17	0.04	0.37	10.43	-
Total Suspended Solid, mg/l	3.66	2.00	10.00	8.00	-
Dissolved Oxygen, mg/l	6.37	6.00	6.90	5.73	≥ 7
Biochemical Oxygen Demand, mg/l	1.97	1.20	2.70	1.77	≤ 5
Chemical Oxygen Demand, mg/l	4.29	2.61	5.87	11.18	
Salinity, mg/l	5156.15	4302.07	6113.42	9.00	≤ 40000
Total Alkalinity, mg/l as $CaCO_3$	111.94	67.00	141.00	104.10	-
Total Hardness, mg/l as $CaCO_3$	687.16	472.00	932.00	0.00	-
Chloride, mg/l	2863.57	2389.24	3395.21	4981	-
Sulphate, mg/l	813.71	684.12	931.22	565	< 250
Nitrate, mg/l	14.12	11.87	16.16	0.04	< 0.7
Phosphate, mg/l	0.18	0.15	0.20	NA	< 50
Calcium, mg/l	146.64	95.61	210.84	91.83	-

Magnesium, mg/l	78.33	53.16	105.65	164.71	-
Sodium,	1371.37	1144.43	1625.87	1909.08	-
Potassium, mg/l	567.98	457.65	699.12	441.14	-
Total Hydrocarbon Content, mg/l	0.15	0.05	0.29	0.00	< 1
Lead , mg/l	BDL	BDL	BDL	BDL	-
Copper, mg/l	0.01	0.00	0.02	BDL	-
Iron, mg/l	0.22	0.04	0.45	1.310	-
Zinc, mg/l	0.02	0.01	0.04	0.01	-
Cadmium,	BDL	BDL	BDL	ND	-
Barium, mg/l	BDL	BDL	BDL	3.30	-
Vanadium, mg/l	BDL	BDL	BDL	BDL	-
Total Coliform Count, MPN/100ml	227.19	140.00	390.00	9	-
Feacal Coliform Count, MPN/100ml	34.62	10.00	90.00	NA	-

4.4.4 Ocean Dynamics

Characteristically, the area is a typical tidal water zone with fresh water input but with extensive mangrove swamps, inter-tidal mud flats, and influenced by a semi-diurnal tidal regime. The tidal range in the Bonny River estuary is about 0.8m at neap tides and 2.20m during spring tides. Extreme tidal ranges of between 3.5 and 12.5m are occasionally experienced at Bonny town, a distance of about 15km from the mouth of the estuary. The Bonny River System has the highest tidal volume of all the river systems in the delta. There is generally a net flux of tidal water up the river, which disperses into various creeks and channels (Diop et. al., 2014).

The Bonny estuary is located on the immediate eastern flank of the Niger Delta between longitudes 7^{o}00’ and 7^{o}15’ and latitudes 4^{o}25’ and 4^{o}50’ (**Figure 4.5**). The

Bonny barrier island is immediately east of the estuary. The topography of the area is flat and consists mainly of swamps and flood plains. The dominant island around the estuary is the Bonny Island. The island is bordered by the Andoni River estuary in the east and the Bonny River estuary in the west. The coastal plain deposits are a mosaic of marine, deltaic, estuarine, lagoonal and fluvio-lacustrine materials (Diop et. al., 2014).

Figure 4.15: Satellite Imagery of South Nigeria Showing Location of Bonny Estuary (Source: Diop et.al., 2014)

Sediment Dispersion in Bonny Estuaries/Tidal Channels

Natural or anthropogenic processes can fluidize and or re-suspend sediment in a flowing water body and be transported or dispersed and re-deposited in a different location. The transportation of sediment in a water column can be by suspension (for fine grained particles), rolling and saltation (for coarse grained particles). The dispersed sediments have effects on the various components of the ecosystem which include: 1). Influenced on the productivity of the aquatic life by enriching the water column with nutrients and also the reduction of availability of sunlight necessary for photosynthesis, 2). Sedimentation or siltation of the harbor area or the navigable channel resulting in expensive dredging, 3). Mortality of benthic organisms through burial, and 4). Released of toxic substances such as heavy metals stored in the sediment into the water body. The extent of dispersion of sediment in a water body depends on the following factors that were investigated in the Bonny estuary and associated tidal channels

4.4 Geology and Hydrogeology

The study area's geology belongs to the coastal sedimentary basin of Niger Delta. This basin is made up of three units; the Agbada, Benin and Akata formations. The summary of the Niger Delta stratigraphy and tectonic setting are presented in **Table 4.8** and **Figure 4.15** respectively.

Table 4.8: Stratigraphy of the Niger Delta

Formation	Lithology	Age	Thickness (m)
Benin	Continental, fluviatile gravels and sands	Eocene – Recent	0 -2100
Agbada	Paralic Sequence of interbedded sand and shales	Eocene – Recent	300 -4500
Akata	Pro-delta Marine Shales and clays with some turbidites and sand bodies	Eocene – Recent	600 - 6000

Source: Modified from Short and Stauble, 1967

The coastal sedimentary basin of Niger Delta has been the scene of three depositional cycles. The first began with a marine incursion in the middle Cretaceous and was terminated by a mild folding phase in Santonian time. The second included the growth of a proto-Niger delta during the late Cretaceous and ended in a major Paleocene marine transgression. The third cycle, from Eocene to Recent, marked the continuous growth of the main Niger Delta. A new threefold lithostratigraphic subdivision is introduced for the Niger delta subsurface, comprising of an upper sandy Benin formation, an intervening unit of alternating sandstone shale named the Agbada formation, and a lower shaky Akata formation. These three units extend across the whole Delta and each range in age from early Tertiary to Recent. They are related to the present outcrops and environments of deposition (Short and Stauble, 1967; Weber and Daukoru, 1975).

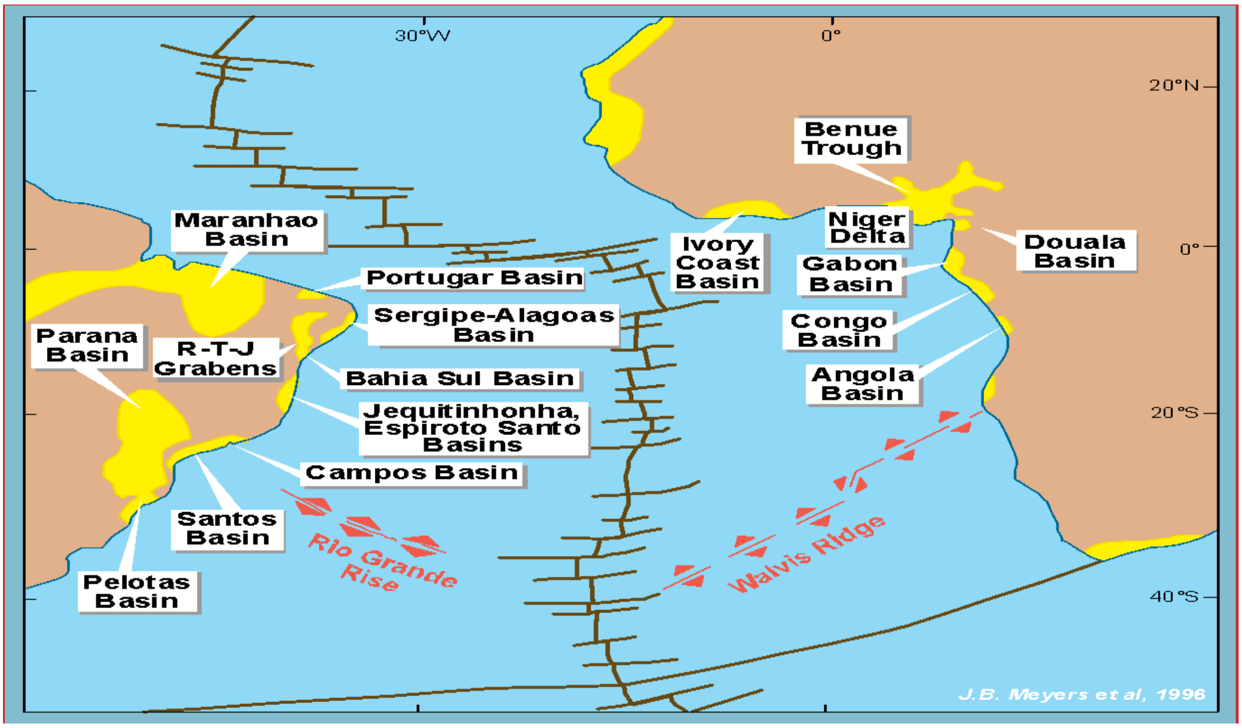


Figure 4.16: Tectonic Setting of the Niger Delta

4.4.1 Local Geology/Hydrogeology

The proposed project site in Bonny Island falls within the Beach ridges on-shore geomorphic sub- environment of the Niger Delta. It consists of Pleistocene and Recent sediments deposited by fluvial and shelf hydrodynamic processes which include that of waves, tides and longshore currents that still characterized the area till date. The Island is bounded in the south by the Atlantic Ocean, in the east by the Bonny estuary and in the North and west it is bounded by another meandering tidal channel or creek that flows to the Atlantic Ocean and also connects to the Bonny estuary in the north.

Structure: The beach-ridge complex sedimentary structure of Bonny Island is made up of the following five components:

Beach face: This is the southern-most part of the Island that is wash by waves of the sea. It slopes gently to the sea and is part of the foreshore that extends from the place the ocean reaches at low tide to the place it reaches at high tide. It is about twenty-six kilometers (26km) long, with variable width that range from 25 - 120m along the shoreline. The subsurface vertical profile consists of gently seaward dipping layers of well sorted white sand that coarse upward, while laterally, it consists of well sorted white sand that fines away from the shoreline.

Sand Ridges: This is the part of the backshore of beach-ridge complex that is elevated above mean high tide. Naturally these are the areas that are vegetated with trees and shrubs, and used as human dwelling places and fishing farms settlements (e.g. Finima Nature Park and Bonny Island Gulf club). The subsurface vertical profile consists of intercalated well sorted sand, silt and clay, and overlays the beach-face succession.

Offshore: This is the subaqueous component of the beach ridge complex that includes the open sea and the Bonny estuary. The open sea is the region of high waves and tides processes. The sediment fines in sea-ward direction, from coarse/medium sand to mud as the depth increases. In subsurface vertical profile, it underlies the beach succession. The Bonny estuary is the drowned river valley where moderate to well sorted sand bars accumulate and aggrade but does not prograde into the open sea and hence always requires regular dredging. It is a zone of waves, tide and fluvial processes. The width of the estuary increased from about 2.0km at the beginning of Bonny Island from the north to about 14.0 km at the entrance to the sea.

Tidal Channels: These are network of meandering channels that cut through the backshore zone of Bonny Island and act as conduit for water flow during tidal cycles. Flood and ebb tidal current deposits sand along the channel. In the meander zones, alternating layers of sand and mud are deposited.

Tidal Flats: These are areas that are variably covered with seawater at high tide and sub-aerially exposed at low tide. It is adjacent to and along tidal channels or creeks and estuary. It is marshy, consist of organic rich mud and commonly vegetated with mangrove plants. It is the areas commonly reclaimed through sand-filling for human dwelling places and industrial purposes. For examples the northern/eastern side of Oguede community, eastern sides of Perekule, Iwoama and Jack-Wilson Pepple communities, and northern/eastern sides of Macauley community and Northern/western sides of Akiama community

4.4.2 Hydrogeology of the study Area

The main hydrological feature of the study area is the adjoining creeks that lead to Bonny Island. To assess ground water hydrology of the study area, three (3) wells were drilled to the first aquifer; BH 1, BH 2, and BH 3 in triangular array using hand auger. The water level or static water level (SWL) in BH 1 was 6.8m. The value was 6.3m in BH 2 while BH 3 had a value of 5.7m. The flow direction was influenced by the difference in level of water (i.e. water flows from areas of high energy to areas of lower energy). This was generally observed at south direction with water level at 5.7m from the ground surface; and it's supported by the regional factors such as South South East (SSE) trending pattern of Patrick waterside, topographic conditions as well as the buried stream channels (surface out flow) in the area. The ground water in the area is naturally recharged via surface infiltration from precipitation and very slowly, discharges naturally into the swamp which empties into the Creeks/River. The stratigraphy underlying the study area reveal that the study area is underlain by Alluvia sediments containing deposit of silts, sand, clay and coarse-gravel sand which varies locally as seen in the logs.

The aquifer in the study area is shallow, unconfined and stratified coarse sand. The grain size increases with depth indicating that the hydraulic conductivity also varies with depth. This reflects the recent coastal plain deposits of top of Benin formation in Niger Delta.

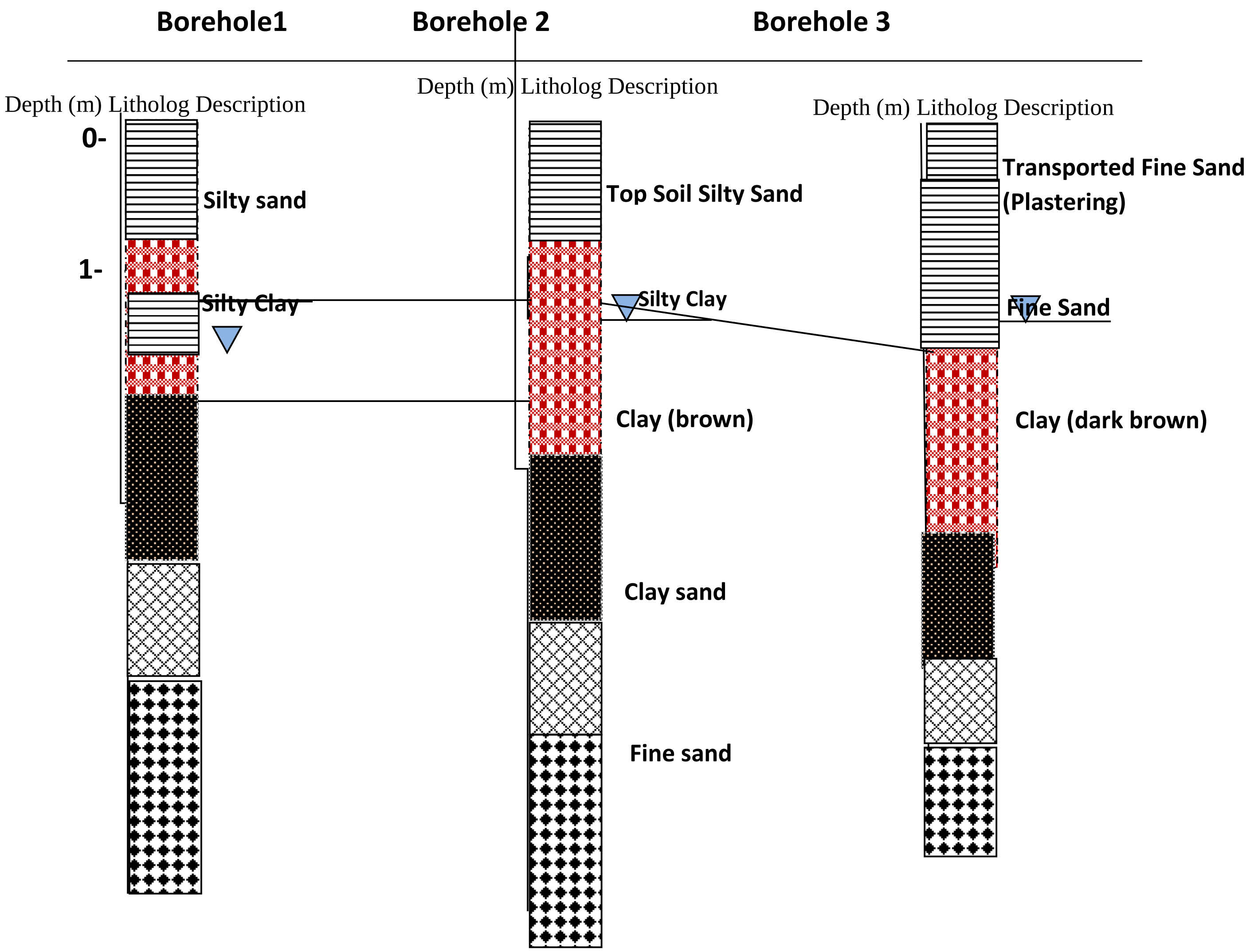


Figure 4.17: Schematic Diagram of the Soil Profile of Study Area

4.5 Groundwater

The current groundwater quality within the catchment area of the proposed Bonny deep sea port presented. Groundwater serves as source of drinking water and for other domestic use to most people in the Niger delta region of Nigeria. Therefore, the quality of this source of water needs to be ascertained in other to ensure that it meets the standard required by most environmental protection agencies. It should be noted that groundwater quality can be affected by geogenic or anthropogenic factors. However, the aim of this study is not to determine the quality of the groundwater for consumption or domestic purposes, but to evaluate the present condition of the preexisting quality of the groundwater. This will help in determining the impact of the proposed project on the environment following subsequent environmental evaluation reviews.

The sampling locations are presented in **Figure 4.15** the raw result from the laboratory was presented in the Appendices which was summarized in **Table 4.8**. The interpretations of the summarized results are as follows:

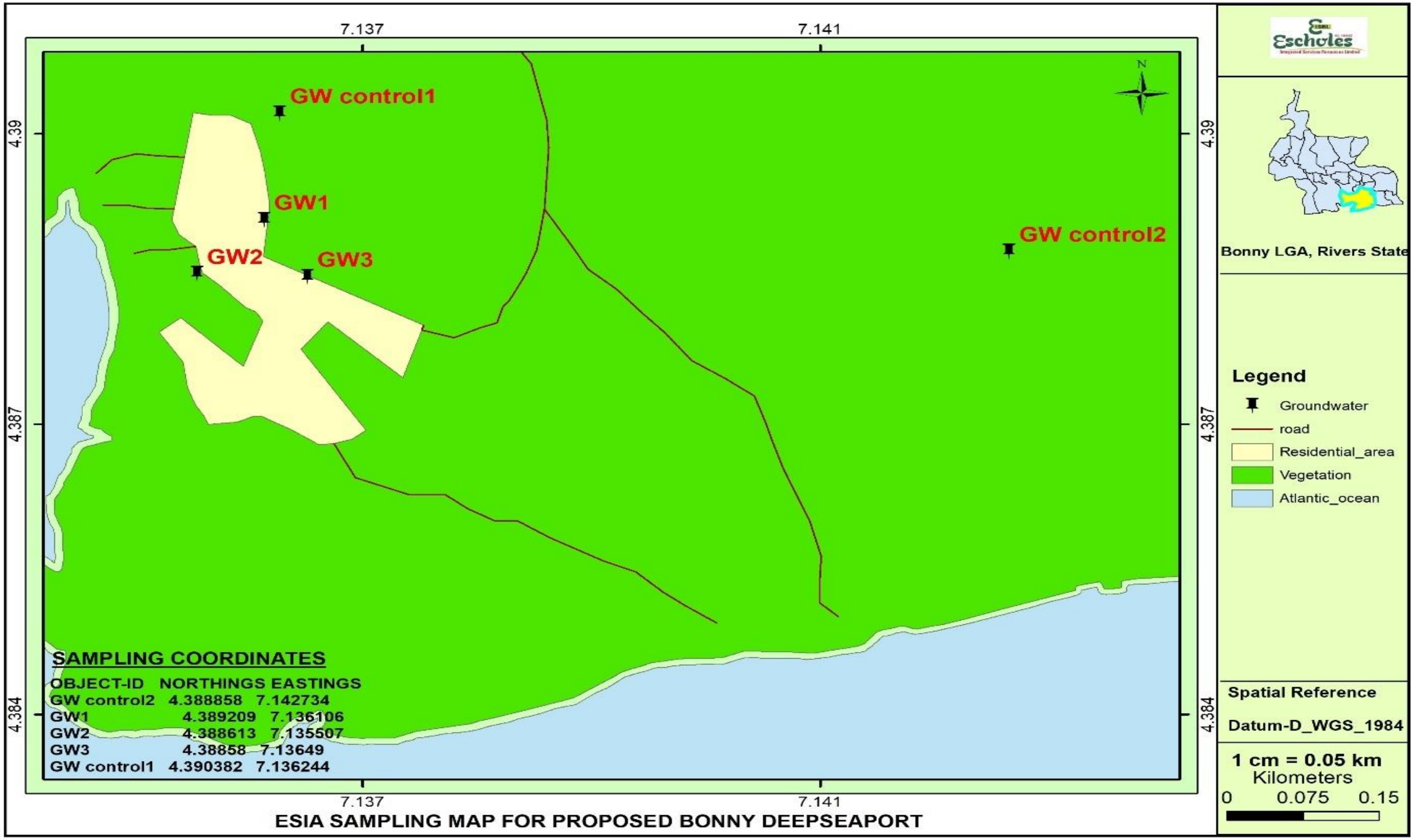


Figure 4.18: Ground water Quality Sampling Map

pH, Electrical Conductivity, Total Dissolved Solid, Total Suspended Solids, Salinity, and Turbidity:

The average pH, EC, and TDS of the samples collected were 7.28, 240µS/cm, and 174mg/L (**Figure 4.18**) with ranges of 6.3-8.1, 140-320µS/cm, and 110-230mg/L respectively. This shows that the groundwater falls within FMEnv and WHO permissible limit of 6.0-8.0. The EC and TDS values also fall within FMEnv and WHO permissible limit 500mg/L for TDS and 1000 µS/cm for EC. These results are consistent with other similar report such as Efe and Mogborukor (2012), and Amadi and Akobundu, (2014) within the Niger delta region. Similar observation was made in concentration levels of turbidity, salinity and total suspended solids (TSS) which has average concentration values of 0.57 NTU, 53.924 mg/L, and 2.4 mg/L respectively. The turbidity and TSS values also fall within FMEnv and WHO permissible limit 5NTU for turbidity and <10 for TSS. The high salinity value implies that there may be salt intrusion in the ground water.

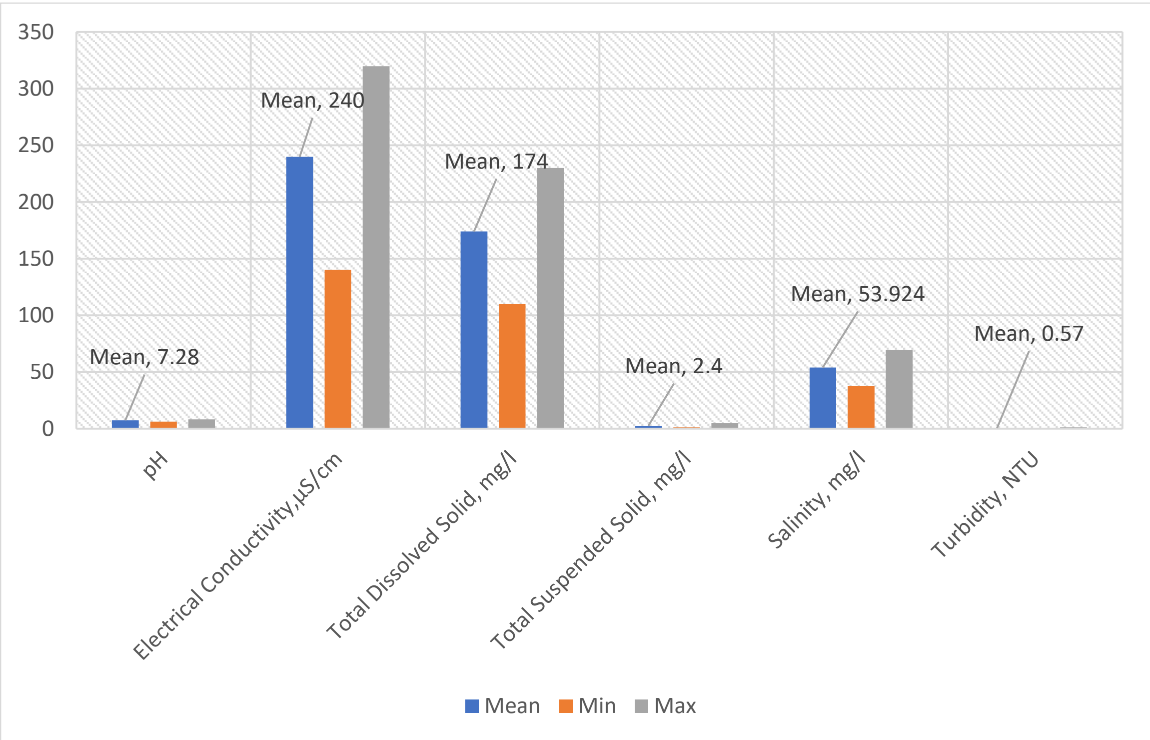


Figure 4.19: pH, EC, TDS, Salinity, Turbidity and TSS in the groundwater samples

Oxygen Demands:

The average values of the dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD) from groundwater samples in wells within the project area are 3.14mg/L, 0.94mg/l and 2.16mg/l with a range of 2.7-3.6mg/L, 0.7-1.2mg/l and 1.53-2.81mg/l respectively (Figure 4.18). These values compares favourably with the values obtained from previous studies in the area. Depletion of dissolved oxygen in water supplies can encourage the microbial reduction of nitrate to nitrite and sulphate to sulphide. It can also cause an increase in the concentration of ferrous iron in solution, with subsequent discoloration at the tap when the water is aerated (WHO, 2008). Therefore this should be taken into consideration in further environmental development studies within the area. The general relationship between the COD, BOD_5 and DO is shown in **Figure 4.19** the concentration of DO in the study area is highest and in quantity is followed by the COD while the BOD_5 remains low, thus indicative of unpolluted groundwater.

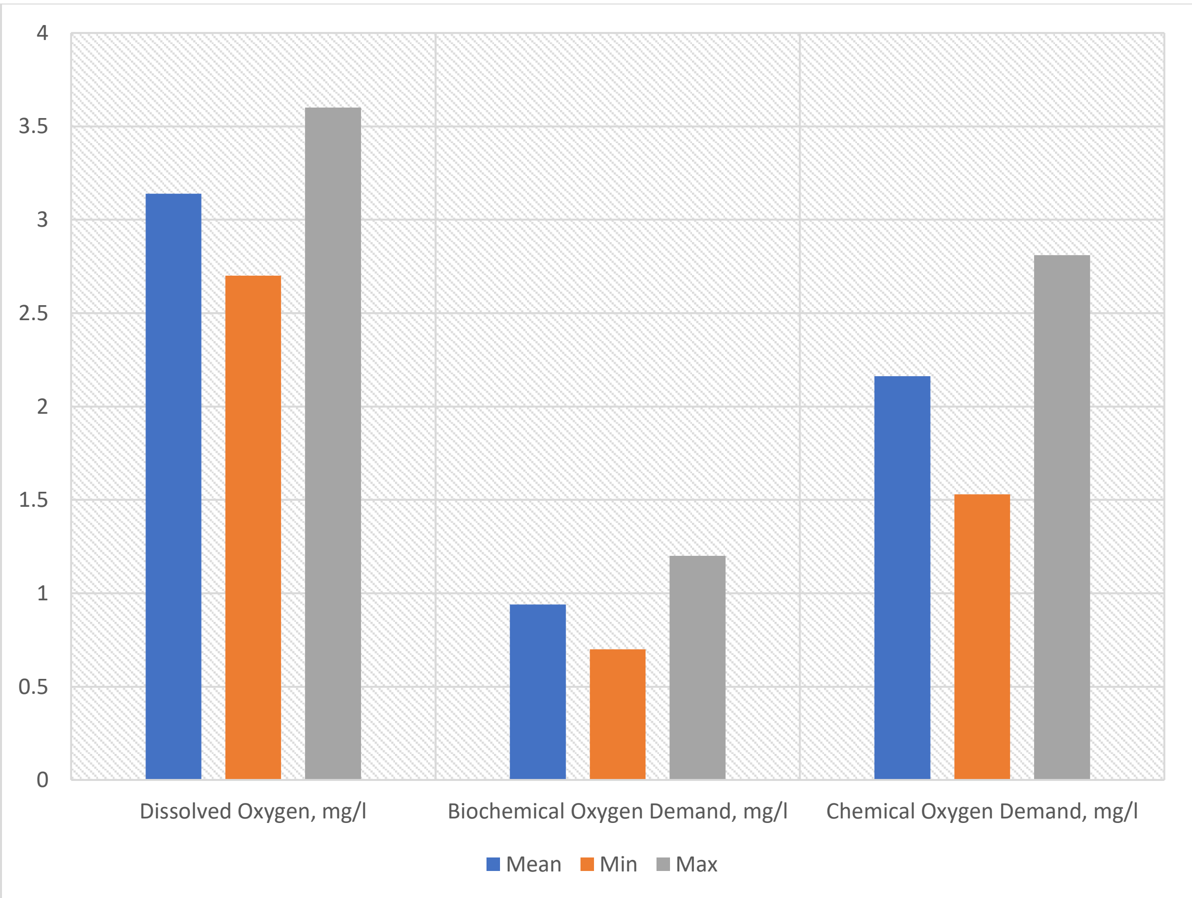


Figure 4.20: DO, BOD and COD in the groundwater samples

Heavy metals and trace elements:

The analyzed metals include; Copper, Lead, Cadmium, Iron, Barium, Vanadium and Zinc. Most of these elements are toxic to humans and animals even at lower concentration. Most importantly, they can enter the food chain through uptakes by plants and consumptions by livestock; hence posing a problem to human health. All the heavy metals tested in the groundwater samples had values below equipment detection limits.

Hydrocarbon:

Problems associated with hydrocarbons include; interference with such vital processes as the mass transfer of oxygen from air to water (essential in river reaeration), blockage of pipes, odour and taste problems, cancers, etc. However, none of these compounds were detected in the wells tested. Therefore there is no hydrocarbon contamination of the groundwater within the study area.

Microorganisms:

Microbial activities in ground water can be a measure of the general quality of the environment. The result (**Table 4.9**) revealed that the average count value for the total coliform is 46 MPN/100ml while Feacal coliform was not detected within the study area.

Table 4.9: Summary of Ground water Values of Bonny Study Area

Parameters, unit	Bonny DSP ESIA (Wet)			Bonny Oloma EIA (Dry) (2018)	FMEnv Limit	WHO Limit
	Mean	Min	Max	Mean		
pH	7.28	6.3	8.1	6.93	6.00 – 8.50	6.00 – 8.50

Temperature, °C	28.88	28.7	29.1	29.37	-	-
Total Dissolved Solid, mg/l	174	110	230	423.67	500	-
Electrical Conductivity,µS/cm	240	140	320	673.33	1000	
Colour, TCU	1.2	1	2	-	-	-
Odour	U/O	U/O	U/O	U/O	-	-
Turbidity, NTU	0.57	0.02	1.13	28.50	5.0	5.0
Total Suspended Solid, mg/l	2.4	1	5	24.67	<10	-
Dissolved Oxygen, mg/l	3.14	2.7	3.6	4.77	-	-
Biochemical Oxygen Demand, mg/l	0.94	0.7	1.2	2.10	-	-
Chemical Oxygen Demand, mg/l	2.162	1.53	2.81	7.16	-	-
Salinity, mg/l	53.924	37.96	69.32	0.87	-	-
Total Alkalinity, mg/l as $CaCO_3$	85.6	32	134	98.00	-	30 - 50
Total Hardness, mg/l as $CaCO_3$	100.2	26	155	-	-	-
Chloride, mg/l	29.952	21.08	38.52	106.16	250	-
Sulphate, mg/l	2.196	1.59	2.84	27.01	500	250
Nitrate, mg/l	0.136	0.09	0.18	-	50 (10 as N)	50
Phosphate, mg/l	0.023333	0.01	0.04	-	-	-
Calcium, mg/l	0.2214	0.05	0.354	13.86	-	-
Magnesium, mg/l	0.109	0.031	0.17	2.92	-	-
Sodium,	14.3414	10.095	18.437	91.14	-	-
Potassium, mg/l	5.9816	4.038	7.946	11.58	-	-

Total Hydrocarbon Content, mg/l	BDL	BDL	BDL	0.00	-	-
Lead , mg/l	BDL	BDL	BDL	ND	0.01	0.01
Copper, mg/l	BDL	BDL	BDL	ND	2.0	2.0
Iron, mg/l	BDL	BDL	BDL	0.55	0.3	0.3
Zinc, mg/l	BDL	BDL	BDL	0.13	5.00	3.00
Cadmium,	BDL	BDL	BDL	ND	0.01	0.003
Barium, mg/l	BDL	BDL	BDL	ND	-	-
Vanadium, mg/l	BDL	BDL	BDL	ND	-	-
Total Coliform Count, MPN/100ml	46	20	70	22.67	-	-
Feacal Coliform Count, MPN/100ml	ND	ND	ND	6.67	-	-

4.6 Sediment Study

The present condition of sediments quality within the proposed project area is presented here. The physicochemical composition of sediments within deltaic environment can have wide variation due to its relative potion to land and sea. The sources of chemical, physical and biological pollutants of these sediments can be very difficult to ascertain because they can be transported from very far distances to this environment both from land and sea. However, frequent assessment of the physicochemical properties of these sediments within a given area can help in determining any abnormal increment and the direction to which it comes from. For this reason, it is imperative to carry out sediment quality assessment within the catchment area of any proposed project prior to its commencement. This will help to understand the present condition of the environment and to ascertain the impact of the project on the environment after subsequent environmental evaluation reviews.

pH and Electrical Conductivity

The pH of the sediment collected from the proposed project location is acidic with an average value of 5.86 and a range of 4.20-7.40. These pH values of the sediments are similar with most other sediment quality reports generated within the region.

The electrical conductivity (EC) of the sediment collected from the proposed project area are generally high with an average concentration value of 17344 µS/cm and a range of 3380-35100 µS/cm. High values of EC is mostly attributed to the presence of ionisable salts in the sediments.

Nutrients

One major nutrient that is very essential for plant growth is Phosphorus. The phosphate content in the sediment from the study area ranged from 1.13 to 15.18mg/kg (mean=7.83mg/kg). Other macro nutrient that is very significant and essential for plants growth is Nitrogen. The Nitrate content of the sediment collected within the study area ranged from 6.67-30.30mg/kg with a mean of 19.37mg/kg.

The total organic carbon (TOC) within the study area between 1.08-5.11mg/kg (mean=3.25mg/kg). In general, the nutrient content of the sediment is low, hence may not support adequate plant growth required for self-remediaiation of contaminated sediments.

Exchangeable cations

The average concentration values of sodium, potassium, calcium and magnesium in the sediments within the proposed project location is 278.40, 12.75, 268.23 and 21.65 mg/kg respectively. Apart from the concentration level of sodium and calcium which was significantly high, the exchangeable cations are all moderate in quantity.

Table 4.10: Physico-Chemical Properties

Parameters		pH	EC, MS/cm	TOC, %	SO_4, mg/kg	NO_3, mg/kg	Av. P, mg/kg	Ca, mg/kg	Mg, mg/kg	K, mg/kg	Na, mg/kg
Deep Sea Port ESIA	Mean	5.86	3.34	3.25	2224.96	19.37	7.83	268.23	21.65	12.75	278.40
	Min	4.20	2.54	1.08	379.12	6.67	1.13	123.18	9.88	1.86	156.24
	Max	7.40	4.91	5.11	4427.19	30.30	15.18	689.83	45.29	24.40	411.29
Bonny Oloma EIA (Dry Season), 2018 (Mean)		5.13	19.320	0.74	229	0.03	0.13	564	399	311	2788

Heavy metals:

The sources of heavy metal composition of sediments may be difficult to ascertain due to their relative position to land and sea. However, higher amount in the concentration of some of these metals in sediments is an indication of anthropogenic pollution. The heavy metals analysed include Iron (Fe), Copper (Cu), Zinc (Zn), Lead (Pb), Cadmium (Cd), Chromium (Cr), Vanadium (V), Nickel (Ni), Barium (Ba) and Arsenic (As). The average concentration values of 1420.78, 3.31, 17.33, 1.00, 0.16, 268.24, 0.01 and 17.25mg/kg were obtained for Iron (Fe), Copper (Cu), Zinc (Zn), Lead (Pb), Cadmium (Cd), Chromium (Cr), Vanadium (V) and Nickel (Ni) respectively. Barium (Ba) and Arsenic (As) values were below detection limit of equipment used for analysis. Sediments often acts as sinks for heavy metals especially in coastal estuarine locations. But the high concentration of iron in the study area is not due to anthropogenic sources, but iron occurs naturally in high concentrations in the soils and sediments of the Niger Delta.

Table 4.10a: Heavy metals Properties

Parameters		Fe, mg/kg	Cu, mg/kg	Zn, mg/kg	Pb, mg/kg	Cd, mg/kg	Cr, mg/kg	V, mg/kg	Ni, mg/kg	Ba, mg/kg	As, mg/kg
Deep Sea Port ESIA	Mean	1420.78	3.31	17.33	1.00	0.16	268.24	0.01	17.25	BDL	BDL
	Min	56.65	BDL	4.44	BDL	BDL	3.03	BDL	0.12	BDL	BDL
	Max	3296.17	9.22	37.87	3.10	0.54	8289.00	0.03	44.37	BDL	BDL
Oloma EIA (Dry), 2018 (Mean)		3209	2.28	36.11	10.30	0.72	0.76	BDL	-	1.13	BDL

Hydrocarbon:

Organic substances prevents oxygen penetration within the soil sediments. Hydrocarbon indicating parameters such as THC were low with a mean value of 0.72mg/kg obtained within the study area. Previous studies also show low concentration of hydrocarbons in the study area.

Microorganisms:

Sediments microbial activities are very important indicator of the sediments general quality. For sediment to be suitable for the growth of plant, high microbial activity is required for the breaking down of some of the sediment nutrients for plant uptake. The result revealed high microbial activities within the sediments, with a mean count value of 3.31 cfu/gx$10^7$and 1.50 cfu/g x10^3 for the total heterotrophic bacteria (THB) and total heterotrophic fungi (THF) respectively within the study area.

Table 4.10b: Hydrocarbons and Microbiological Properties

Parameters		THC, mg/kg	THB, cfu/gx10^7	THF, cfu/g x10^3	HUB, cfu/g x10^5	HUF, cfu/g x10^1
Deep Sea Port ESIA	Mean	0.72	3.31	1.50	1.79	0.71
	Min	BDL	2.02	0.65	0.89	0.28
	Max	2.27	7.63	3.82	4.72	1.76
Bonny Oloma EIA (Dry), 2018 (Mean)		7.91	-	-	-	-

4.7 Hydrobiology

Phytoplanktons

Phytoplanktons are the autotrophic microscopic plant organisms in water bodies, which fix solar energy by the process of photosynthesis. Phytoplanktons are of great ecological significance because they constitute the major portion of primary producers in the aquatic ecosystems and are at the base of the aquatic food pyramid. Majority of phytoplankton species are used for biological monitoring of the environment since they cannot survive in adverse environmental conditions like high turbidity, anoxic state, extreme salinity and low nutrient level (Fonge *et. al.* 2012; Peerapornpisal et. al. 2004).

A checklist of the phytoplanktons is presented in **Appendix.** The recorded major families of phytoplanktons were three (3); namely Baccillariophyta, Cyanophyta, Chlorophyta, Euglenophyta, Dinophyta. The contribution of each of the major families of phytoplankton in the aquatic environment is graphically presented in **Figure 4.19.**

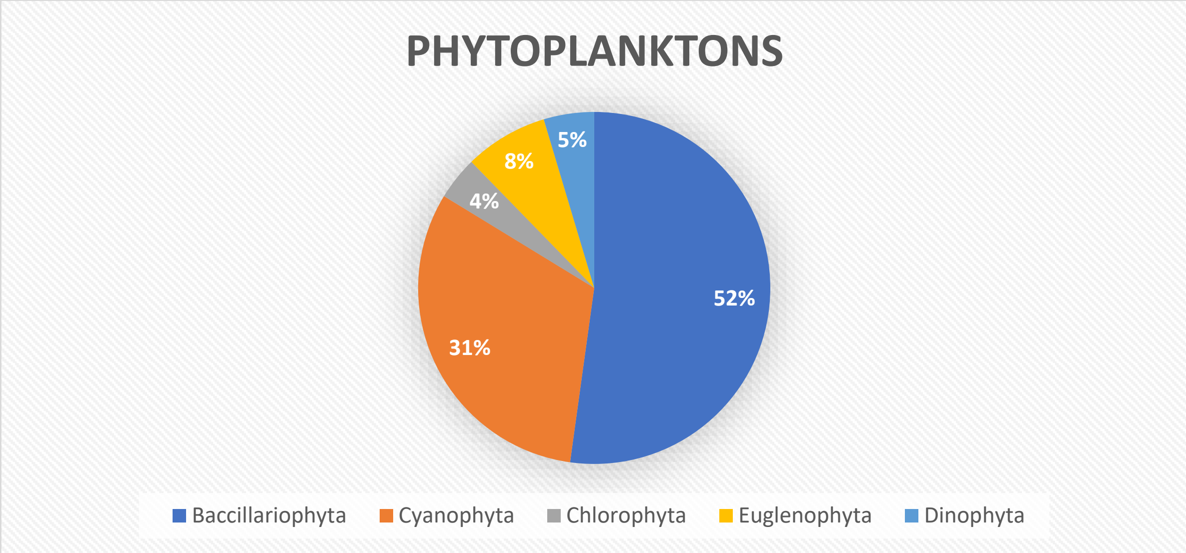


Figure 4.21: Families of Phytoplanktons around the Study area

Baccillariophta were the dominant family and constituted 52% of the total number of phytoplankton. The Baccillariophyta were represented by 38 species in the sampled locations with numerical contribution ranging from 0.25% (*corethrone sp*) to 5.2% (*Nitzchia sp)*. The second dominant family of phytoplanktons was Cyanoophyta, which contributed 31% of the total number of phytoplankton count (**Figure 4.20**). They were represented by 22 species. The dominant Cyanophyta specie was *Oscillatoria chalybalea* (2.72%). The least dominant specie was *Isocystis sp.* (0.2%). In all, the dominance pattern of the various families of phytoplankton was Baccillariophyta > Cyanophyta< Euglenophyta > Dinophyta > Chlorophyta.

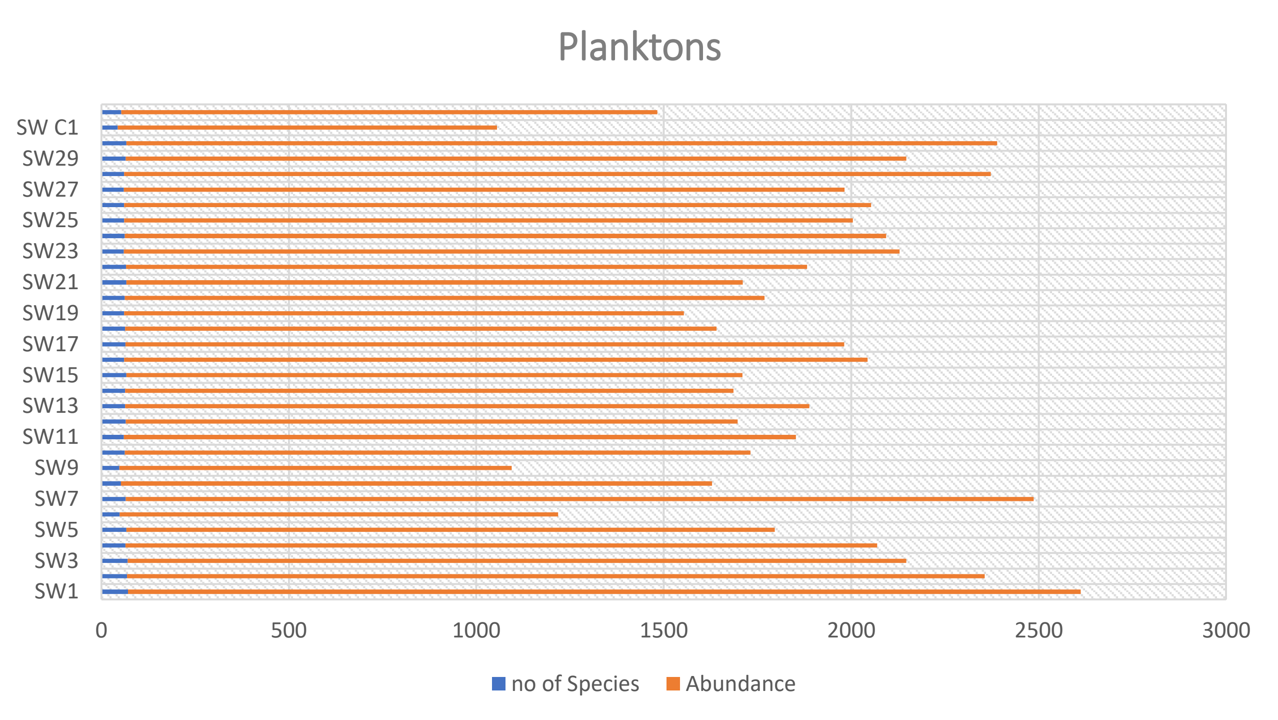


Figure 4.22: Phytoplanktons around the study area

Diversity measures for Phytoplanktons Diversity indices measure the stability and resilience capacity of ecosystems against any form of perturbations. The results of diversity analysis for phytoplankton (**Table 4.11 and Figure 4.21**) revealed that the study area around the proposed Deepsea port project was highly diverse and ecologically stable.

Table 4.11: Phytoplankton Diversity Indices

Diversity Indices	Mean	Min	Max
no of Species	61.625	44	71
Abundance	1821.531	1011	2541
Dominance_D	0.029171	0.02094	0.03649
Simpson_1-D	0.970831	0.9635	0.9791
Shannon_H	3.760781	3.583	3.991
Evenness_e^H/S	0.705694	0.5828	0.8767

Brillouin	3.680938	3.497	3.923
Menhinick	1.455406	1.269	1.653
Margalef	8.086563	6.215	9.033
Equitability_J	0.914088	0.8716	0.9668
Fisher_alpha	12.36638	9.384	14.04
Berger-Parker	0.066018	0.03776	0.09606
Chao-1	62.36594	44	75.33

Zooplanktons

Zooplanktons are microscopic animals found mainly in the pelagic zone of water bodies where they depend on water currents and waves for motion. The zooplankton occupy a central position in the food webs of aquatic ecosystems and many of them feed largely on phytoplankton, algae and bacterial, and in turn, fall prey to numerous invertebrate and fish predators. They are good biological indicators of water quality as their sensitivity to environmental factors (natural and man-made), makes them of considerable significance in pollution and environmental impact assessment studies (Asibor 2001).

A checklist of the zooplanktons around the project area is presented in **Appendix.** The recorded major families of zooplanktons were six (6); namely Copepoda, Rotifers, Hydrozoas,Decapod larvae, Molluscan larva and Chaetognatha,. The contribution of each of the major families of phytoplankton in the aquatic environment is graphically presented in **Figure 4.22.**

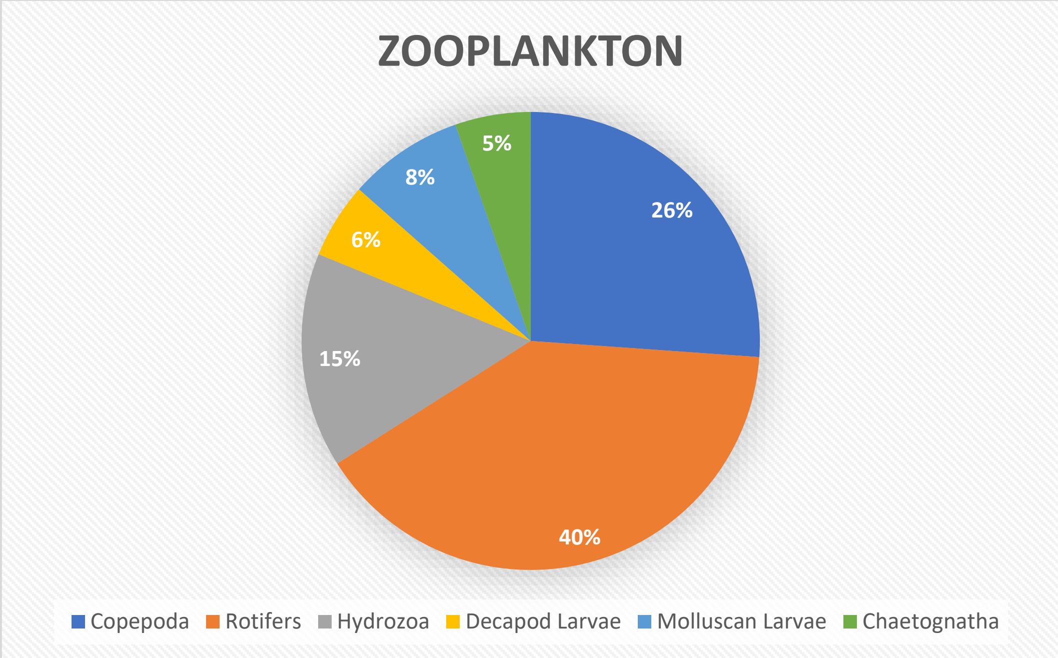


Figure 4.23: Families of Zooplanktons around the Study area

Rotifers were the dominant family and constituted 52% of the total number of zooplankton. The Rotifers were represented by 12 species in the sampled locations with numerical contribution ranging from 0.77% (*Trichocerca vostei*) to 3.98% (*L. climacois)*. The second dominant family of zooplanktons was copepoda, which contributed 26% of the total number of phytoplankton count. They were represented by 14 species. The dominant Copepoda specie was *Oscillatoria Cycopina longicornis (*5.48%). The least dominant specie was *Copila mirabilis.* (1.11%). In all, the dominance pattern of the various families of phytoplankton around the study area was Rotifers > Copepoda < Hydrozoa > Molluscan Larvae > Decapodlarvae > Chaetognatha.

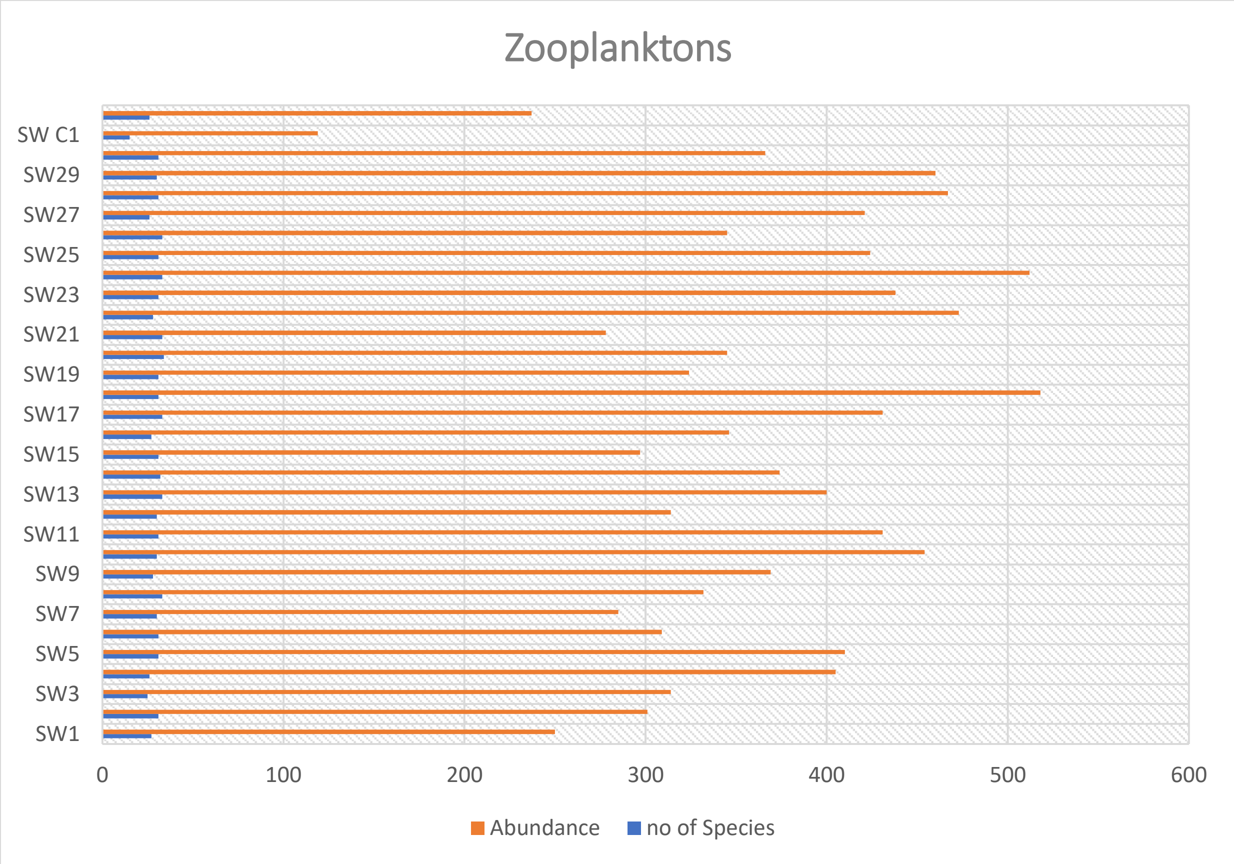


Figure 4.23: Zooplanktons around the study area

Diversity measures for zooplanktons Diversity indices measure the stability and resilience capacity of ecosystems against any form of perturbations. The results of diversity analysis for zooplankton (**Table 4.12and Figure 4.23**) revealed that the study area around the proposed Deep sea port project was highly diverse and ecologically stable.

Table 4.12: Zooplankton Diversity Indices

Diversity Indices	Mean	Min	Max
no of Species	29.78125	15	34
Abundance	367.1563	119	518
Dominance_D	0.058618	0.04857	0.09639
Simpson_1-D	0.941375	0.9036	0.9514
Shannon_H	3.05975	2.482	3.215
Evenness_e^H/S	0.723747	0.6481	0.7979

Brillouin	2.903906	2.279	3.068
Menhinick	1.577031	1.267	1.979
Margalef	4.892625	2.929	5.686
Equitability_J	0.904166	0.8726	0.9297
Fisher_alpha	7.751625	4.541	9.749
Berger-Parker	0.117154	0.08398	0.1647
Chao-1	29.965	15	34

Benthic Invertebrate Fauna

The benthic invertebrate fauna are organisms which are over 1.0mm in size, living on or in the substrate of a water body. They may be wholly or partially buried in soft or hard substrates. They constitute the consumer trophic level and contain the top-level predators in the aquatic ecosystem. These organisms are economically and ecologically important. They have been used as bio-indicators in pollution/impact assessment studies (Asibor and Adeniyi 2017; Asibor 2015; Okoroafor 2014. Ayoade and Olusegun 2012; Arimoro *et. al*. 2007).

A checklist of the benthos around the project area is presented in **Appendix.** The recorded major families of benthos were six (6); namely Crustacea, Polychaete, Gastropods and Bivalve Molluscs. The contribution of each of the major families of phytoplankton in the aquatic environment is graphically presented in **Figure 4.24.**

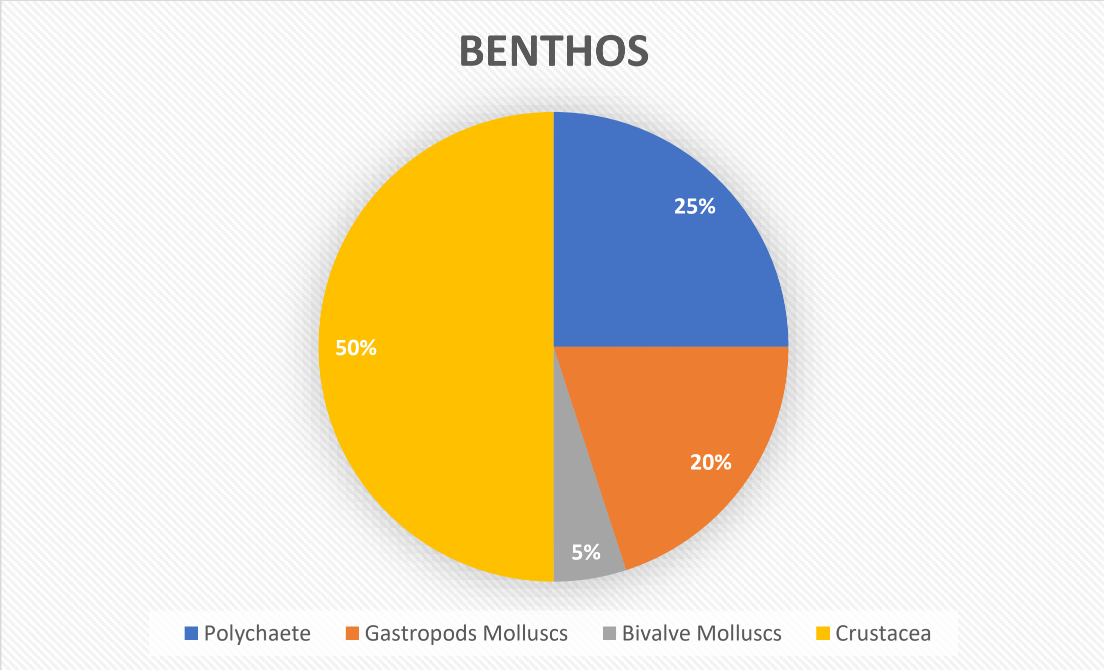


Figure 4.24: Families of Benthic Organisms around the Study area

Crustacea were the dominant family and constituted 50% of the total number of Benthos (**Figure 4.23 and Appendix**). The crustacea were represented by 8 species in the sampled locations with numerical contribution ranging from 1.27% (*Gammarus*) to 5.5% (*Trinad sp)*. The second dominant family of benthos was polychaete, which contributed 25% of the total number of phytoplankton count (**Figure 4.23**). They were represented by 11 species. The dominant polychaete specie was *Nephtys incisa (*5.07%). The least dominant specie was *Hyposoimus sp.* (2.33%). In all, the dominance pattern of the various families of phytoplankton around the study area was Crustacea>Polychaete>Gastropods Molluscs>Bivalve Molluscs.

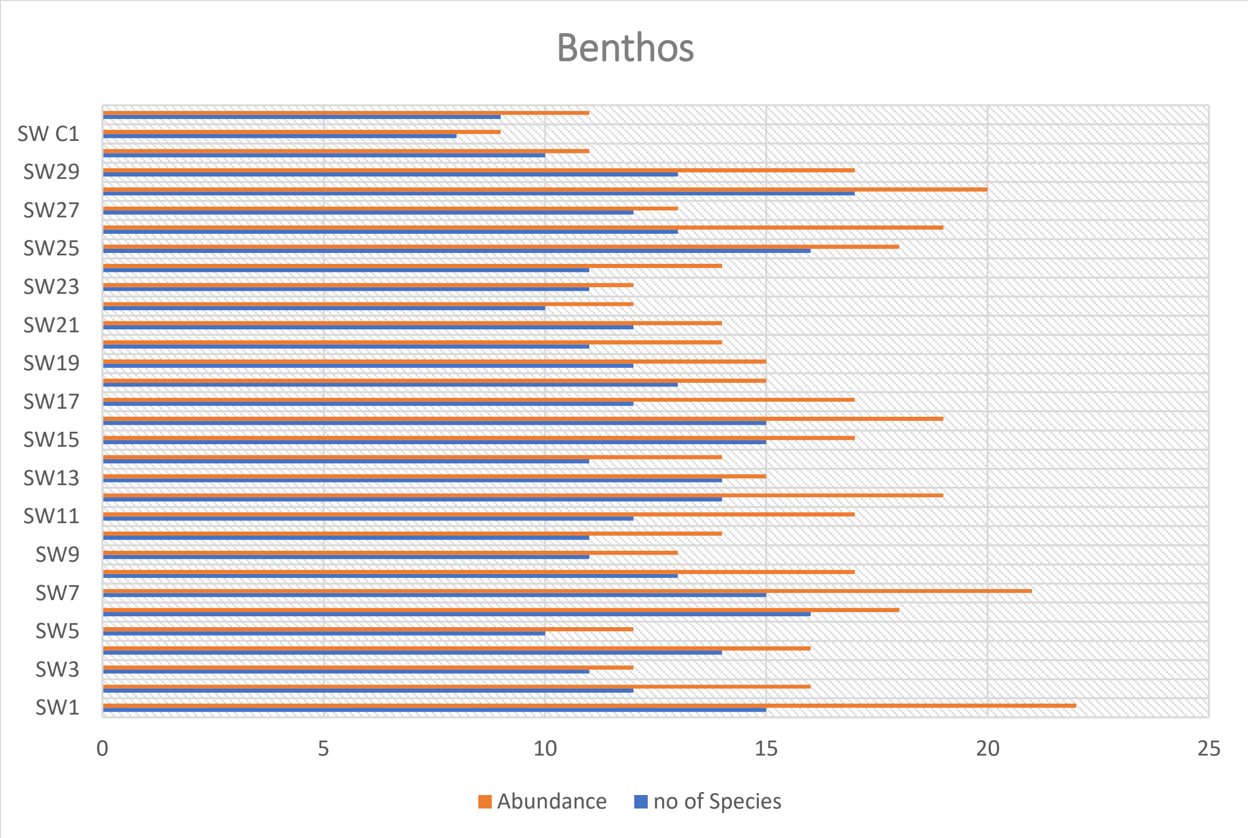


Figure 4.25: Benthos around the study area

Diversity measures for benthic Diversity indices measure the stability and resilience capacity of ecosystems against any form of perturbations. The results of diversity analysis for benthos (**Table 4.13 and Figure 4.25**) revealed that the study area around the proposed Deep sea port project was highly diverse and ecologically stable.

Table 4.13: Benthic Diversity Indices

Diversity Indices	Mean	Min	Max
no of Species	12.46875	8	17
Abundance	15.40625	9	22
Dominance_D	0.092687	0.0679	0.1358
Simpson_1-D	0.907322	0.8642	0.9321
Shannon_H	2.454656	2.043	2.762
Evenness_e^H/S	0.947947	0.9109	0.9768

Brillouin	1.735531	1.345	1.993
Menhinick	3.176531	2.667	3.801
Margalef	4.196844	3.186	5.341
Equitability_J	0.978613	0.9611	0.9911
Fisher_alpha	39.12375	18.15	102.6
Berger-Parker	0.147711	0.09524	0.2222
Chao-1	28.19344	15.5	69.5

Fishery Study

Fishing activity in the study area is carried out in the nearby watercourses including the Rivers and Creeks, within a few nautical miles from the communities while very insignificant proportion of fishers do fishing up to the Atlantic Ocean. Several types of fishing gears and methods are employed by fishers in the study environment. The principal gears and methods utilized by fishers were identified to include, throwing of nets and setting traps with a hand-paddled canoe, the use of hook-lines and hand lines respectively. Some fishers trawl parallel to the shore, others use hand-lines and the seine nets for fishing. In all, the artisanal canoe (hand-dug wooden boat) is the main fishing vessel used by majority of fishers in the project study environment, while less than a quarter use both the hand-pulled and engine-powered boats for their fishing expedition.

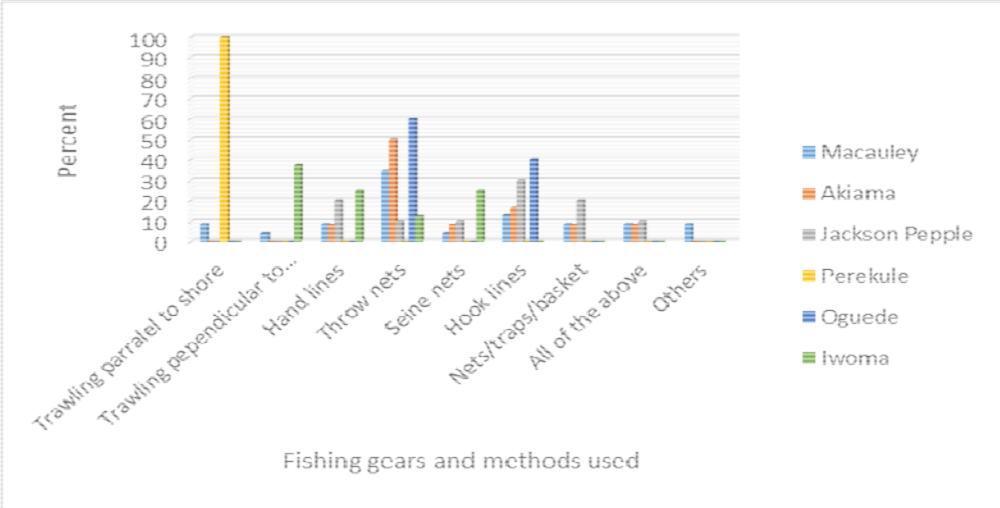


Figure 4.26: Fishing Gears and Methods in Study Area

(Source: MPN Fieldwork for EIA of BLRP, 2018)

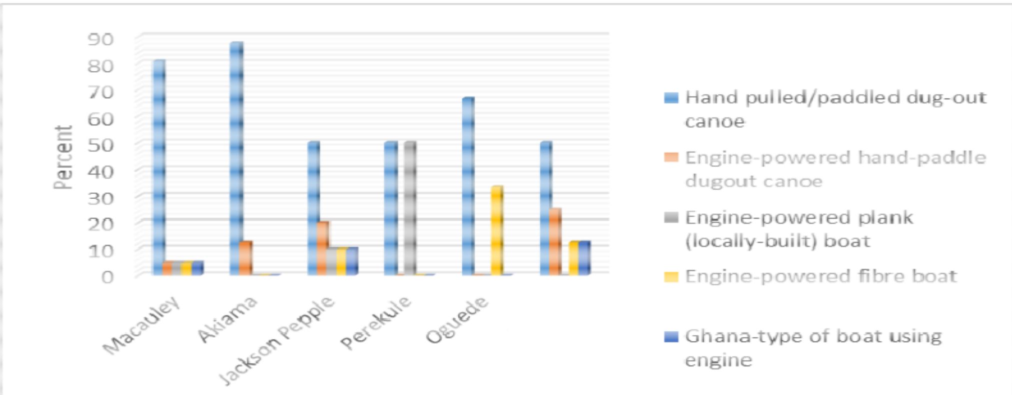


Figure 4.27: Type of Fishing Vessel/Canoe used by Fishers

(Source: MPN Fieldwork for EIA of BLRP, 2018)

The boat size measures some 6 metres in length, mostly dugout canoes with some artisanal canoes measuring up to 8 metres, while close to one quarter of the fishers also claimed to use boats as big as 8 metres to 35 metres in length (locally built trawlers). The type of fish caught from fishing expeditions included the shining nose, cat fish, tilapia, scale fish and the red snapper. Fishing implements are artisanal, yet quantities caught more than meet domestic requirements, hence there is a large scale trade in fish. It is widely claimed that implements are expensive. The womenfolk collect periwinkles, oysters and other pelagic organisms (barnacles) along the riverbanks and mangrove forests. An insignificant fraction or members of the resident population were also observed to be engaged in other fisheries-related industry activities particularly, weaving of traps and baskets for fish drying and fetching of firewood as energy for smoking of the fish

The project affected population (PAP) alleged that fisheries productivity and catch have decreased considerably over the years. This is due to water pollution, arising from oil and gas activities, high-sea-going vessels and boats and their discharges of oil/diesel on the water courses, which have polluted the water, killed the fishes, and reversed fisheries' productivity and catches formerly gotten from fishing efforts. Fishing productivity measured qualitatively by catch per unit effort (CPUE) also revealed reduced harvest. Over two thirds of the sampled respondents alleged there has been a drastic reduction in harvests in recent years. Some also thought fish catches have remained the same and increased respectively

As to what could be the reason for the observed decrease in fisheries' harvest in recent years, some respondents identified '' it as a result of local (artisanal) refinery activities, also known as 'kpo fire' as well as ''increased population and fishermen involved in the fishing activity'' as principal causes. Lack of funds to acquire fishing gears and equipment (boats and engines) needed for modern fishing was also identified.

Plate 4.6: Pictures of Fish catch around the project area during the study

Exploitation of fish resources in the study area is largely by artisan fishers. These fishers operate in dugout wooden canoes measuring 7-10m in length and 0.6-1.8m in width. The boats are hand-paddled and movement is occasionally complimented by the use of sail. Two fishers usually operate each boat. Fishing gears are largely made of long setlines, circling nets and seine nets of different mesh sizes varying between ½”, 1”, 1½”, 2”, 2½ and 3” (1.0 mm to 5.0 mm). Gears measure 6-12m in length and 2-4 meters in width. Nets are manually operated. They are set and allowed to stay for up to one hour before they are removed with the catch. When the net is set and before it is removed another net is also set. Catch rates are seasonally dependent and varied between 15-120 kg/day depending on the season. The fish species identified in the landings of these fishers and their relative abundance in the study area is presented in below.

Table 4.14: Species Composition of Fishes within Bonny Creeks River

FAMILY	SPECIES	COMMON NAME	ABUNDANCE RATING
Family Megalopidae	*Tarpon atlantica*	Tarpon	1
Family Pristidae	*Pristis pristis*	Saw fish	2
Family Ephippidae	*Chaetodipterus goreensis* (Cuv., 1831)		3
Family Clupeidae	*Ethmalosa fimbriata* (Bowdich, 1875)	Bonga	4
	Sardinella maderensis (Lowe, 1939)	Sardine	4
	Sardinella aurita (Lowe, 1939)	Sardine	3
Family Mugilidae (Mullets)	*Liza falcipinnis*[Val,1836]	Mullet	3
	Liza grandisquamis [Val, 1836]	,	4
	Mugil bananensis [Pellegrin, 1927]	,	3
	Mugil curema Val, 1836	,	4
Family Sphyraenidae	*Sphyraena guachancho* Cuvier, 1829	Barracudas	2
Family Polynemidae	*Galeoides decadatylus* (Bloch, 1795)	Threadfins	2
	Pentanemus quinquarius (Linn, 1758)	Shiny nose	3
	Polydactylus quadrafilis		3
Family Eleotridae	*Butis koilomatodon* [Bleeker, 1849]	Sleepers	2
Family Elopidae (Lady fishes)	*Dormitator pleurops* [Boul, 1909]	Lady Fish	1

Family Trichuridae	*Trichuris lepturis* Linn, 1758		**2**
Family Drepanidae	*Drepane africanus* Osorio, 1892	Spade Fish	2
Family Scianidae	*Pseudotolithus senegalensis*	Short croaker	2
	P. elongates	Long croaker	2
	P. brachignathus (Bleeker, 1863)	Croaker	1
	P. typus (Bleeker, 1863)	Croaker	1
Family Scombridae (Tuna, Mackerels)	*Scomberomorus tritor* (Cuv., 1831)		3
	Thunnus obesus	Big eye tuna	2
	T. albacares	Yellow fin tuna	3
	Euthynnus allettratus	Frigate tuna	2
Family Lutjanidae	*Lutjanus goreensis* (Val., 1830)	Snapper	2
	L. dentatus Dumeril, 1858		3
	L. agennes Bleeker, 1863		2
laemulidae (Grunts)	*inchus macrolepsis* (Bleeker, 1863**)**	Grunt	1
	Pomodysis jubelini (Cuvier, 1830)		1
	P. peroteti (Cuvier, 1830)		2

Table 4.15: Species Composition of Fishes (Cont'd.)

FAMILY	SPECIES	COMMON NAME	ABUNDANCE RATING
Family Lobotidae	***Lobotes surinamensis* (Bloch, 1870)**		**1**
Family Gerreidae	***Eucinostomus melanopterus* (Bleeker, 1863)**		**1**
Family Serranidae	***Epinephellus aeneus* (G. Saint Hilaire, 1809)**	**Groupers**	**2**
yngnathidae	***Enneacampus kaupi* (Boulenger, 1909)**		**1**
Family Ariidae	***Arius heudeloti* (Val., 1840)**	**Sea catfish**	**2**
	***A. latisculatus* (Gunther, 1864)**	**Sea catfish**	**1**
	A. gambiensis	**Sea catfish**	**2**
	A. mercatoris	**Sea catfish**	**2**
Family Denticipitidae	***Denticeps clupeoides* (Clausen, 1959)**	**Denticle herring**	**1**

Key to Abundance Rating: 1 = Rare; 2 = Low abundance; 3 = Abundant; and 4 = Very Abundant.

4.8.2 Condition Factor/Fecundity

The mean condition factor (K) of fish samples obtained from the study area is shown in **Table 4.11**. These conditions ranged between 1.8 and 2.1. According to Bagenal 1978, these fishes are in a generally healthy state. The gonadosomatic index (G. S. I.) and fecundity of various species of fish as shown below and G. S. I values ranged between 2.8 and 3.3.

Table 4.16: Condition Factor of Fish Species within Patrick water side

Fish species	Condition (K)	GSI	Fecundity
Arius heudeloti	2.1	2.9	8, 421± 1,126
Thunnus obesus	2.0	2.8	15, 800 ± 1, 241
Trichuris lepturis	2.0	3.1	15, 000 ±3,935
Liza grandisquamis	1.8	2.9	15, 500 ± 5550
Strongylura senegalensis	2.0	3.3	17, 500 ± 2,800
Drepane africanus	1.9	2.9	10, 500 ± 3,451
Scomberomorus tritor	2.0	3.0	17, 450 ± 3,500

4.8 Soil Quality

Thirty- two (32) surface and subsurface soil samples were collected from designated sampling points including two (2) controls as shown in the sampling map. Results of the laboratory analysis are presented in the Appendices while the results summary is shown in **Table 4.14.**

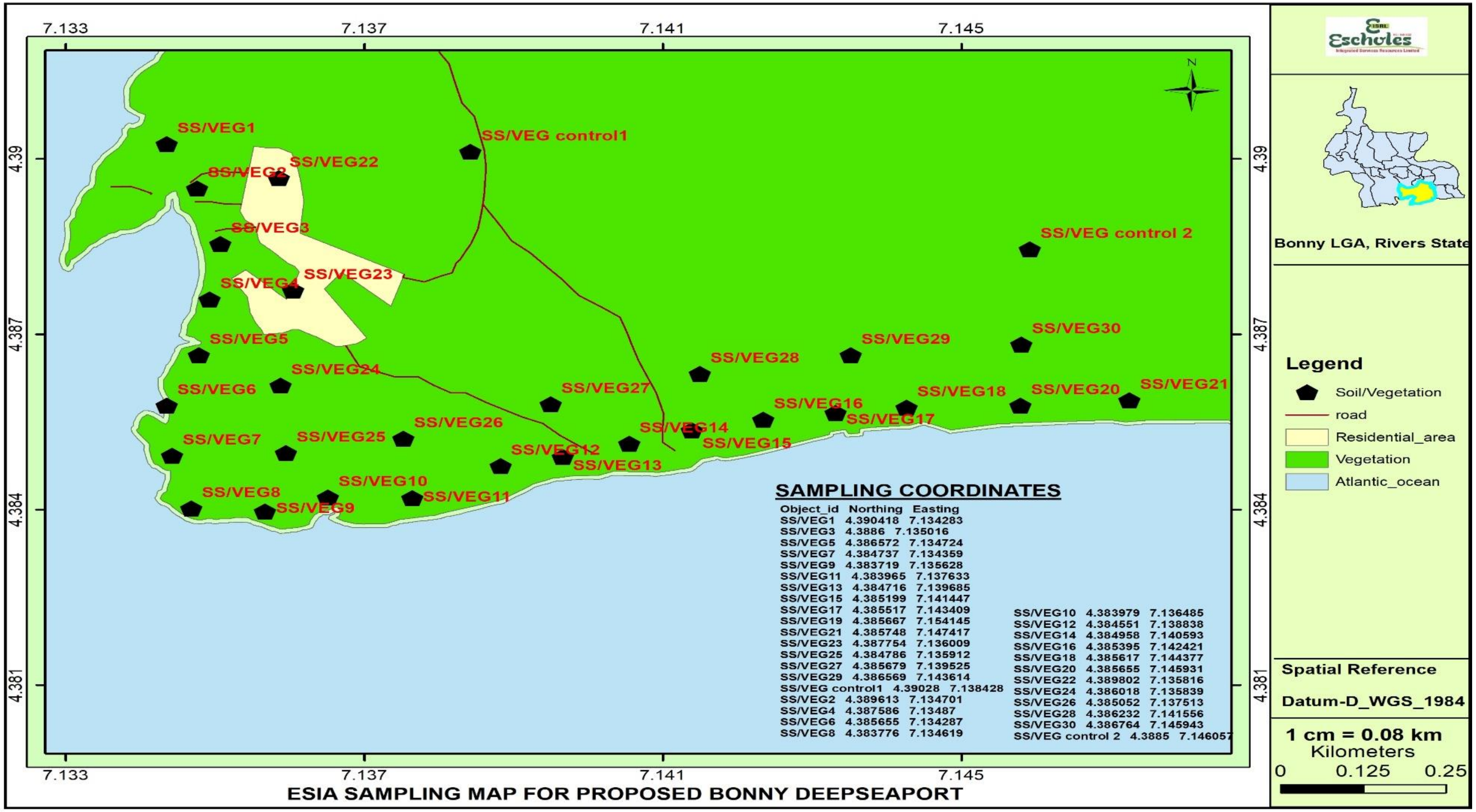
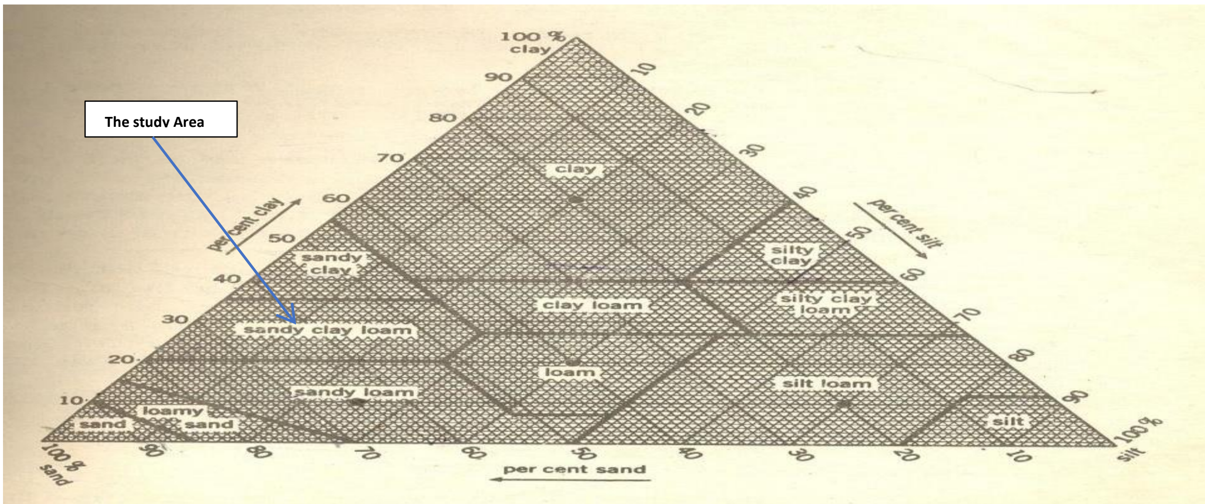


Figure 4.28: Map showing sampling stations for air quality, soil and Groundwater. Source: Fieldwork, 2020

Soil Physical Properties

The texture varied from coarse sand to sandy clay. Clayey soils are the most unfavorable. Sometimes, clay soil even pumps water up into the pavement, which eventually leads to failure of the pavement. Some amount of sand in the soil is not a bad thing, though. Too much sand as seen during the investigation will help drain the pavement and inhibit compaction of the soil.



(*Source: Donahue et al., 1990)*

Figure 4.29: Particle Size Distribution within the Study Area

Soil Chemical Properties

Soil pH and Electrical Conductivity

The chemical properties of the soils are presented in Table 4.3 Average soil pH of the study area top soil was acidic (5.26) as against 5.00 at the sub soil (strongly acidic). The strong to very strongly acidity could be attributed to leaching loss of exchangeable bases due to high soil moisture (Aroh, 2003). Severe acidification can cause nonreversible clay mineral dissolution and a reduction in cation exchange capacity, accompanied by structural deterioration (Goulding, 2016).

Average Electrical conductivity EC was 105440 and 91900us/cm in top and subsoil of the study area respectively. The high EC is associated with high salinity of the sea water. Smith and Doran (1996) found that EC above 1000 uS/cm is detrimental for crop growth. Soil microorganism activity declines as EC increases. This impacts important soil processes such as respiration, residue decomposition, nitrification, and denitrification.

Soil Organic Carbon, Nitrates and Phosphorus

The average Total organic carbon was 0.84 and 0.69% in the study area. Some soils analysed were very deficient compared to the critical level of 1% in Nigeria (Agboola and Ayodele, 1987). Low organic carbon is an indicator of low organic matter and its contribution to plant nutrient availability (Brady and Weil, 1999). High EC of the soil will lead to the destruction of useful soil microbes.

The soil nitrate in line with the soil organic carbon were very low in the study area with a mean value of 1.29 and 1.14mg/kg in the study area for top and sub soil respectively. This indicates low organic materials and low mineralization by microbes in the soil. Available Phosphorus content of the soils was very low. Mean contents of P recorded were 0.60 and 0.51 mg/kg in the top and subsoil of the study area respectively. The low total N and P is in relation to low soil organic carbon that could be mineralized to enrich the soil N and P. The very low N and P of the soils could also be attributed to leaching loss, low litter mineralization due to high EC and nature of clay mineral.

Exchangeable cations

Mean exchangeable K in the top and subsoil of the study area 0.88 and 0.77 mg/kg. Mean Mg and Ca were generally deficient with mean values of 1.25 and1.14 mg/kg respectively for Mg in top and sub soils and then 1.76 and 1.64mg/kg for Ca in top and sub soils. The low concentrations of exchangeable cations (Ca and Mg) could be due to the inherent low contents of the clay minerals and the soils may have significantly lost these cations through leaching and other weathering processes. In relation to the low Ca and Mg values, Na was also low as mean values at top and sub soil were 0.51and 0.42mg/kg respectively.

Table 4.17: Soil Physico-Chemical Properties

Parameters			pH	EC, MS/cm	TOC, %	SO_4, mg/kg	NO_3, mg/kg	Av. P, mg/kg	Ca, mg/kg	Mg, mg/kg	K, mg/kg	Na, mg/kg
Bonny Deep Sea Port ESIA	Mean	Top-soil	5.26	105.44	0.84	3.34	1.29	0.60	1.76	1.25	0.88	0.51
		Sub-soil	5.00	91.92	0.69	3.17	1.14	0.51	1.64	1.14	0.77	0.42
	Min	Top-soil	4.07	26.41	0.26	1.58	0.33	0.13	0.51	0.30	0.23	0.11
		Sub-soil	3.80	18.73	0.20	1.36	0.25	0.08	0.46	0.23	0.18	0.07
	Max	Top-soil	6.41	420.08	1.67	6.84	2.94	1.26	4.11	3.69	1.88	1.21
		Sub-soil	6.34	370.14	1.41	6.56	2.68	1.21	4.05	3.56	1.72	1.14
Bonny Oloma EIA (Dry), 2018 (Mean)		Top-soil	5.86	0.13	0.71	3.37	0.05	0.04	1.60	0.83	1.85	14.17
		Sub-soil	5.90	0.12	0.64	3.95	0.05	0.03	1.94	1.57	3.26	12.36

Heavy Metals

The heavy metals analysed include Iron (Fe), Copper (Cu), Zinc (Zn), Lead (Pb), Cadmium (Cd), Chromium (Cr), Vanadium (V), Nickel (Ni), Barium (Ba) and Arsenic (As). The levels obtained from the analyses of most the metals shows values below equipment detection limit of AAS used for analysis. However values were obtained for Fe> Cu> Zn> Cr.

Iron and Cu occurred in mean concentrations of 90.23 and 7.32 mg/kg respectively in top soil and then 47.23 and 2.84mg/kg in sub soil. While Zn and Cr occurred in mean concentrations of 1.50 and 0.10 mg/kg respectively in top soil and then 0.53 and 0.04mg/kg in sub soil.

4.18: Soil Heavy metals Content

Parameters			Fe, mg/kg	Cu, mg/kg	Zn, mg/kg	Pb, mg/kg	Cd, mg/kg	Cr, mg/kg	V, mg/kg	Ni, mg/kg	Ba, mg/kg	As, mg/kg
Bonny Deep Sea Port ESIA	Mean	Top-soil	90.23	7.32	1.50	BDL	BDL	0.10	BDL	BDL	BDL	BDL
		Sub-soil	47.23	2.84	0.53	BDL	BDL	0.04	BDL	BDL	BDL	BDL
	Min	Top-soil	38.77	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
		Sub-soil	15.20	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Max	Top-soil	156.48	56.40	9.88	0.02	BDL	0.28	BDL	BDL	BDL	BDL
		Sub-soil	89.54	19.13	6.57	BDL	BDL	0.12	BDL	BDL	BDL	BDL

Bonny Oloma EIA (Dry), 2018 (Mean)	Top-soil	1187.51	0.28	16.97	3.77	0.57	0.29	0.06	5.00	0.34	ND
	Sub-soil	1055.40	0.27	17.84	4.00	0.42	0.27	BDL	4.68	0.40	ND

Hydrocarbons

Total hydrocarbon content (THC), Total petroleum hydrocarbon (TPH), total polycyclic aromatic hydrocarbon (PAH) and total BTEX contents of the soils occurred in traces or below detectable limits and therefore possesses no threats in soils of the study area and the control.

Soil Microbiology

In the study area THB count was highest in the top and subsoil (1.90 and 1.73 x 10^7 cfu/g). THF counts was also higher in the top and subsoil of the study area; mean THF 0.26 and 0.15 x 10^3 cfu/g were recorded in the study area respectively at both depths of top and sub soil. In reverse to the higher THB in the study area, mean HUB of 0.41 and 0.27 x 10^5 cfu/g was recorded in the study area respectively at both depths of top and sub soil. HUF followed similar pattern of HUB. However, microbe contents were not significantly different in both soils. Rashid et al. (2016) asserted that the proliferation of soil bacteria and fungi contributes to bioavailability and aggregate formation in degraded soils especially with very low nutrient reserve.

Table 4:19 Soil Hydrocarbons and Microbiological Properties

Parameters			THC, mg/kg	TPH, mg/kg	PAH, mg/kg	BTEX, mg/kg	THB, cfu/gx10^7	THF, cfu/g x10^3	HUB, cfu/g x10^5	HUF, cfu/g x10^1
Bonny Deep Sea Port ESIA	Mean	Top-soil	BDL	BDL	BDL	BDL	1.90	0.26	0.41	0.10
		Sub-soil	BDL	BDL	BDL	BDL	1.73	0.15	0.27	0.02
	Min	Top-soil	BDL	BDL	BDL	BDL	1.47	ND	ND	ND
		Sub-soil	BDL	BDL	BDL	BDL	1.40	ND	ND	ND
	Max	Top-soil	BDL	BDL	BDL	BDL	2.84	0.76	0.96	0.41
		Sub-soil	BDL	BDL	BDL	BDL	2.53	0.63	0.74	0.21
Bonny Bonny Oloma EIA (Dry), 2018 (Mean)		Top-soil	-	BDL	BDL	BDL	30	3.500	1020	64
		Sub-soil	-	BDL	BDL	BDL	30	4.040	-	-

4.9 Vegetation Studies

The species composition, plant vigor, vegetation structure, diseased plant etc were assessed. The dominant plant species were identified and the unidentified plant species were taken to University of Port Harcourt Herbarium for proper identification. The study area is located in the rain forest zone of south-south Nigeria.

Vegetation types within the study area are mainly mangrove, freshwater swamp forest, dry land rain forest, mixed mangrove/swamp forest vegetation and some bush fallow on cleared areas of the forest.

Plate 4.7: Mangrove Swamp Forest

Within the study area, mangrove vegetation types are found in the tidal plans and are the predominant vegetation around Olom Abalami, Ayaminima, Abalaiyie, New Finima and Coconut Estate. The dominant mangrove species found within this area include *Rhizophora racemosa, Rhizophora mangle, Rhizophora harrisonii and Avicennia* spp. Species zonation within these areas are fairly parallel to the coastline, with *R. racemosa* at the edge of the coast while *R. harrisoii and R. mangle* further inland. Other associated species in these areas are *Nypa fruticuns, Acrostichum aureum*; grasses such as *Paspalum vaginatum sp*., and dicot herb such as *Dalbergia ecastaphyllum* (**Plate 4.7**).

Plate 4.8: Mangrove Swamp Forest vegetation

Structure

The life-form spectrum in this mangrove forest is dominated by mesophanerophytes, megaphanerophytes and microphanerophytes, constituting about 84% of the total life-form types and represented by *Rhizophora racemosa*, *Rhizophora mangle*, *Rhizophora harrisonii. Laguncularia racemosa* and *Avicinia africana.* This makes the forest woody. The non-mangrove species consist of *Nypa fruticans, Acrostichum aureum and Paspalum vaginatum*.

Relative Abundance of the Mangrove Swamp Forest Vegetation

The most abundant species in the mangrove swamp forest vegetation *is Rhzophora mangle* with relative abundance of 24.26%. This is followed by *Rhzophora racemosa* 18.38%, *Paspalium vaginatum* 14.71%, *Nypa fructicans* 13.24%, *Acrostichum aureum* 11.76%, *Avicenia Africana* 7.35% and *Rhizophora harrisonii* 5.88%. The least relative abundance was recorded by *Laguncularia racemosa* 4.41%.

These forest ecosystems comprised patches of freshwater swamp vegetation and dry land species and are found within the freshwater and brackish water bodies. The plant species within this vegetation types are mixture of mangrove and rain forest species. Also, they have large areas of freshwater swamp mixed with either mangrove, open swamp, dry land rainforest or dune slacks are found over much of the study areas. This vegetation type occurred further away from the coastline behind the mangrove vegetation and made up of terrestrial/swamp forest species such as *Raphia* spp., *Pandanus* spp., *Calamus* spp., *Alchonea cordifolia, Cyrtosperma* spp., *Ancistrophyllum* spp. and some timber species such as *Mitragyna* sp., *Symphonia* sp., *Tectonia grandis, Cliestopholis patens, Uapaca guineensis, Elaeis guineensis* and undifferentiated inland swamps, which are seasonally flooded and have an open structure with dense shrubs and lianas. These forests can also be associated with aquatic grassland and herbaceous swamps, usually found at the outer edges of the swamp forest.

The most abundant species in the swamp forest vegetation are trees/small trees, herbs, shrubs and with relative abundance of 34.95%, 26.34% 20.43% and 13.44% respectively while the least abundant species grasses 4.84% (**Figure 4.28**).

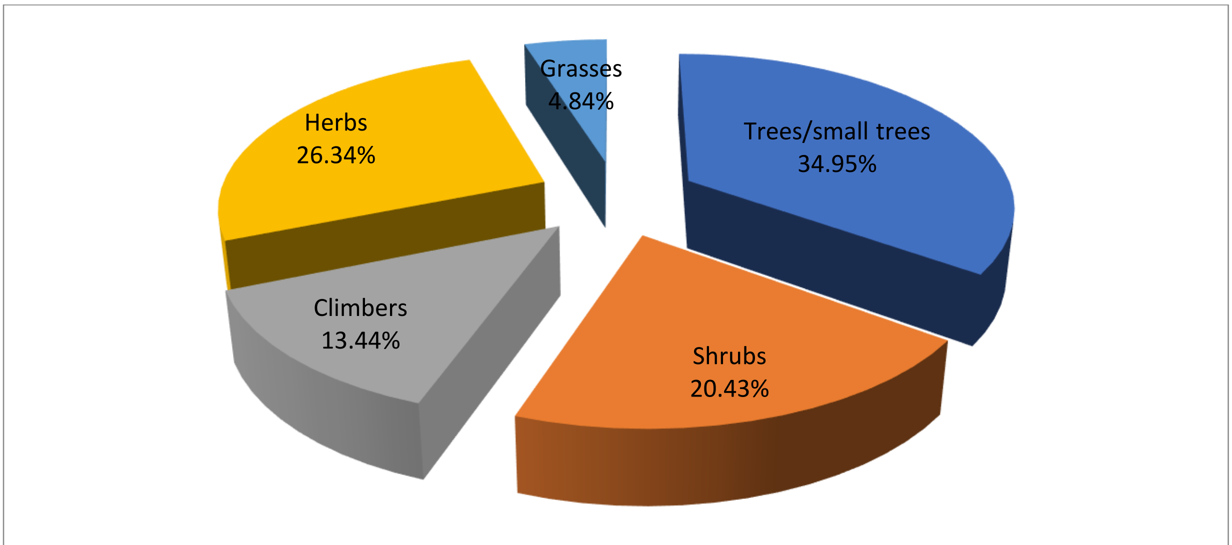


Figure 4.30: Relative Abundance of Dominant Plant Species in Swamp Forest Area

Plant Uses

Plants within the study area have several economic, social and ethno-botanical uses and some of which are as follows:

- They provide nestling site for sea, terrestrial and shoreline birds and habitants for diverse animal life;
- The of mangrove trees serve as a critical nursery for fisheries, prawn and habitants for crabs and molluscs; and
- The silt roots of *Rhizophora* spp. bind the tidal mudflats together; hence ensure the stabilization of soil and protection of shoreline from erosion.
- Provide raw materials for the manufacturing of fishing traps, carving of canoes, building of houses, Source of timber and as domestic energy source (firewood).
- The roots, leaves and bark of some of plants are for by the locals for the treatment of many ailments such as stomach disorder, ear and eye infections, infertility in male and female, etc
- Trees such as *Newbuldia leavis* and *Dracinia* spp. are used as boundary trees and are in and their shrines.
- *Nypa fructicans* and *Raphia* spp. leaves are used for roofing thatch.

The Checklist of some of the economic plants encountered during the field work and their uses is presented in **Table 4.20.**

Table 4.20: Checklist of Some Economic Plants in the Study Area

S/N	Species Name	Economic importance	Status within the study area
1	*Acrosticum* spp.	Fish trap	Satisfactory
2	*Aframomum* spp.	Medicinal	Satisfactory
3	*Alchornea cordifolia*	Medicinal/fuel wood	Satisfactory
4	*Alstonia boonei*	Medicinal/fuel wood	Satisfactory
5	*Anthocliesta vogelii,*	Fuel wood	Satisfactory
6	*Avicennia* spp	Fish trap	Satisfactory
7	*Calamus* sp.	Fish trap	Satisfactory

9	*Chromolenea ordorata.*	Medicinal	Satisfactory
10	*Cliestopholis pentans*	Timber/fuel wood	Satisfactory
11	*Elaeis guineensis,*	Food/fuel wood	Satisfactory
12	*Garcina kola*	Medicinal/timber/fuel wood	Satisfactory
13	*Dracinia* sp.	Medicinal/fuel wood	Satisfactory
14	*Harungana* sp	Fuel wood	Satisfactory
15	*Ipomea* spp.	Food	Satisfactory
16	*Macaranga heterophylla*	Timber/fuel wood	Satisfactory
17	*Mangifera indica*	Food/fuel wood	Satisfactory
18	*Millettia thonningii*	Fuel wood/medicinal	Satisfactory
19	*Mitragyna stipulosa*	Timber/Fuel wood	Satisfactory
20	*Musanga* sp.	Timber/Fuel wood	Satisfactory
21	*Napoleana* sp	Medicinal/ fuel wood	Satisfactory
22	*Nauclea pobeguinii*	Timber	Satisfactory
23	*Newbuldia leavis*	Medicinal/food	Satisfactory
24	*Phylanthus amarus*	Medicinal	Satisfactory
25	*Pteridium aquilum*	Vegetable	Satisfactory
26	*Raphia* spp.	Wine/thatch	Satisfactory
27	*Rhizophora harrisonii*	Fuel wood/ Fish trap	Satisfactory
28	*Rhizophora mangle*	Fuel wood/ Fish trap	Satisfactory
29	*Rhizophora racemosa*	Timber/fuel wood/ Fish trap	Satisfactory
30	*Sterculia tragacantha*	Fuel wood	Satisfactory
31	*Symphonia globulifera*	Timber/fuel wood	Satisfactory
32	*Tectonia grandis*	Timber/fuel wood	Satisfactory

Source: Field work, 2020

Plant Pathology

Within the study area, some diseased plants were observed and recorded. Most of diseases observed are host specific and mostly of fungal origin. These diseases are not associated with environmental stress was found. The forest species appeared very healthy however, some leaf spots with negligible incidence were observed.

Wildlife Status

The wildlife survey and interview with the local hunters in the study area revealed the presence of some mammalian, avian, amphibians/reptiles, molluscs and insect species. Significant among the species include: insects, Antelopes, Sunbirds, Weaverbird (*Pleisisositaara spp*), kites, Cattle egrets (*Ardeola ibis*), Doves, Fruit pigeon, Parrot, etc.

***Mammals*:** Eleven (11) main species of mammals encountered in the study area include; antelope *Hippotragus equines*, Spotted grass mouse *Lemniscomys striatus*, Pigmy mouse *Mus minutoides*, Geoffroy's ground squirrel *Xerus erythropus*, Tree squirrel *Funisciurus pyrrhopus* Giant rat *Cricetomys gambianus*, Stripped mouse *Hvbomvs triviraatus* Derby's flying squirrel *Anomalurus derbianus,* Black rat *Rattus rattus,* African Civet *Viverra civetta* and bushbuck *Tragelaphus scirptus*.

***Avian*:** Red eye dove *Streptoprelia semitorquata*, Carmine bee-eater *Merops nubicus*, Black kite *Milvus migrans*, hawk *Polyboroides radiatus*, African grey parrot *Psittacus erithacus*, Hooded vulture *Necrosyrtes monachus*, Cattle egret *Ardeola ibis*, Barn owl *Tyto alba*, Spotted eagle owl *Bubo atricanus*. Straw-coloured fruit bat *Eidolon helvum*, *Haliaeetus vocifer* (African eagle).

Amphibians/reptiles: Toad, *Buto regularis* Frog *Rana temporaria*, Tortoise *Kinixys* spp and snakes.

***Mollusks*:** African aiant snails *Archachatina marginata* and *Achatina spp.*) and *Limicolaria aurora, Gonaxis spp* etc

***Insects*:** The major groups of insect identified in the area were butterflies, flies, ants, beetles and spiders. Some of these include *Colias spp., Pontia daplidice, Pyrgus spp., Hipparchia spp., Polyommatus sp., Crambus ericellus, Hyloicus pinastri, Hedya atropunctana, Lasiocampa quercus, Brachicoma devia, Colletes succinct,Cinindela sp., Pterotichus adstrictus, Aphodius lapponum, Miscodera arctica, Coccinella hieroglyhpica, asemum striatum, Hylobius discolor, Episinus truncates*, *Textrix denticulate* etc. The predominant and diverse species in the area are insects covering about 38.46% of the total fauna species identified. This is followed by avian, amphibians/reptiles and mammals with 19.23%, 19.23% and 17.31% respectively. The least abundant species were the mollusk with 5.77%. A check list of wildlife in the study area is given in **Table 4.19.**

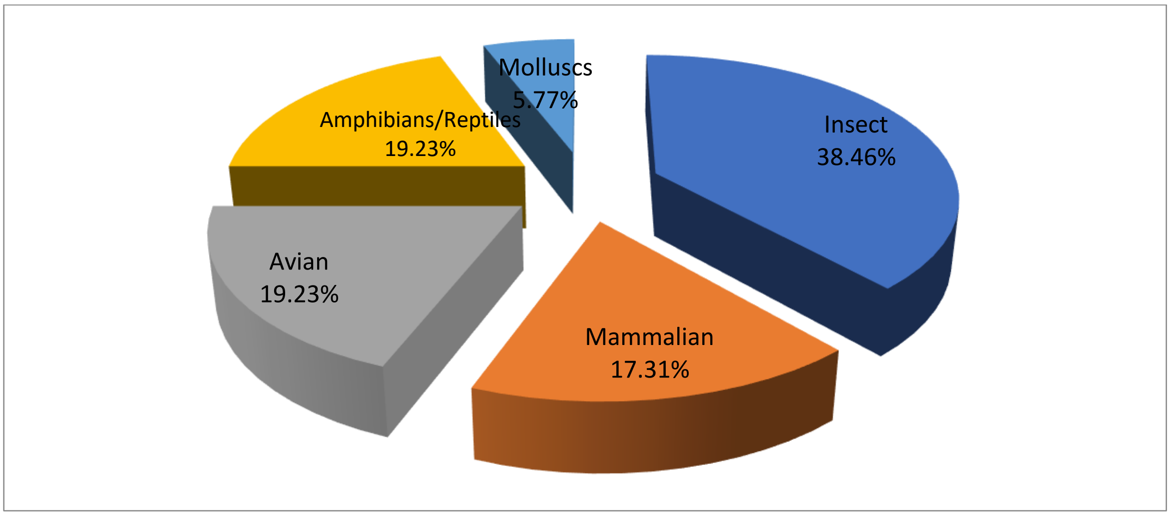


Figure 4.31: Relative Abundance/Diversity of Fauna in the Study Area

Table: 4.21: Checklist of Wildlife in the Study Area

Class	**Family**	**Species**	**Common name**	**Habitat**	**Status**
Mammalia	Muridae	*Cricetomys gambianus*	Giant rat	Forest	LC
	Muridae	*Rattus rattus*	Common rat	House/Garden	LC
	Sciuridae	*Protoxerus strangeri*	Squirrel	Forest	LC
	Thryonomidae	*Thryonomys swinderianus*	grass Cutter	Forest	LC
	Hippopotamidae	*Hippopotamus amphibius*	*Hippopotamus*	Forest	VU
	Chiroptera	*Pteropus sp*	Fruit bat	Forest	LC
	Cercopithecidae	*Cercopithecus erythrogaster*	Monkey	Forest	VU
	Viverridae	*Viverra civetta*	African Civet	Forest	LC
	Bovidae	*Hippotragus equines*	Antelope	Forest	VU

		Tragelaphus scirptus	Bushbuck	Forest	VU
	Hominidae	*Gorilla gorilla*	Gorilla	Forest	EN
Reptilia	Agamidae	*Agamma agamma*	Common lizard	House/Garden	LC
	Viperidae	*Bitis gabonica*	Gaboon viper	Forest	LC
	Crocodylidae	*Osteolaemus tetrapis*	Dwarf Crocodile	Forest	VU
		Crocodylus niloticus	Nile Crocodile	Forest	LC
	Testudinidae	*Kinixys* spp	Totoise	Forest	LC
Amphibia	Bufonidae	*Bufo regularis*	Toads	Forest/Garden	LC
	Ranidae	*Dicroglossus sp*	Frogs	Forest/Garden	LC
Aves	Accipitridae	*Necrosyrtes monarchus*	Common vulture	Garden/road sides	CR
	Corvidae	*Corvus albus*	Pied crow	Forest/road sides	LC
	Accipitridae	*Milvus nigrans*	Black kite	River bank/pond sides	LC
		Polyboroides radiatus	Carrier hawk	Garden/road sides	LC
	Ardeidae	*Ardeola ibis*	Cattle egret	Garden/road sides	LC
	Pycnonotidae	*Pycnomonus barbatus*	Common garden bulbul	Garden/road sides	LC
	Eimeriidae	*Plesiositagra cucullatus*	Weaver birds	Garden/river banks	LC
	Strigidae	*Otus leucotis*	Owl	Garden/road sides	LC
	Accipitridae	*Haliaeetus vocifer*	African eagle	Forest	LC

EN = endangered, UV = vulnerable, LC = least concern, CR = Critically Endangered;

Source: Fieldwork, 2020

4.10 Socio Economic Study

This section presents the human environmental aspects, consisting of the socioeconomic baseline conditions as an integral parts of the Environmental. As an integral part of ESIA, information of interests includes those socio-economic receptors which are sensitive to perturbation or impact from planned project's activities. These receptors are considered fundamental to the survival and quality of life of the people who live close to the proposed project or cohabit within project environment. The detailed scope for the socio-economic component of the proposed project required an extensive gathering of socio-economic data covering the following on the study area:

- Population characteristics of the project affected communities;
- Economy and livelihood/occupational characteristics;
- Community development/infrastructures in the area (including education and support services);
- Socio-cultural institutions and;
- Community and institutional framework.

4.10.1 Study Approach/ Data Acquisition

Socioeconomic data was obtained using multiple methods, namely:

i. Review of available literature;
ii. Field visit for socioeconomic data collection;
iii. Discussions with inhabitants in project-affected communities (PACs); and
iv. Application of professional knowledge and experience.

The consulting team embarked on the field study of the proposed project site environment. Prior to the field study, extensive consultations were undertaken and affected communities identified. The administration of questionnaires is universally accepted as the basic social science research tool. Consequently, based on the sample size of the study population, one hundred and ten (110) copies of structured questionnaires were administered to respondents face-to-face by the consultant and all were retrieved for statistical analysis. As a survey instrument and primary data collection method, the questionnaire was structured such that binary, optional and open-ended questions were asked to solicit the necessary answers from the householder. The simple random survey technique was employed in questionnaire administration. In the community, the consultant administered questionnaires face-to-face to respondents and consensus opinion was sought from Focus Group Discussion (FGD).

In addition to the FGDs and administration of questionnaires, semi-structured interviews (SSIs), and Key Informant Interviews (KIIs) which are also participatory rural appraisal techniques were employed in data collection. The community leaders and/or appointed representatives were the target audience and detailed information concerning the community's historical background, its people, economy and socio-cultural setting were solicited. Photographic documentation of the human environment and other pertinent socio-economic attributes also complemented the data gathering exercise.

The secondary source of data collection was also extensively used to aid the report writing. In particular, a desktop review was conducted reviewing the following documentations to aid the report preparation:

- National Population Commission (NPC) and ICF International, Nigeria Demographic and Health Survey (NDHS) 2013, (2014).
- NPC 2006 Population and Housing Census, Priority Tables, III, 2010 NPC 2006 Population and Housing Census, Priority Tables II, 2010 NPC 2006 Population and Housing Census, Priority Tables I, 2009
- National Bureau of Statistics (NBS) (2012), Annual Abstract of Statistics
- Maps and available satellite imagery of the proposed project site/ environment
- Reports prepared by the SIA Consultant for projects in the Bonny area and nearby environment.

Data gathering and analysis were also based on advocated philosophy of "triangulation" (use of a variety of data sources, multiple perspectives and multiple methods).

4.10.2 Community Consultation and Reconnaissance Visit

Prior to the commencement of the field sampling activities, a reconnaissance visit was carried out to familiarize the team with the study area. Participation and integration of the local populace (landlords, community residents and other stakeholders) of the project affected communities was carried out in the socio-economic study for the proposed road project. The community consultation and integration programme for the socio-economic impact assessment consisted of the following;

- **Visits to key State Government and LGA stakeholders** (**political leaders / traditional rulers / civic leaders**). This was done for advocacy purposes to inform, and also to secure permission and co-operation for the project and the study.
- **Direct Consultation with Identified Stakeholders**. This involved consultative meetings with identified stakeholders and community groups.

The stakeholders were engaged issue boarding on direct / indirect, adverse/beneficial, short / long term impacts of the proposed project. Stakeholders' concerns, expectations and community needs were also identified with a view to safeguarding the rights of the local population and knowing areas in which development in the host community could be assisted by project proponents and government agencies. Consultation activities are continuous and the results are feedback which is important for community integration, co-existence and sustainable development of all stakeholders and the environment. A listing of these discussions and interviews, and the issues discussed is presented in this report. These meetings were interactive and provided opportunities to intimate the groups with the proposed project activities and the potential impacts.

To analyze both field and secondary data, simple descriptive methods and uni-variate summary statistics, i.e. simple averages and cross tabulations (means, range, mode, and percentages) in tabular and graphical modes were preferred data presentation formats, where applicable, as these were considered the most appropriate analytical techniques for the study objectives. Seven (7) major units of analysis (or levels of aggregations) were employed to describe both empirical and/or secondary data: National; Regional; State; LGA; Settlement/Community; the Household and individual Respondent. Although a national census was completed in 2006, figures for the individual settlements/localities are yet to be published.

The Exponential Growth Model was used in estimating the population of the projected affected communities (PACs). The formula is:

Exponential Growth Model

$$P_n = P_o * (1 + nr)$$

Where:

P_o = the base population

r = growth rate of the population (as obtained from NPC)

n = time lapse, in years

Sex ration was determined by:

$$\text{Sex Ratio} = \frac{\text{Number of males in the community X 100}}{\text{Number of females in the community}}$$

Dependency ratio was determined by:

$$\text{Ratio} = \frac{\text{Population (0-14years) + population aged 65years and above X 100}}{\text{Population aged 15-64years}}$$

Crude Birth Rate was determined by:

$$\text{(CBR)} = \frac{\text{Number of life births in a community in one year X 1000}}{\text{Midyear population}}$$

4.10.3 Socio-cultural Resources and Structure

4.10.3.1 Consultations

The key objective of the consultation is to notify the stakeholders of the nature, scale and timing of the proposed project, thereby eliminating any fears or apprehensions. Secondly, it facilitates information gathering between the proponent and other stakeholders. This two-way communication enables the proponent to learn from its stakeholders and neighbors and avoid misunderstandings about the project. Consultation also provides a mechanism by which stakeholders will be carried along all through the project's lifetime, as well as a forum of addressing community's concerns, issues and needs.

Consultation equally helps the proponent learn through the input of local knowledge, enhance the acceptability of the projects, limit unrealistic expectations and focus on the delivery of benefits.

Throughout the lifespan of the project, the proponent shall maintain effective communications with authorities and other relevant stakeholders. The intention of this is to:

- avoid conflicts by addressing issues promptly;
- ensure that fears and apprehensions about the nature, extent and impact of the operation have been addressed; and
- avoid any misunderstanding about the development.

The ESIA document will be made available to public for comments through the regulatory agencies. One of the stages of consultation was carried out in the Scoping Workshop organized for all the communities likely to be impacted by the proposed project. The scoping workshop held on 13th November 2020 in Port Harcourt. (Attendance and Report Contained in Appendix)

Detailed activities of the project were discussed at the workshop and the communities raised issues and concerns based on the following themes: Project impacts, stakeholders likely to be affected, sensitive/vulnerable environmental components that could be impacted as well as measures to enhance beneficial impacts and reduce/eliminate identified adverse impacts.

All these were collated and integrated into the Terms of Reference for this study. Another stage of consultation was done by the environmental consultant which involved paying homage to the selected communities, and informing them of the proposed project. The last stage was during the focus group discussions held with the various groups at the community level. During the consultations, the consultants explained the scope and justification of the project and took note of the people's fears, impressions and expectations concerning the proposed Deep-Sea project.

Plate 4.9: Highlights of the Scoping Workshop Exercise

Future Consultations

The proponent shall continue to consult with the Regulatory Agencies, the host communities, all stakeholders concerned with or likely to be affected by the project at all stages of project development. The consultations will be sustained throughout the lifespan of the proposed project. Plates 4.10 – Plates 4.12 show sessions during the consultation exercise for proposed project.

Bonny Oloma , Ayaminima, Oguede, Finima and Bonny town in Bonny Local Government Area of Rivers State were consulted among others.

Plate 4.10: Stakeholders engagement at Bonny Town

Plate 4.11: Stakeholders engagement at Bonny Town

The primary impact zone include fishing settlements and units situated immediately within the shoreline Area whose livelihoods are dependent on the portion of the sea where this proposed port will be sited. This settlements and communities located within and around the above defined precinct are also termed primarily-affected communities.

By definition, significantly affected persons are those who derive their income from both the land and other resources that are tied to a primary area of impact and also inhabit the impact zone with respect to health issues.

Plate 4.12: Significant Signpost in some of the Project Affected Communities

4.10.4 History and Settlement Pattern/Structure

Bonny is situated on one of the coastal barrier islands of the lower Niger Delta region and is traditionally of the Ibani ethnic nationality. The history of the Ibani *(Igbani)* indigenous ethnic group is closely related to other neighbouring coastal groups of the Delta. Bonny Island has been an important trading centre since the 16th century. This is reflected in the complex ethnic mix of its people. What is not clear in the literature and even face-to-face interactions during other social studies is their origin (migration). Historical narration by Anene (1965) has it that the 'house system' which was the characteristic structure of the social, economic and political life of the people serve a number of useful purposes and at the same time a source of weakness. William Dappa Pepple ascended the throne of Bonny in 1837 as Pepple V, almost at the same time when the 'royal' house was being outstripped in wealth by other 'houses', especially those of Manilla Pepple and Annie Pepple, that were under the control of dynamic ex-slaves who had risen to the leadership of their 'houses'. The competition and opposition as well as British interests combined to weakened the existing structures and in 1854, the British consul Beecroft, deported Pepple V of Bonny, leading to a period of confusion and after 1866, the situation further degenerated and the king who reigned between 1886 and 1888 hardly exercised any influence over his 'over-mighty' subjects, who drifted into a civil war. This was the time when Jaja, a former slave had to formed his own settlement, Opobo, the second Ibani community outside Bonny Island.

The settlements/villages/communities that make up the Bonny Kingdom are related to one of the 36 major-minor houses that constituted its historical origin (14 major and 22 minor houses make up Bonny, with the Bristol, Pepple, Green, Halliday and Brown families as first major houses) (Uriel J. Jumbo, Bonny Local Government Environmental Protection Committee, per. Comm., 2009). Although over sixty permanent settlements were enumerated in 1991 as individual localities within the Bonny area, there are certainly more than these especially since the establishment of the Nigeria Liquefied Natural Gas Project (NLNG) in 1999 and subsequent additional plants and related industrial concerns, which in turn gave birth to secondary habitations/settlements. In addition to the permanent settlements that make up the Bonny Kingdom, there are several fishing ports/camps which are temporary in nature but more often than not turn out to be permanent settlements. While the permanent settlements are inhabited predominantly by the ethnic Ibani (Igbani) people, the fishing ports/camps are on the other hand, inhabited by a wide variety of people of different ethnicities but mostly the Andonis, Okrikas, Kalabaris, Ijaws, Ogonis, Ibibios, Ibos, and those from Calabar (Cross River), Delta/Edo, Yorubas (Ilajes) and non-Nigerians (Ghanaians and Cameroonians).

The physical setting and housing pattern of the communities in the project environment with the exception of the Bonny main Town and New Finima which are heterogeneous, cosmopolitan and urban, are characteristically rural dispersed settlements (the urbanized areas are nucleated clusters); houses are set up mainly according to family/lineage ties (the house system) with the influence of transportation and communication networks/routes, particularly the rivers and creeks of critical importance. Consequently, the settlements also conform to the nodal and linear settlement patterns (Plates 4.10).

Plate 4.13: Settlement along Tarred Road in Bonny

Apart from the general historical narratives documented about the Bonny kingdom, each of the project affected settlements visited laid claim to some historical importance within the entire Bonny framework. For example, community respondent in Oloma asserted that ''*Oloma existed before the Bonny Kingdom and its economic significance among the comity of settlements is outstanding, possessing 21 oil wells and 5 gas wells respectively''.* Here, the 11 'house' system is operated in the governing structure.

4.10.5 Religious Affiliations, Customs, Belief Systems

The Ibani ethnic group (Bonny and its constituent villages/settlements/communities) has a long historical origin of Christianity as the predominant religion in the area although there are strong influences from traditional religious beliefs. King William Dappa Pepple who ascended the throne of Bonny in 1837 as Pepple V, later deported in 1854 (Anene, 1965) and reinstated in 1861 introduced Christianity to Bonny, having being converted to Christianity while in England (Alagoa and Fombo, 1972, as cited in SPDC 1999). Although, one of the earliest *Amanyanabo*, King George (Secondus) Pepple

II, crowned in 1932 was reportedly crowned by a Christian Anglican priest, a tradition that has continued up to the present traditional ruler, King Edward Asimini William Dappa Pepple, William Dappa Pepple III, crowned in 1996.

Samuel Ajayi Crowther (1806-1891), the first black bishop of the United Church of England and Ireland (Anglican) in 1864 is another person reportedly instrumental in bringing Christianity to Bonny Island. He founded the first missions in the Niger Delta at Bonny shortly after; he was well received in Bonny by King William Dappa Pepple and the local chiefs. After signing agreements for the establishment of the mission, the Bishop returned to Bonny with two missionaries who opened a school and preached in the streets and marketplace. Memorial stones placed in memory of the two personages are visible within the premises of St. Stephen's Cathedral Church in Bonny.

The presence of Churches dominated as it were by the Anglican denomination and other emergent Pentecostal denominations established of late, even in the remotest parts of the Bonny kingdom settlements is evidence of the peoples' beliefs in the Christian faith. More often than not, a Church building of great magnificence is a demonstration of the faith professed. Some earlier studies like NLNG (2002), have found that in the main Bonny town and Finima, a very high proportion of the population were Christians; less than 2% of the residents reported to be practicing Muslims, while less than 5% were traditionalists.

In spite of the Christian stance of the Bonny people however, the Ibanis (as the Bonny ethnic group is called) is rich in culture with some of the cultural practices celebrated with strong religious fervor in their seasons. Masquerades, mostly colourful and artistic in their make-up and paraphernalia, are a common sight during festive occasions. Masquerades are either religious or historical personifications of the rich legends of the people. The major shrines in the project affected communities include *Simmgi* in Finima. *Fungu* and *Iria* ceremonies are common festival is observed in the community and the Oposu house is their main heritage site. In Oloma community, *Iria, Nwaotam* and *Owuogbo* festivities. Main cultural and tourist attractions among the Ibani are the war canoe displays or boat regattas in Bonny and its constituent villages.

As custodian of the culture, several of the festivals identified with the Ibani people have to be sanctioned and through the *''Amanyanabo-in-council''* before they can be celebrated. The ''Alali'', the ''Simingi'' (goddess of the river) and the ''Fungu'' were all festivals and deities worshipped and celebrated in September before the influence of Christianity made them unfashionable (Ojile, 2009j). They were used in cleansing the tombs as a way of celebrating the dead. Parades of ''warring masquerades were part of the ''fungu'' festival. This was usually followed by the ''Nwatam'' festival as end of year festival with several festive displays and now leads to the present day New Year which came with Christianity. The ''Sermingi'' and Ibimingi'' representing the ''good and bad tides'' respectively are commissioned to ''carry away the ill-fortunes of the past year and usher in the good fortunes of the New Year'' with symbolic objects thrown into the river.

Amongst the Ibani, *Owu-ogbo* (for the men), *Ereminogbo* (women) and *Nwantam* (cultural dance group/cult) masquerade dances are the most celebrated festivals organized in the festive periods of Easter (March/April) and Xmas/New Year (December/January). During the *Nwatam* festival, bona-fide Ibani sons and daughters, in a colourful display of culture, accompany their masquerade into the river as directed by the god of their land. Pregnant women are prohibited from both seeing the masquerade and taking part in the festivity or face the wrath of *'Ikuba'*god whose shrine is located at the *Ikuba* square. This prohibition has implications for access and use of maternal health facilities especially during emergencies. The cosmology of Ibani people is better understood by examining their religious practice. At the apex of religious worship is the supreme God (*Tamuno*) believed to transcendentally relate with the *Ikuba* god – symbolically represented by the 'Iguana'. The *Ikuba* priest has the exclusive permission of attending to and communing with the god on unlimited areas of human activities. The people hold this exclusive right sacrosanct. According to the *Ikuba* priest, attitudes and behaviour follow the god's injunctions, while anti-normative activities which constitute cultural taboos are punished as directed by the god.

There are other belief systems, which revolve around common taboos and forbids the doing of some things at certain times, etc. and violations are frowned at and punished accordingly. Polygamy is a practiced form of matrimony; bride price/dowry payment is regarded highly while inheritance is patrilineal. Although the Ibani are patriarchal, men still value their daughters highly. This explains the basis of a local aphorism *ere-ibim*, meaning literarily "woman is good" (Banigo, 1996); male child preference is not explicitly emphasized among the people. However, Ibani women, given the premium placed on children, generally prefer a large family size.

There is a belief among the Ibani that the placenta that follows childbirth should of necessity be buried beside an economic tree. For the people, this serves two purposes: it is believed that like the tree, the child would be fruitful and also live long. People whose placentas cannot be accounted for are said to be threatened with barrenness and untimely death. The perception among a large majority of Ibani people is that TBAs give placentas (after birth) more readily to parents of babies for proper traditional disposal than other birth attendants, as a result of which they are preferred for child delivery.

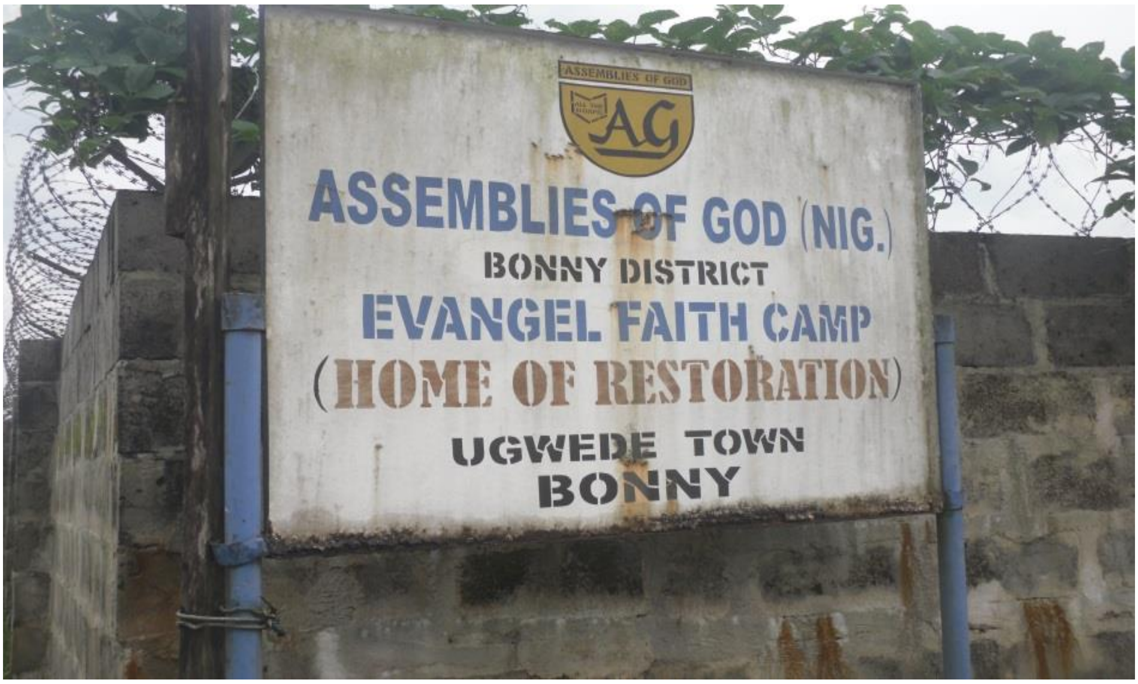


Plate 4.14: A Pentecostal Church in Bonny

4.10.6 Local Governance Structure and Capacity

Politically Oloma, Oguede, Finima, Bonny Town are communities in Bonny Local Government Area of Rivers State. Oloma is in Ward 10, Oguede is in word 6 and Finima is in ward 5.

No description of the political life of the people of the coast communities in the Niger Delta today is intelligible without an analysis of the social structure known as the 'house' system. Each city-state comprised a number of 'houses', with each house more or less a trading association of freemen and slaves under a head or chief. There were usually four social classes in a 'house'-the chief, the sub-chiefs, the freemen, and slaves. The division into classes was not rigid as a dynamic and successful slave could rise to become the head of a 'house'. Technically the heads of 'houses' formed a sort of advisory council over which presided the king of the city-state. Inter-house rivalry was a constant menace to stability, and if there was a weak king, civil war invariably threatened (Anene, 1965).

In Bonny, the social and cultural fabric of local societies is centered upon the household, attitudes to gender, and the traditional authority structures that exist. Monarchy has survived in Bonny to this day and so has the house (extended family) system of traditional governance. At the head of traditional governance is the paramount ruler or king, known as the Amanyanabo, who presides over thirty-five houses, headed by chiefs. Below the king and chiefs, society is stratified into age groups. Women are excluded from the institution of chieftaincy, and paramount ruler-ship. Their roles in society have hitherto been bound by cultural norms that have tended to relegate them to purely household chores. However, with modernization and increased education, they are playing wider roles, and are now active in community and even regional and national affairs. Youths are also becoming increasingly active in both modern and traditional governance.

The Bonny kingdom is made up of 5 War Canoe Houses made up of:

1. Bristol – Alagbarigha Royal House
2. King Halliday – Awusa Royal House
3. Dublin Green House
4. Prince Oruasano Tolofari Royal House
5. Buoye – Omuso (Brown) Major House

The families are structured into 34 Houses (14 Major Houses and 20 Minor Houses) including the Royal House (George Pepple). His Royal Majesty (HRM), King Edward Asimini Dappa Pepple III JP CON Perekule XI is the Present King (Amanyanabo) of Grand Bonny Kingdom together with his recognized Chiefs and Cabinet of elders constitutes the traditional institutions of Bonny Kingdom. There are recognized traditional tittles in Bonny Kingdom amongst which are: Amapusenapu, Amasenapu,

Warisenapu, Warialapu and of interest is the feminine title Amaopuerebo for women who have rendered selfless services to the kingdom.

The youth group under the umbrella of the Bonny Youth Federation (BYF) and women wing, Bonny Women Forum (BWF) complement the efforts of the traditional organs particularly in the area appertaining to their nomenclature. The youths particularly are effectively in charge of issues relating to labour recruitment for any oil and gas work within their immediate environment.

All of the above traditional arrangements are however, under the Bonny Kingdom administration, with the King (HRM) or Amanyanabo of Grand Bonny at helm of affairs. This ruler-ship commands very high respect and all other bodies/groups defer to it. The Bonny Chiefs Council (BCC), and the Bonny Kingdom Development Committee (BKDC), are the two other recognized powerful traditional institutions, which assist in the administration of the Bonny Kingdom (Figure 4.30)

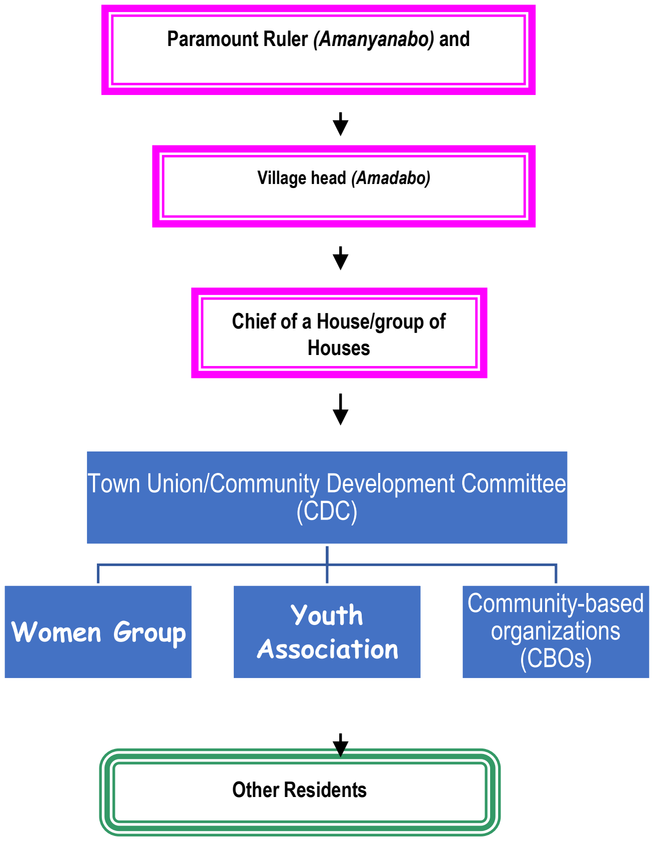


Figure 4.32: Traditional Governing and Power Structure in the Bonny

Several organisations also exist, including those representing special interests such as on the environment, represented by the Bonny Environmental Consultative Committee (BECC) which interfaced with all industrial organisations (NLNG, SPDC, MPN, etc.) on all environment matters. There are also community-based and non-governmental organisations for men, women and youth respectively. In recent times, the putting into effect the global memorandum of understanding (GMOU) by the oil and gas multinational companies have brought up implementation organs. A Cluster Development Board (CDB) with representatives from the various stakeholder communities is usually charged with the implementation of the GMOU.

Conflicts and Resolutions

Conflict is common in the Niger Delta region as a whole and in the study area as well. Types of conflict include:

- Conflict between communities and companies
- Conflict between communities

- Conflict within communities and
- Conflict between communities and government

Conflict in the Niger Delta generally as well as in the study area predate the advent of crude oil exploitation, most of which were related to issues of land ownership, especially of palm oil bearing land, quests for autonomy and struggles for leadership, etc. However, conflict today is either directly caused by issues surrounding crude oil exploitation or fuelled by them. In other words, crises have been magnified by oil and gas exploitation in the Niger Delta over the years. Causes of conflict between communities and companies include:

- Non-recognition of community as stakeholder Oil spillages
- Border/land disputes
- Agitation for employment
- Refusal of companies to repair damaged road
- Non-payment of compensation
- Non-compliance with court rulings and order
- Failure to honour MOUs
- Perceived intimidation of the communities
- Perceived “divide and rule tactics”
- Ineffective communication channels

Before the late 1990s, the conflict resolution strategies of communities in the study area were through dialogue in special meetings summoned by the elders-in-council, council of chiefs, elders and chiefs assembly, religious leaders, juju priests, youth council and women groups. Issues could either be discussed at the lower levels of family, age grade and women or taken directly to the community leadership. In addition, appeals and summons are common processes utilized at community level. Issues are referred to the police and courts, when they are criminal offences that are mandatory to be reported and when the resolution of the conflict overwhelms community leadership. Conflict resolution at community level could attract penalties such as fines, seizures of assets and ostracisation.

As vividly illustrated in the preceding narratives, conflicts and contentious issues are resolved in the affected study communities by collaboration among the traditional head (Amanayabo), the Council of Chiefs/Elders, the Community Development Committee, Youth and Women groups respectively. The rungs of power are many as revealed by the well organised administrative structures; from the family heads, compound chiefs, all through the various organs which terminate at the feet of the Amanayabo. In the event that a community member runs fowl of the law, the issue is handled from the lower organ, youth or women group and the deviant is punished according to the gravity of the offence; smaller crimes could lead to monetary fines, according to the nature and gravity of the offence. Serious cases therefore involve meting out serious punishment, including being given up to the police.

4.10.7 Socio-demographic Characteristics

Population Size and Growth

Accordingly, the recently released 2006 census result may be more accurate, representing the human environment of the Bonny LGA and Island in particular. A total of 215,358 persons were estimated for the area (Federal Government Official Gazette, 2007), which translated into an annual growth rate of 4.3 percent over the elapsed 15 years. Although figures for the respective localities/villages are yet to be published, there are indications that the Bonny mainland and proximate settlements like Finima have and continues to have the highest concentration of the population. In other words, the growth in population is higher in Bonny mainland and Finima and minimal in the satellite villages/fishing ports, due to the influx of migrant construction workers to these more developed settlements. Attempts at projecting the population of the respective settlements, using a 3.4 percent annual exponential growth rate suggested for Rivers State (FG Official Gazette 2007) (except for Bonny main town and Finima at 5%). The population estimates suggest that Bonny remains the main population centre, accounting for over a third (33.2%) of the entire LGA population while Finima comes second with a 6.5 percent contribution.

With respect to the proposed project directly affected communities, apart from Bonny main town, Jumbo, Ishile Ogono with over 8,000 persons, has the highest concentration of population, corroborating the boast of indigenes that the community is a ‘’gateway and an economic power house in the area’’. Halliday on the other, with less than 700 persons remains the least populated, although going by what was seen during the field work, Orupiri is the smallest settlement and expectedly had the least number of households and population. The fact is, a very high proportion of the population of the Bonny area are in the Bonny main town or are in the Diaspora and reasonable number of persons in any one of the communities can only be found during the festive periods of Easter and Christmas/New Year seasons.

The Bonny LGA and Bonny main town in particular have had the greatest controversy in terms of how many people live in and around the environment. In 1991, from 14,892 households, a total persons of 76,124 were counted and Bonny main town alone contributed about 30% of the LGA’s population (NPC 1991), while Finima, the nearest popular settlement had 5,590 persons (7.3% of the Bonny LGA’s population).

Accordingly, the 2006 census result may be more accurate, representing the human environment of the Bonny LGA and Island in particular. A total of 214,983 persons were estimated for the area (NPC, 2010; NBS, 2012), which translated into an annual growth rate of 4.3 % over the elapsed 15 years. Although figures for the respective localities/villages are not published or available, there are indications that the Bonny mainland and proximate settlements like Finima have and continues to have the highest concentration of the population (**Table 4.22**). In other words, the growth in population is higher in Bonny mainland and Finima and minimal in the satellite villages/fishing ports, due to the influx of migrant construction workers to these more developed settlements. Attempts at projecting the population of the respective settlements, using a 3.4 % annual exponential growth rate suggested for Rivers State (FG Official Gazette 2007) (except for Bonny main town and Finima at 5%), yielded the results in Table 4.36 and Figure 4.31. The population estimates suggest that Bonny remains the main population centre, accounting for over a third (33.2%) of the entire LGA population while Finima comes second with a 6.5 % contribution.

LGA/State	1991			2006			Area (km²)*	Pop. Density	2011
	Males	Females	Total	Total	Males	Females			
Bonny	40,105	36,019	76,124	214,983	116,340	98,643	645.601	333	254,820
Rivers State	**1,654,501**	**1,533,363**	**3,187,864**	**5,198,716**	**2710665**	**2474735**	**10432.28**	**498**	**6,128,934**

Source: NPC, 1991, 1994, 1998; NPC, 2010, 2009, NBS, 2012)

Table 4.22: Population Statistics of Bonny Kingdom Communities

Community/Settlement/Locality	1991 (NPC)			1996	2006	2011	2016
	M	F	T				
Eferewari Bonny	206	138	344	407	569	672	794
Ererekiri and others	265	349	614	727	1016	1,201	1419
Otobie and others	611	572	1,128	1,335	1865	2204	2606
Abai Jumbo	67	97	164	194	271	320	379
Dan Jumbo & others	613	733	1346	1593	2226	2630	3109
Nanabie & others	250	261	511	605	845	999	1181
Ajegunle Bonny	323	347	670	793	1108	1309	1548
Oke Ere (Olumegelebie)	289	285	574	679	949	1121	1325
Iwokiri & others	182	203	385	456	637	753	890
Oputumbi	279	267	546	646	903	1067	1261
Bethel	435	474	909	1076	1503	1777	2100
New Jerusalem & others	164	105	273	323	451	533	630
Okumbi	152	112	264	312	436	515	609
Epelema Tubo & others	20	27	47	56	78	93	109
Agaja Bonny (1-4)	659	546	1,205	1,426	1992	2,355	2783
Bariko	240	124	364	431	602	712	841

Ama-Ariaria Finima	199	133	332	393	549	648	767
Owubiri (Fishing Camp)	347	303	650	769	1074	1270	1501
Finitasengi	483	228	711	841	1175	1,389	1641
LightHouse Ikpoama	422	422	844	999	1396	1,649	1950
Agiokolo (Fishing Camp)	515	349	864	1023	1429	1,689	1997
Old Finima	664	421	1,085	1,284	1794	2,120	2506
Bonny Town	12,595	10,394	22,989	27,207	44,317	56,561	72,188
Achiama & others++ (Akiama)	301	297	598	708	989	1169	1382 (1879)
Epelema	510	454	964	1141	1594	1884	2227
Orupiri	245	185	430	509	711	841	993
Ayaminama Bonny	154	141	295	349	488	576	681
Otokolomabie & others	285	287	572	677	946	1024	1321
Henry LongJohn Bonny	164	157	321	380	531	628	742
Georgekiri	594	557	1151	1362	1903	2249	2658
Oloma Bonny	447	438	885	1,047	1463	1,729	2043
Agbalama Nnadozie	794	937	1731	2049	2863	3383	3999
Polokiri	161	174	335	396	553	654	773
Egwede (Oguede)++	207	256	463	548	766	905	1070 (1708)
Burukiri-Amokue	1236	1233	2469	2922	4082	4825	5703
Oloma/Bonny & others	206	225	431	510	713	842	995
Abalamabie							
Jumbo	317	344	661	782	1,093	1,291	1526
Hart	262	244	506	599	837	989	1169
Long John	784	755	1,539	1,821	2,544	3007	3554
Dema Abbey	958	916	1874	2218	3099	3662	4329
Isile-Banigo Bonny	782	779	1561	1847	2580	3050	3605
Jumbo IshileOgono	2255	2167	4422	5233	7311	8641	10213
Beresiri & others	265	255	520	615	859	1016	1200
Green Iwoama Bonny	1370	1292	2662	3150	4401	5201	6148
Williams	235	266	501	593	828	979	1157
Ikuluewu & others	76	45	121	143	200	236	279
George Pepple Bonny	182	155	337	399	557	659	779
Christ Wilcox Bonny	346	333	679	804	1123	1328	1569
Halliday Bonny	172	182	354	419	585	692	818
JackMay Bonny	271	203	474	561	784	926	1095
Fiafiakiri & others	185	162	347	411	574	679	802
Opu Asaramatory	253	266	519	614	858	1014	1198
Ama-Naaman	213	164	577	446	623	675	871

Ama-Oriko-Asarama	107	105	212	251	351	415	490
Ama-Piànbo-Asarama	337	219	556	658	919	1087	1284
Peterside	767	722	1489	1762	2462	2910	3439
*Iworma & others++	198	154	352	417	583	689	814 (1220)
Kalabiama Bonny	1471	1448	2919	3455	4827	5705	6743
Sodienyekiri	560	608	1168	1382	1931	2282	2697
New Finima	2,451	2,059	4,510	5,337	8693	11,095	14,161
LGA Total	40,105	36,019	76,124	90,090	133,409	157684##	198,661##
					**215,358	**254,545	**300,861
					(119,116 M;		
					96,242 F)		
Rivers State					5,185,400	6,128,934	7,244,154 7
					(2,710,66 5M;		
					2,474,735 F)		

(**Note:** M = Male, F = Female; 5% and 3.4% population growth rate used for the projection of Bonny, Finima/Oguede/Iwoama/Akiama main towns/communities and the villages respectively and base year is 1996. Bonny LGA and Rivers State Population for 2006 according to 2006 Census. **+++** -surveyed communities. (Source: NPC, 1991, 1994, 2009, 2010; NBS, 2012)

<u>**Note:**</u> Some settlements are popular but had no documeneted population figures (not included in table above); may have been subsumed under more permamnet communities because several of the settlements have temporary status as itinerant fishing camps/ports and/or posts for illegal bunkering activities

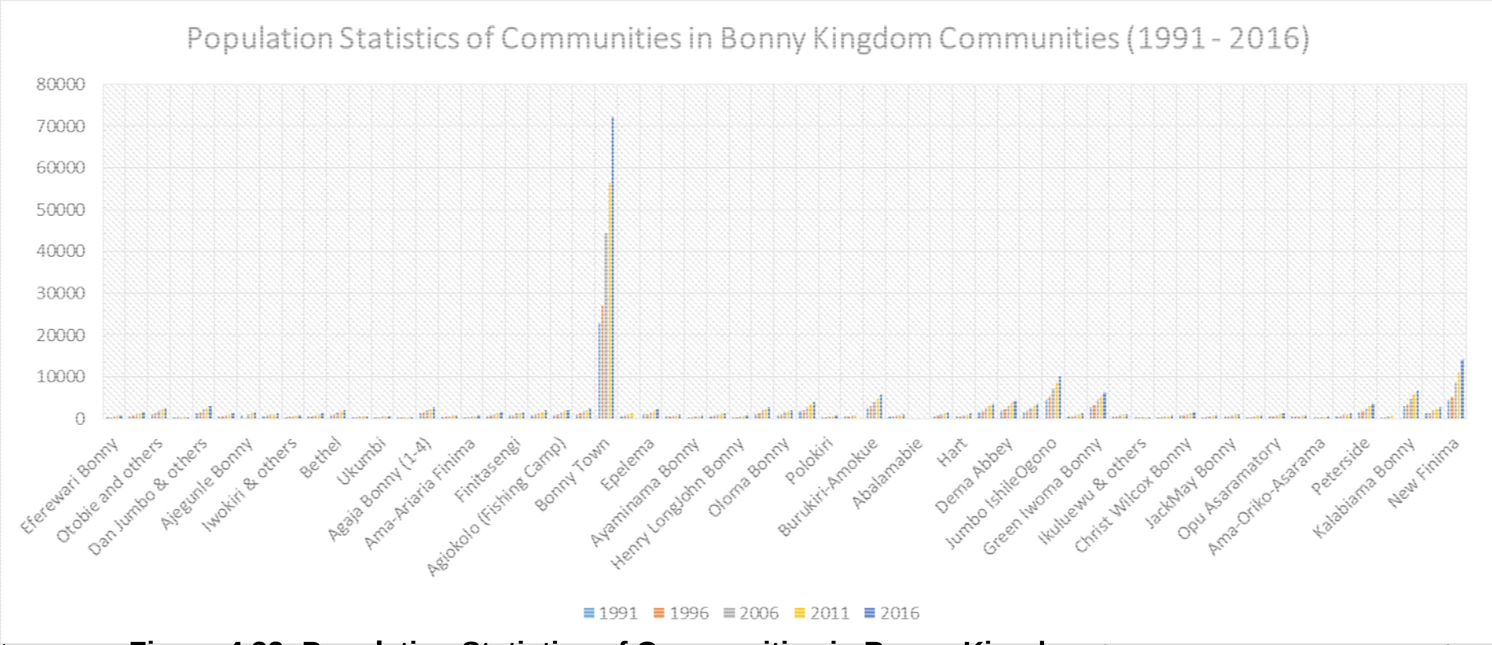


Figure 4.32: Population Statistics of Communities in Bonny Kingdom (Source: PHSS & RSMOH, 2011)

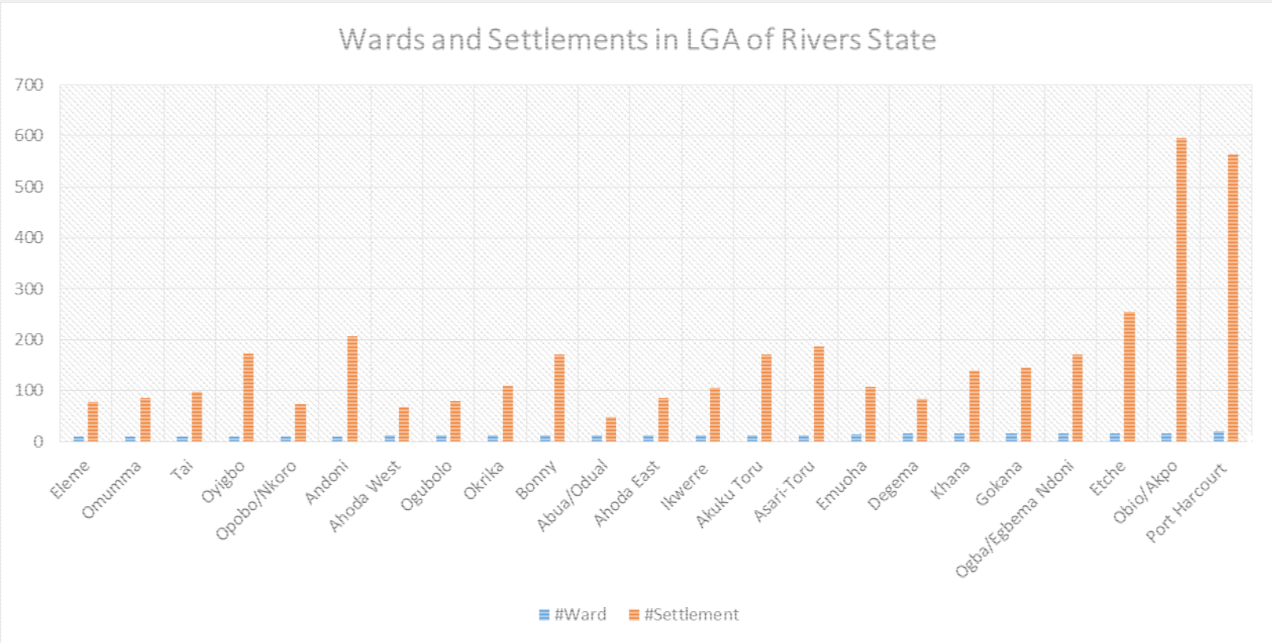


Figure 4.33: Number of Wards and Settlements in Rivers State (Source: PHSS & RSMOH, 2011)

4.10.8 Household Structure and Size

The household structure of the project-affected communities parallels the patriarchal leadership structure of most Nigerian ethnic groups. Men are typically the head of Nigerian households; there are overwhelmingly more male (92%) heads of households than females (8%) in the Niger Delta. The three different types of male-headed household structures are traditionally one husband and one spouse, polygamous, and single male (male with no spouse, including widowers and males that have never been married). Traditionally, the male is responsible for all the major household decisions.

The analysed questionnaires also revealed that average number of children per married woman in the surveyed communities ranges from 1-9 and translates to mean household size of 7 persons per household in the study area. About 24.5% of the households were made up of household size of 1-3; families with 4-6 people constituted about 41% of sampled households, about 27.5% were also made of families of 7-10 persons while those composed of members above 10 constituted 7%. Several reasons accounted for the large household sizes in the study area in particular and the Niger Delta region in general. First is the recognition of marriage as a basic cultural institution for procreation in the communities. Marriage is a socio-cultural norm that is highly recognized in the area and the people marry at a relatively early age. Second is the fact that most males married more than one wife in the area, with some of them keeping and maintaining several concubines. This suggests freedom and permission to high amorous (sexual) promiscuity among both sexes giving rise to high number of fertile intercourse amongst the people.

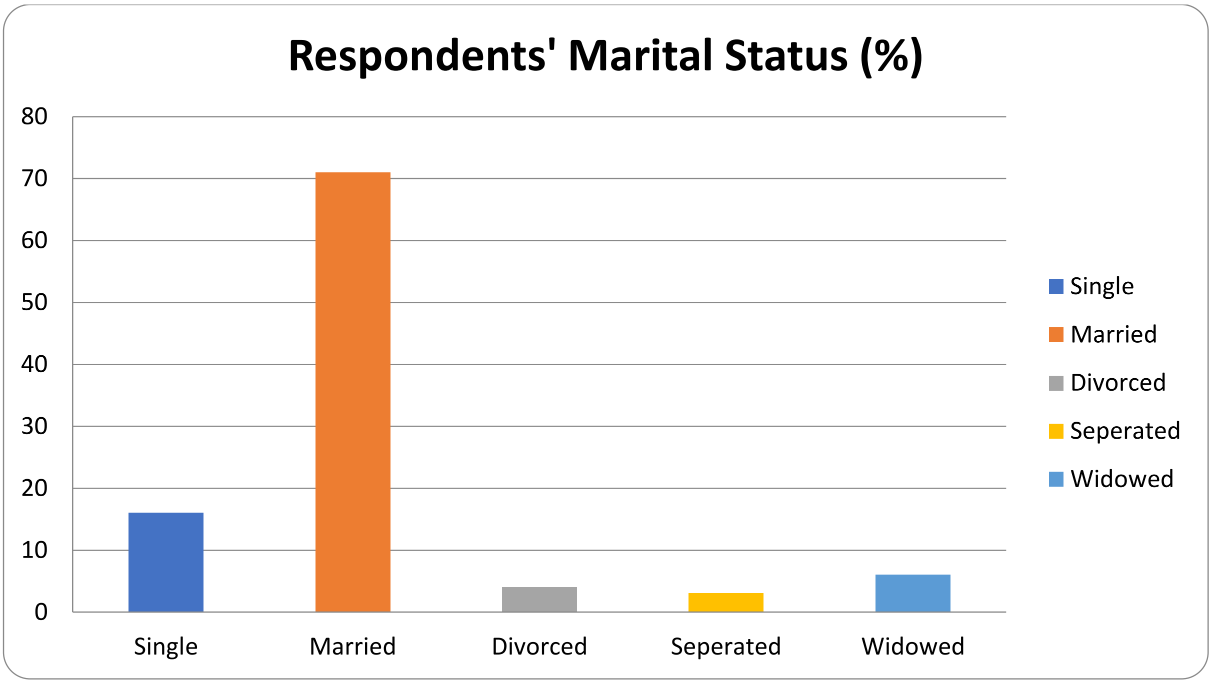


Figure 4.34: Marital Status of Respondents

The percentage of single males and females ranged from 58% to 71.8%, while that for married people ranged from 17.2% to 32.8%. This low percentage of married persons was thought likely to be a reflection of the high influx of single migrant workers and a high percentage of school age children. A most recent study of the Finima area found that although, an overwhelming majority of the community respondents were adults aged 30 years and above, those found married were barely over one-tenth (12.5%), while a third (31.25%) of the population was of the single marital status (Ojile, 2009j). Widowhood and living separated appears to be a phenomenon in the Finima study area; one half (25% apiece) are either widowed or separated persons, while divorced persons constitute 6.25 percent. Young adults aged 2-29 years constituted barely 6.3 percent of the population sampled. A higher percentage of the resident population in the villages and fishing ports/camps around the Bonny area are however, married.

The size of families differ from community to community, influenced in large measure by the cultural attitude of the people, economy of the settlement and educational status/awareness of the resident population amongst other factors. A total of 3,919,364 households were enumerated during the preparation of the Niger Delta Regional Master Plan Development with an average household size of 7.46, but with more than

70% of them having an average of 8 occupants. Large households were found more prevalent in the rural areas (NDDC 2006). The average household size in the region however comes down to 6 persons with considerable variations among the individual States, Local Government Areas and senatorial districts.

4.10.9 Population Structure (Age and Sex Composition)

Socio-economic sample survey results indicate that most of those surveyed were adults of at least 20 years of age. Approximately 41.3 percent of the respondents were in the 20-39 years age bracket while over one half (52.2%) were aged 40-59 years. The aged (60 years and above) constituted 6.5 percent of the respondents. Expectedly, the male-dominant sex structure of the study area total population was reflected in the number of respondents; over two-thirds (69.7%) of the respondents in the sampled project-affected communities were males; the women however were more readily available for focus group discussions and indeed confirmed to be active enough in the affairs of the communities as well as in farming.

As at 1991, the household age structure and distribution of the project area population conforms somewhat to the overall Niger Delta and indeed Nigeria's pyramidal structure. Population was rather overwhelmingly loaded from the lower age-cohorts; the bulk of the population is made up of persons below 25 years old. Infants and children of primary school age make up over one-third (16.4% and 19.3%respectively) of the entire population, while adolescents/teenagers (post-primary/secondary school age bracket) and young adults/youths make up another one-third (33.8%) of the population (NPC, 2002). This implied a young and growing population with heavy burden on the adult population, a high dependency ratio, as well as huge unemployed human number as was witnessed during the field studies. There is therefore the need to provide more training, including vocational education and educational facilities to accommodate this young population.

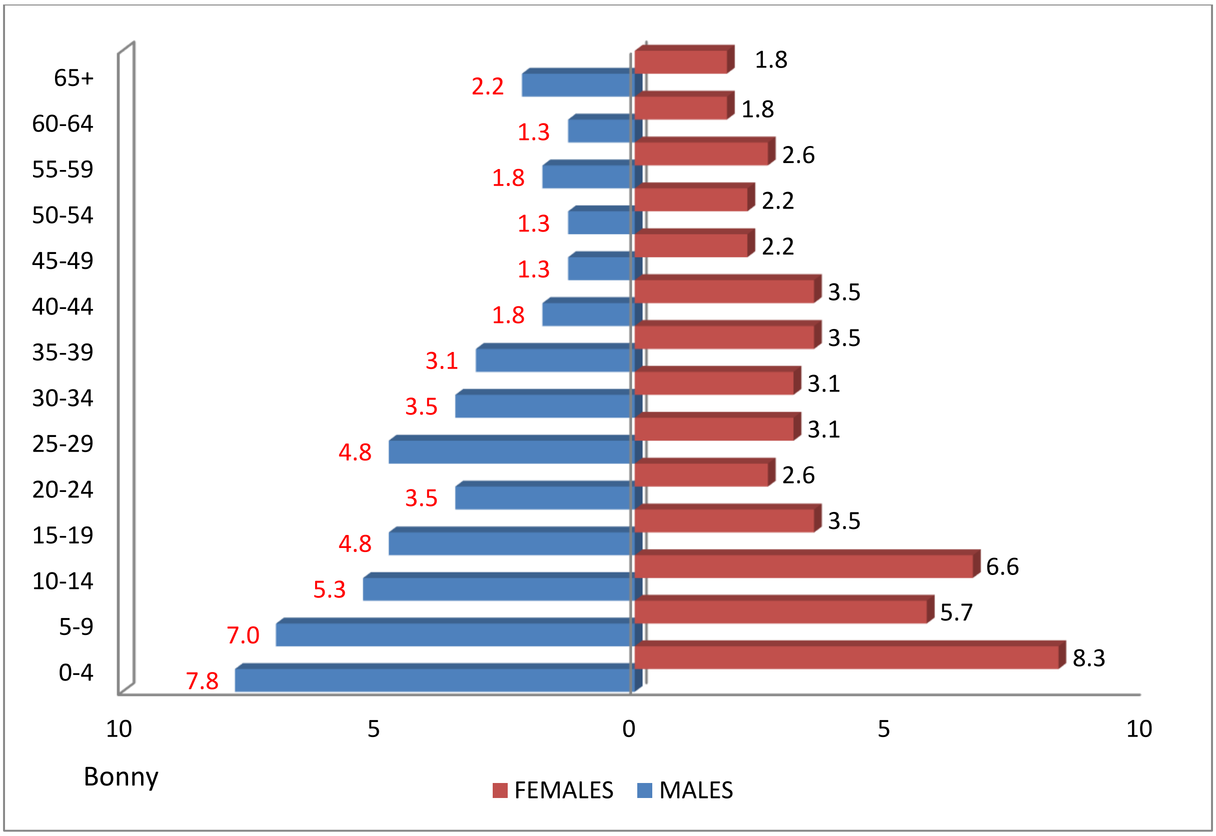


Figure 4.35: Population Pyramid of the Area

In the Finima area, the population was recently found to be rather overwhelmingly loaded from the lower age-cohorts, with the bulk of the population (53%) made up of persons below 19 years old and about 40.7 percent of the household members also aged 19-59 years while approximately 7 percent are 60 years and above. This confirmed an earlier study where the age group 0-19years were found to constitute about half (51% approximately) of the entire Finima population, while the corresponding figure for the Fishing ports lumped together was 42.2%. In contrast, those aged 55 years and above make up about 6.2% and 2.6% of Finima and fishing ports respectively. The economically active age group 20-54 years on the other hand was found to constitute about 43.3% and 55.2% of the Finima and the fishing ports population respectively.

Available information on the age structure of the population of states in the Niger Delta region depicts a large segment of young people below 30 years of age. This group comprises 62.1 per cent of the population of the region, compared with 35.8 per cent of adults in the 30 to 69-year age bracket. Approximately 53% of the population of the

Bonny LGA was made up of the male gender, compared to the females' 47%. The sex ratio of the area has increased even the more within the intervening years; as revealed by the 2006 national census; about 55.3 percent are males as against 44.7 percent females in the LGA. This is most likely caused by higher influx of job seeking male migrants into Bonny than any other settlement in the area. Another study has also reported that the sex distribution of the Finima population is such that males make up about 55.8% as against the females' 44.3%, while the fishing ports close to Mobil's BRT have about 54.2% males and 45.8% females (Ojile, 2009j).

According to the 2006 national census, 52.3 percent of the population is constituted of the male gender and 47.7 percent are females and translates to an overall sex ratio of 109.5 for the entire Rivers State (FGN Official Gazette, 2007). This means that, for every 100 females there are to be found almost 110 males, far above the national average of 105 (FGN Official Gazette, 2007). The males are still very dominant of the entire population in both the Bonny LGA and Rivers State.

Several factors usually account for the migration patterns of a population; the economic background of the environment inclusive and the fact that the male gender has higher propensity to move than the female. Also, the sex ratio at birth in most countries has been reported to be about 105 or 106 males per 100 females, but that after birth, sex ratios vary because of different patterns of mortality and migration for males and females within the population (Haupt and Kane 2004). That the males are consistently far in excess of females in the Bonny area could be either as a result of more female out-migration while the males remain behind to find employment in the many industrial opportunities available within their domain or natural selection; more male children are being born than females.

The age profile of the study area thus mirrors the entire Rivers State structure and indeed, the age profile of the Niger Delta. Approximately 70 percent of the population is below the age of thirty. Data from the different studies, including that used for the preparation of the Niger Delta Regional Development Master Plan (NDRDMP) indicated that the structure of the population of the Niger Delta Region is largely youthful with over 62% of the people being below the age of 30 years. Adults in the age group 30-69 years make up only 36% while those aged 70 years and above constitute just 2% of the population.

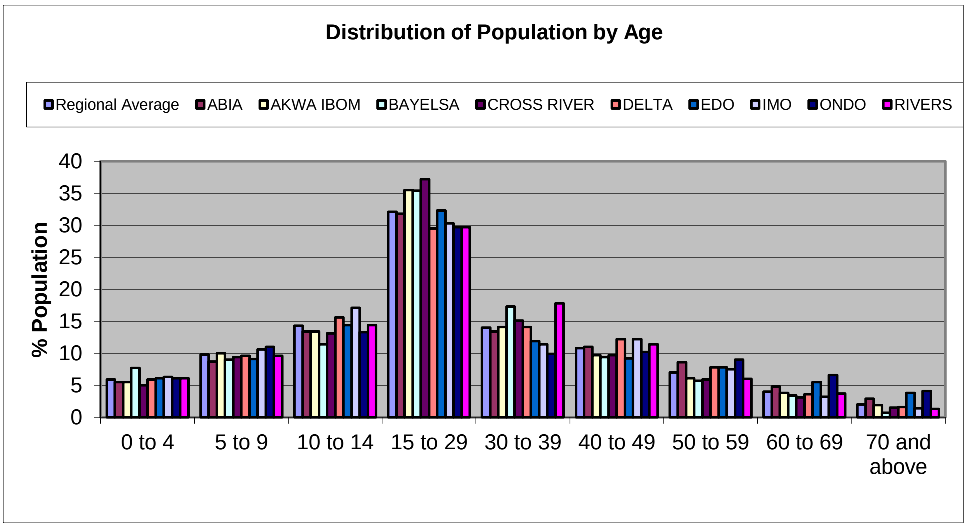


Figure 4.36: Percentage Distribution of Household Members according to Age Composition in the Niger Delta. (Source: NDRD Master Plan Baseline Survey)

Gender statistics of the project-affected communities indicates a preponderance of the males over the females although the gap is marginal. In 2006 census, about 50.6% of household members were males as against 49.4% that were females. Surveys carried out in the course of the Niger Delta Master Plan development process confirmed this statistics. The overall implication of the age profile in the project affected community was a young and growing population. It suggested a high dependency ratio that placed heavy economic burden on the adult working population. It also indicated a low average life expectancy. This suggestion was in line with UNDP report, 2006, justifying the need to provide more training opportunities for people in the area, including vocational education and educational facilities to accommodate and empower the young population.

Educational Characteristics

The percentage of people who indicated having some form of education across the surveyed project-affected communities appears to be very high. A greatest part of the percentage is made up of people with secondary. However, there is also high level of both tertiary and vocational/technical training in the area. Only 4% of the respondents have no formal educational training or cannot categorize their level of education. Respondents' spouses were also found to possess a level of educational training similar to their spouses. About 37.1% possesses the secondary education, 20.1% possesses vocational education, 9.5% the primary education and approximately 29.3% have some tertiary educational training. A large proportion of the respondents' spouses have formal education including vocational and/or technical skills.

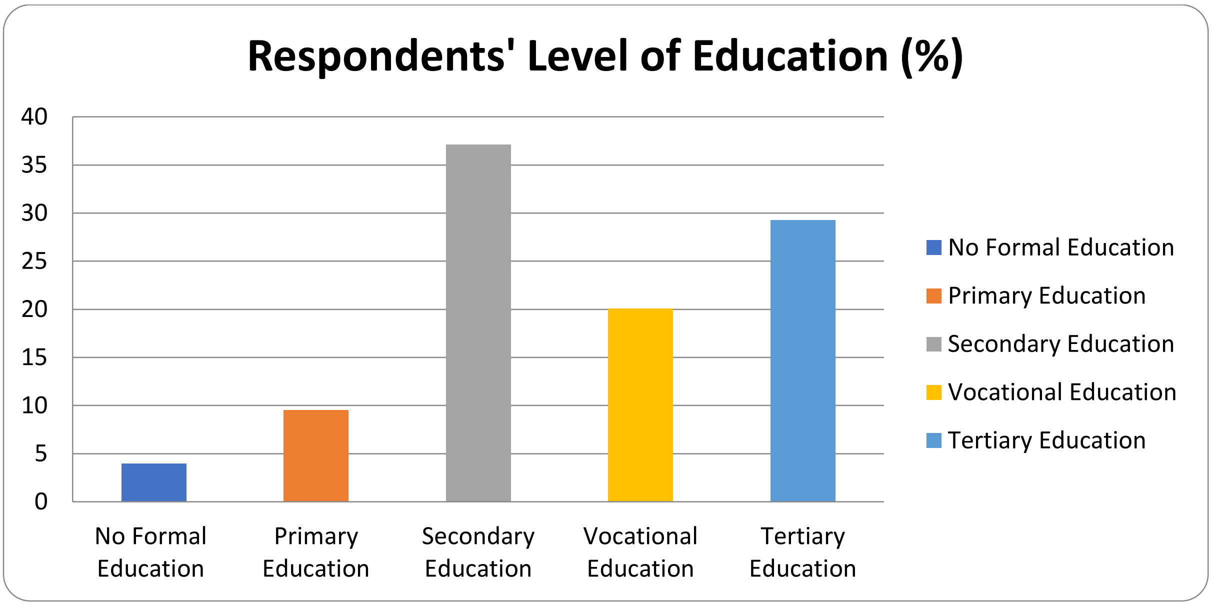


Figure 4.37: Level of Education of Respondents

The socioeconomic survey also attempted to establish whether respondents' children who are of school-going age were in school. Approximately 60% of the children in the communities sampled were found attending primary and secondary schools respectively. Statistical estimates have put the proportion of children attending primary school in the Niger Delta region at 80 per cent (which compares favourably with the estimated national average of 54 per cent). The adult literacy level of the population is 78.7%. The educational attainment at Primary and Secondary levels has however been reported to suffer from a high teacher-pupil ratio (1:42) compared with the national average of 1:36.

There are only 21 primary schools in the Bonny LGA and only one was confirmed located close to the study area; Central School, Bonny, which serves the educational needs of children and wards of the affected 6 communities (**Table 4.24**). Government statistics indicated the school had a pupil enrolment of 638 as at the 2010/2011 academic session, some 11.6 % of total enrolment in the LGA (RSUBEB, 2011). Sad to say however, there were only eight (8) teachers in the school and seven (7) non-teaching staff. Post-secondary schools are even more limiting in the Bonny LGA; there are only 4 senior and four junior secondary schools within the council area, there each located within the mainland Bonny. These are accessible to students from the land reclamation project area. The four JSS had 1534 students in the 2010/2011 session with 54 teaching and 22 non-teaching staff members (**Table 4.25 and Figure 4.38**) (Government of Rivers State, MOE, 2010).

Table 4.24: Pubic Primary Schools' Statistics in Bonny LGA Communities

School	Enrolment	Teaching Staff
ST. MICHAELS, BONNY	434	10
BOYLE M.S, BONNY	386	16
BONNY G.S, BONNY	496	15
MPS, BONNY	526	14
CENTRAL SCH, BONNY	638	8
CPS, ABALAMBIE	180	9
CPS, FINIMA	395	14
CPS, LIGHT-HOUSE	465	9
CPS, RIVER 7	109	4
CPS, AGAJA	182	5
CPS, KURUMA	111	3
CPS, DAN JUMBO	245	4
CPS, ALMALGAMTED AGBALAMA	176	3
CPS, PETERSIDE	118	3
S.B.S, BURUKIRI	163	4
CPS, OLOMA	165	4
CPS,DEMA ABBEY	106	4
CPS, QUEENS IWOAMA	100	2
CPS, BANIGO	240	4
CPS, KALAIBIAMA	159	2
CPS, IWOKIRI	108	2

TOTAL	**5502**	**139**

(Source: Rivers State Universal Basic Education Board, Port Harcourt, 2011 and Government of Rivers State, Ministry of Education 2011 School Census Analysis)

Table 4.25: Statistics of Junior Secondary School by LGA, 2010/2011

School	Student enrolment	Teaching staff	Non-teaching staff
BMGS (UBE), BONNY	556	14	6
GGSS (UBE), BONNY	450	16	6
CSS, BONNY	418	14	5
CSS (UBE), BURUKIRI	110	10	5
TOTAL	1534	54	22

(Source: Government of Rivers State of Nigeria, Ministry of Education, Port Harcourt, 2011)

4.10.10 Local Economy, Livelihood and Employment

Occupation, Income-Generating Activities and Employment

Economic conditions have a vital role to play in people's experience and perceptions of place. A person or a household's socioeconomic status influences the range of opportunities and constraints that people face. In fact, socioeconomic status affects almost all aspects of life. It affects nutrition levels and health, geographic mobility, educational attainment and overall quality of life. Fishing and agriculture are the two major traditional occupations of the Niger Delta peoples (NDDC, 2006; UNDP, 2006).

Traditionally, the main occupations of the Ibani people, including those on Bonny Island, and satellite villages have been fishing, subsistence farming, and trading, but with the increasing industrialization of the area (since the NLNG base project), the proportion of people involved in construction work and trading have increased. Agriculture on Bonny Island and its villages is very limited influenced by the individual community's availability of arable lands and thus only takes place on the relatively poor sandy soils of the dry-land ridges of the galloping swamp forest. Fishing is by far traditionally a very important economic activity on Bonny Island and its villages but again in some cases influenced by the individual settlement's proximity to water bodies (rivers/creeks).

Across the surveyed communities, the local economy was consistently ascertained to be dominated by fishing, little farming and petty trading respectively. Fishing is carried out on the creeks up to the Bonny River estuary, some using HP engine-powered boats but majority are hand-pulled canoes, throwing nets of various mesh sizes or set nets (*gbidi)* while the womenfolk collect periwinkles, oysters and other pelagic organisms along the riverbanks. Fishers confirmed October-April months as most favourable for fishing because the catch is large at this time. In the settlements/communities with fertile arable lands, farming is counted as the primary occupation, with oil palm cutting and milling (*Orupiri*) a major activity, although workers are non-indigenes (from Akwa Ibom). Important agricultural produce such as cassava, plantain, cocoyam, yam, banana, citrus (oranges) and vegetables, pineapples, sugar cane are cultivated.

In the Oloma axis for example, two-thirds of the people are engaged in fishing. In the Bonny main Town, NLNG-SPDC-Bonny Terminal axis, field surveys revealed that about 13.7% of the people are engaged in fishing, followed by trading (10.6%), and junior paid employment (9.3%) and craftsmanship (9.3%). Amongst the female folk, fishing and trading (13.4% each), business activities and paid employment (10% and 12.8% respectively) were the dominant occupations (NLNG, 2002). About 67% of the residents in Finima and 92% of those in the Fishing Ports have been reported to be in either full or part time employment with fishing as dominant occupation. Expectedly and as the names connote, over 80% of the population in the fishing ports engage in fishing, while in Finima, dominant occupational activities are company employment (limited to short-lived or occasional construction work), trading and public/civil service in that order. Self-employment (business), hunting and craft making are also noticeable economic activities in the area.

In some of the Bonny communities like those of Oloma with thick rainforest vegetation at their back swamps, arable lands for meaningful cultivation are available, hence some natives are farmers. The common agricultural produce is cassava, yams, cocoyam, maize and vegetables (okra, pepper, pumpkin, etc). But in all the fishing ports proximate to the company's activities/facilities, fishing and petty trading is most predominant as economic activities. Various fishing gears including nets, hooks, fish traps of different kinds, as well as fish ponds along the creeks and in mangrove forests are used to harvest fisheries products. Hand-dug canoes fitted with out-board engines are also used for fishing up to 10-15 km into the sea. However, onshore fishing is most common, involving the collection of pelagic fisheries species, oysters shellfishes and periwinkles, setting of fish/animal traps in the mangroves, hand (scoop) nets fishing (mostly by the women folks and adolescents), and use of hooks and drag nets by the men folk.

The recent socioeconomic sample survey of the Finima area corroborates the traditionally known engagements of the inhabitants; fisheries is by far the most mentioned and observed occupation that engages the highest number of the adult population of males and females in the area. On the average, about 50 percent of the respondents are involved in this as a primary occupation that yields income. In the Finima-owned settlements established primarily as fishing settlements/port, its inhabitants are over 90% fishers. In all cases, more of the males are involved in the actual fishing, while the women folks, mostly wives of the fishers buy the fish from the husbands; carry out the processing activity and final disposal in the markets. Women also participate actively in inshore fishing, including the collection of periwinkles, oysters and barnacles.

Trading and business/contracting were the second most important income-generating activities in the area, accounting for approximately 12.5 percent of the occupations. With the exception of few cases, the females do more of the petty trading; dispensing goods from stores and open market places on designated community market days. The Finima main town has a modern market with both lock-up and open stores and daily marketing activities were observed to be intensive and comprehensive. A few respondents are also engaged in other fisheries-related industry activities such as boat making and repairs, boat engine servicing, sale and mending of nets, weaving of traps and baskets among others. Carpentry, masonry/bricklaying, fashion designing, etc. are artisan occupations that were also observed though not accounted for by the questionnaire survey and were restricted to Finima and those settlements close to it.

Farming is not a predominant occupation of the population in the Finima area; it was mentioned to be of little relevance because not much of arable land is left to farm on. Vegetables, cassava, plantain, banana, sugar cane among other food crops are planted at the Agaja axis of Finima, mostly by non-indigenes from Akwa Ibom. As a secondary occupation however, more of the resident population take to trading.

In terms of employment opportunities for the people outside the traditional economic activities of fishing, farming and trading, there appears to be plenty of opportunities in the oil and gas industrial establishments, yet unemployment and under-employment have been constantly reported. Consequently, the unemployment rate in the Bonny project area has been high; about half for the males and 40% for the females. Earlier studies indicated that Finima and Bonny main Town have the highest percentage of employed population, yet about 41% on the average of the available workforce from selected towns and villages in the Bonny LGA are unemployed.

Income Level of Respondents

Responses from surveyed respondents in the Bonny communities revealed that incomes are very varied and meager. About 12% of respondent earn between ₦1,000.00 to ₦10,000.00 per month and 21% of respondent earn between ₦11,000.00 to ₦20,000.00 per month. 11% of respondent earn above ₦50,000.00 per month whereas no respondent earn less than ₦1,000.00 per month. Respondent than earn between ₦21,000.00 to ₦30,000.00 per month were the most common among the sampled population. This modal income bracket from further analysis was found to be majorly farmers, traders and fishermen. The incomes level of sampled respondent is presented in Figure 4.35.

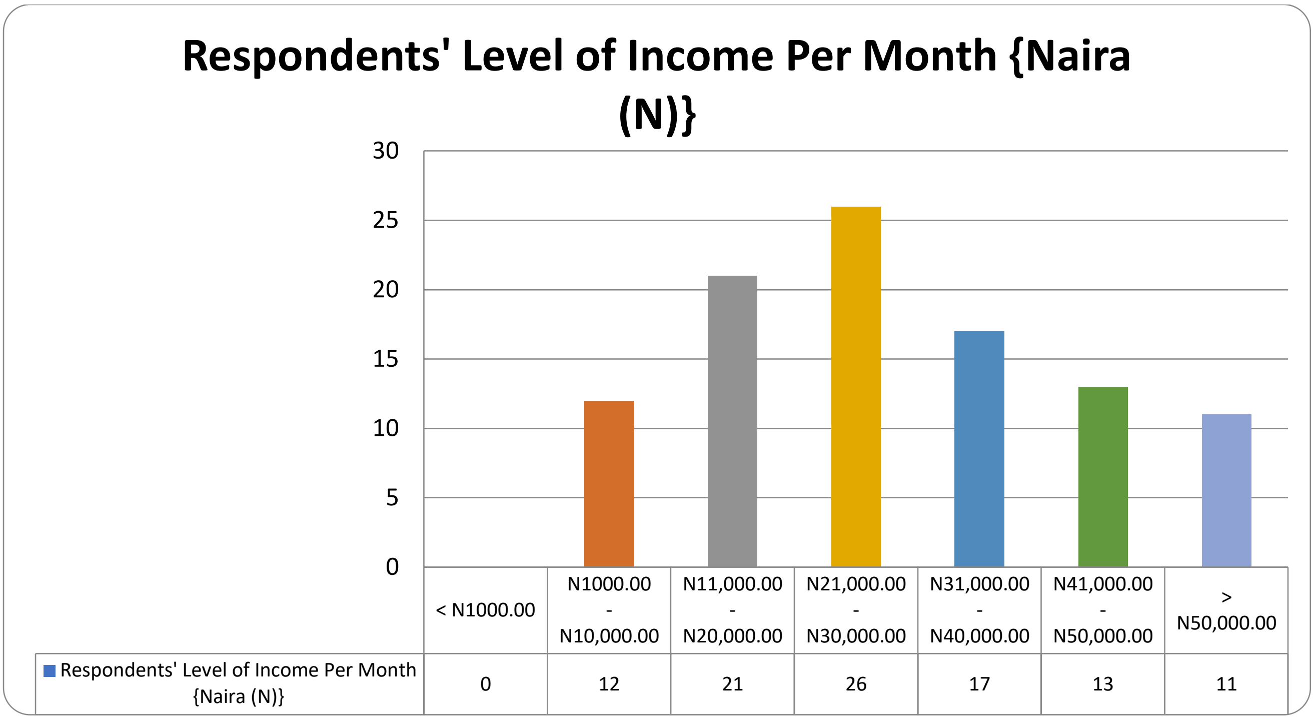


Figure 4.38 Monthly Income Level of Respondents

Creek, river (inshore) and marine or sea fishing is the primary livelihood strategy of households in the Bonny kingdom communities and the coastal settlements/ports established for the purpose respectively. In the remote villages, fishing is carried out mostly on the creeks and smaller rivers and the catch is described ''as barely subsistent''. Only few of the fishers can be described as involved in ''full-time fishing''. The women folk who engages in the collection of periwinkles, oysters and other pelagic organisms also make less than N10,000 from the effort, while traders in the products assemble as 20-50 bags of the 50kg rice bag for onward transfer to the urban markets of Bonny Town and Port Harcourt where better bargain and market value is sought for their efforts.

As was confirmed in a recent survey, for some time now, the average Bonny and Finima indigene is no longer predominantly fishers on account of low fisheries catch close to shore and all creeks are closed and sand-filled and thus fishers are compelled to go fishing in deep sea with vessels/bigger canoes. Consequently, the fishing business is dominated by non-indigenes, mostly Ghanaians, with the indigenes satisfied at investing either in buying the boats used or nets (equipment). Income from sea fishing is generated by boat owners, investors, or fisherman assistants, and by women as fish processors/smokers. Most fishermen do not venture more than eight to ten kilometres from the coast. A typical sea fishing crew (usually 2-6 persons) use a wooden boat measuring about 15 x 16 ft powered by a 30/40 HP engine. The boats are stored on the beach with the engine taken inside the house when not in use.

Average and median annual incomes for the Bonny LGA some few years back found to be N30,015 and N30,500 respectively. Annual income levels for Finima area were also reported to range between N20,000 and N160,000 with average of about N71,000 and in the Fishing Ports annual incomes also ranged between N5,000 and N20,000, with average of about N38,000 respectively. Modal incomes were also found to be about N60,000 and N20,000 per annum in Finima and the Fishing Ports respectively.

The Gini Coefficient (a measure of income inequality, ranging from 0, perfect equality to 1.0, perfect inequality) of the income level of residents of the Bonny LGA has been calculated to be 0.33 (NLNG, 2002). The obtained value indicates high level of income inequality, which compared favourably with what was found in some parts of Rivers State. No doubt, this income inequality may have been introduced by the presence of relatively highly paid oil and gas workers amongst the indigenes dependent on traditional occupations for their livelihoods. The low income levels found for the Finima and the Fishing Ports can also be attributed to the short periods and temporary nature of construction jobs that most adults depend on (in Finima) while several households (in Fishing Ports) fish with hired equipment (boats and nets) while many hands that usually go on one fishing expenditure (4-10 men per boat) may also reduce per capita income even when overall gross revenues appear high.

Income of respondents from their varied economic endeavours at the Finima town was recently found across the income brackets; about 6.3 percent earn less than N1,000 in a month while close to one-fifth (18.8%) of the population also earn above ₦50,000 in a month. Approximately 57 percent of the sampled respondents earn income N1, 000-N35, 000 monthly while another one-tenth (13.5%) earn between N40, 000-50,000 in a typical month. Field survey and key informant interviews also confirmed that incomes and salaries/wages are highly controlled in the Bonny-Finima environment; unionism is very strong and as a result per capita income is high.

Land use /Access

Generally, land is Nigeria's most important long-term resource base and in areas where this finite resource is in short supply can be very contentious. Practically everywhere therefore, Nigerians share land as a common denominator wherein lie most of their hopes and most of their problem. Land means many things, and the manner in which it is acquired, owned, used, and transferred is referred to as land tenure. Before rights can be exercised over land, it has to be acquired in one of six principal methods of land acquisition, namely, inheritance, purchase, lease, pledge, exchange, and gift.

Land is the base for all human activities, including agricultural and industrial development. Rivers State covers approximately 50,000 km^2 and includes about one third of the Niger Delta. However, approximately 75% of the state is riverine and seasonally flooded. By providence the entire Bonny area is also made up of more water than land; in fact, apart from the main Bonny Town an island, each of the constituent settlements is an island by themselves, surrounded as it were by water from all sides. However, vast rainforest arable lands are available at the Oloma axis. While the mangrove vegetation runs along the creeks, a large strip of both a mixture of freshwater and saltwater forest vegetation can be found behind each of the communities. Such lands are owned by families/compounds while the entire community equally owns some. Some of these lands and their high biodiversity are under respectable environmental management groups like the Bonny Environmental Consultative Committee (BECC) signboards have been erected at strategic points along and in the forest areas as environmental education and protection measures) and Ibani Kingdom Environmental League (IKEL).

Land in Nigeria falls under four broad ownership classes, regardless of who the law says holds the land in trust for whom. They are individually-owned, family-owned, communally-owned, and government-owned land. The community can also provide land for the siting of development projects when the need arises. Lands are held in trust by the eldest man in the family/compound and subsequently passed down the generations and acquired through family inheritance. Across the Bonny kingdom project affected communities, the family land ownership system prevails.

As would have been clear from above, arable land is very limiting in the Bonny study area. However, land is used for cropping in those areas where some farming is carried out for between 2 and 5 years and abandoned to fallow to allow it regain nutrients and fertility naturally. Virgin land is cleared for cassava, yam, plantain, maize, melon and vegetables in the dry season in a mixed farming system. The bush fallow system was however, confirmed to be reducing; it used to be seven years before a farmer returns to his original land for planting but now, lands are hardly left to fallow beyond two years, because of increase in population and land take by other competing uses.

Water Supply and Sanitation

Plate 4.15: A Water Supply Facility in Bonny

Communities Healthcare Facilities

Plate 4.16: Health Care Facility in Bonny

Electricity Supply

Data from the National Bureau of Statistics shows that across the Niger Delta region, on average, only 34% of people use electrical lighting. The settlements in Bonny (Finima included) are connected to the national power grid of the Power Holding Company of Nigeria (PHCN). Access to electricity energy (supply) was however, confirmed by community respondents to the availability of electrical power supply.

Regular access to electricity supply in the Bonny Kingdom communities is limited to the main Bonny Town itself and Finima. In Bonny main town, electricity supply is provided by the SPDC through a gas turbine, which is very effective compared to what exists in other places in the Niger Delta in particular and Nigeria in general. There is access to electricity supply in the Finima town; electricity supply is through the NLNG Gas Turbine system and powerful community generators provided by the NLNG. But the entire town is not connected to the gas turbine; some sections of the town are connected to the gas turbine system while the other is energized via the generators. The NLNG it was gathered is pursuing the possibility of the population paying some bills for energy consumption to which they are generally opposed. At the moment, electricity is enjoyed free-of-charge (FOC).

The energy supply situation across the nine constituent states of the Niger Delta is confirmed in the NDRDMP Report; about 72% of the households in the Niger Delta Region are acknowledged to be connected to the electricity network but the percentages are higher in the urban settlements and lower in rural settlements. Electricity supply through the NEPA system/network is unreliable and the average availability of electricity in a day varies from 4.8 hours in Imo State to 13.5 hours in Cross River State. In consequence, virtually all institutions, commercial and Industrial outfits own their private generating sets. For most of them, private generating sets are the prime source of electricity, while NEPA serves as a back-up source when available. On average these outfits use their generators for about 7 to 12 hours daily. Few outfits run their generators continuously for operations and are not connected to NEPA network.

Transportation and Communication

Access to public communication facilities like the telephone and postal services in the project-affected community was also found to be greatly enhanced even though people hardly communicate through postal services these days. The new mode of telephony, the GSM has made telecommunications quite easy within and around the proximate communities.

With particular reference to the Bonny LGA of Rivers State, due to its physical conditions, the development of roads has been much retarded, although attempts have been made since the 1990s to have a Road constructed with the intent to link up the villages to the Bonny main town itself. At the present time, and especially since the inception of the present democratic dispensation, Bonny has been made relatively much more accessible than it used to be. In fact, accessibility to, movement of goods will be accelerated by the proposed project.

For now, access to Bonny and its constituent villages is through water (oil and gas companies operating in the area uses helicopters to airlift their workers in and out of

Bonny). Transportation is through hand-dug canoes (by residents in Bonny villages and Fishing Ports particularly and inter/intra community movement) and the popular fibre or outboard engine boats usually fitted with various grades of HP engines. There are also the more comfortable Rivers State Marine Transport Service, the Bonny LGA Transport Service and the Youth Movement organized transport services, all making movement from Bonny to Port Harcourt or vice versa a lot easier. However, the cost of transportation remains very high and movement can at times be difficult due to bad weather condition.

Postal services are available in Bonny Town and Finima although the introduction of modern telecommunications such as the GSM telephony has rendered this facility and services redundant. Almost all of the Bonny Kingdom communities have access to at least one of the networks of the global system of telecommunication facilities called GSM.

Housing Types and Quality

Majority of the houses are of the rooming type in the study area are characterized with modal walling and roofing materials being concrete block and corrugated iron sheets (zinc/aluminium). Most of the indigent populations live in their own houses. A high proportion of the resident population in the water front settlement referred to as ''*Kozo*'' by the respondents live in mud houses.

Plates 4.17: Mixed Housing Types in the Project Affected Communities

Housing in the Niger Delta region is predominantly of poor quality, especially in the swamps and creeks where dwellings are made up largely of mud walls, and stilt or strip foundations. A survey of 40 locations that included Warri, Port Harcourt and Sapele by the NDES revealed that 30.4 per cent of houses had mud walls, 53.8 per cent had corrugated-iron sheet roofing, and 46.6 per cent had a strip foundation. Flooring materials vary widely, but are predominantly concrete followed by mud. Data from the National Bureau of Statistics (2005) largely confirm the findings of the NDES survey, but the lumping together of data for rural and urban centres distort the picture of housing conditions in the core Niger Delta states where small settlements and camps predominate.

Table 4.26: Summary of Infrastructures and Social Amenities Available in Study Communities

Infrastructure / Community	Education	Energy/Electricity	Roads/Transport/ Communication	Water and Sanitation	Housing	Health and others
Oguede	• Community has a public primary school. • There is no public secondary school; children attend both public and privately-operated post primary school at Bonny Town and/or other distant townships like PH.	• Community is connected to power supply.	• Community has good roads. • Have access to modern telephony (GSM) networks	• Access to water supply is via borehole	• Admixture of modern and old housing stock.	• Community has health C facility • Population also uses General Hospital at Bonny Town on referral or private clinics .

Oloma	• Has a public primary school • Community has no secondary school within immediate domain; children and wards attend school at Borokiri, walking distance from community.	• Connected to national grid of PHCN, but electricity is from a community generator that is not regular	• Accessible via water (boats, canoes) and footpaths from neighbouring communities of Ayaminama, Orupiri, Epelema, Sangama and others • Has a concrete landing jetty • Has access to modern GSM telephony	• Community has two different water facilities but none functional • Mono-pump, water wells and private boreholes are used	• Admixture of both old and modern housing stock but predominance of houses constructed of blocks and corrugated iron zinc, many are well-designed and modern	• Primary Health Centre available • There is a Town Hall for community meetings and ceremonies.
Finima	• Have primary school and secondary school • Children also attend post primary school at Borokiri	• Community have functional electric power supply.	• Community accessible via road, water and footpaths, linked to several neighbours. • Access to modern GSM telephony.	• Have access to potable water supplies;	• Mixture of both old and modern housing stock with those built of blocks and with zinc roofing predominant.	• Access to primary health care services • Has community Hall.
Bonny Town	• As most developed and centralized local	• Residents of Bonny Town connected to	• Bonny Town accessible via water and air, internal	• Access to potable water most	• Both very old architectural and modern	• The Bonny General Hospital and

Escholes Integrated Services Resources Limited

	administrative center in the area, Bonny boasts 32 schools; six (6) public primary and 4 post primary schools, 2 technical and others private.	SPDC's sponsored Gas Turbine, very regular.	roads surfaced and proposed ring road shall improve network efficiency and connectivity, linking all neighbouring communities. • Two concrete jetties available for boat mooring/landings. • Modern telecomm. (GSM telephony) facilities available	challenging; most source water from water wells, some private boreholes even though public water facilities available. • Water tankers sometimes supply water to residents.	hosing stocks available, many family houses, some rented to workers.	Comprehensive Health Centre provides both secondary and primary health care services to population within and beyond Bony Town. • About four private clinics also available.

Waste Disposal

In the study area, majority of the household do not use organized and sanitary waste management systems. Solid waste materials mainly rubbish and garbage are dumped openly (Plate 4.16) or burnt. The quantity of refuse varies from one locality to the other depending on the food habits and customs of the people. The quantity of refuse in the rural area is less than that of the urban areas, but whatever the quality/quantity, they must be sanitarily disposed to avoid breeding of vermin's, fire outbreaks and injuries from broken bottles and sharp metal cans. For effective waste management, dust bins must be provided to collect the waste which must be water resistant. It must also be provided with a cover lid.

Plate 4.18 Waste Disposal Pattern around affected Communities

The Bonny Kingdom and its indigenous Ibani population are very social and hospital people. Several socio-cultural activities are associated with the inhabitants of the area. Apart from Bonny Town and Finima and a few of the villages, many do not have designated community halls for communal meetings and other social events;

community meetings are organized at the palace/home of the community chief or at best social gatherings and events take place at the primary and secondary schools playground especially when large audiences are expected. There is Nature Park as well as a beach in Finima, there a community centre called *Opuwari* in Oguede.

For recreation, football, dancing, masquerade displays, snooker games, table tennis, video/film watching and rentals, among others are organized for recreation, but many take place only in Bonny Town and Finima. School fields, bars and restaurants, open spaces of residential compounds are used as recreational grounds. Once a year, at Christmas, the cultural festival known as Nwaotam is held in Bonny. This festival usually attracts a lot of visitors, so is organized in school playgrounds. Modern town halls with complete meeting accessories are therefore, to be found in few places.

Plate 4.19: A Recreation Facility in Bonny

Perceptions, Concerns and Social Needs of the Population

The priorities of the project affected communities are summarized below:

- The people acknowledged that when the project is completed, it will bring about speedy and rapid development.
- The host community is aware that the project will create high employment opportunity for skill and unskilled workers
- This project will increase the value of property and enhanced income generation
- Influx of people may put pressure on existing infrastructure
- The host community welcome the project as it will create access to other communities and boost business opportunity
- The proposed project will bring in more visitors which will contribute to development
- This project will result in influx of people of different background and lifestyle which could promote social vices
- The project is a welcomed even as we expect speedy completion
- The project could increase crime rate

4.11 Health Survey

The healthcare and wellbeing of an individuals and communities were determined by a wide range of economic, social and prevailing environmental conditions as well as other factors such as family history and access to available healthcare facilities. These parameters were adequately studied and its specific findings are presented in the subsections below.

Knowledge, Attitudes, Practices and Behavior on Sexually Transmissible Infections

The knowledge of respondents, their attitudes, practices and behavior on sexually transmissible infections is quite high and reflects a good understanding of the health education and messages that are regularly carried out on the media and through person to person campaign.

Sexual Behavior and Knowledge of HIV/AIDS and CoVID-19

The sexual behavior of members of the communities can encourage the transmission of sexually transmitted infections, including HIV/AIDS. Although polygamy is commonly practiced especially among the fishing communities, most adult males and single girls had multiple sexual partners, as a man is culturally permitted to engage in extra-marital affairs. This sexual behavior, according to the discussants at the various focus group discussions held in the communities studied revealed that over 97 % of the households are aware of the repercussion of bad sexual behavior and HIV/AIDS.

Respondents in almost all the communities visited expressed some basic knowledge of STIs, and the most popular was gonorrhea. There was also a high level of awareness about HIV/AIDS among the communities in the proposed project area with as much as 97.2% of respondents that have heard about HIV/AIDS (Figure 4.20).

However, only 49.7% of those who had heard of HIV/AIDS could say whether the disease posed a threat to their communities. This could be a function of the level of available data of HIV/AIDS statistics in the communities and did not detract from the fact that members of the community were aware of the existence of the condition. The commonest sources of information on HIV/AIDS were the media, health workers and friends.

Generally, HIV in adult Nigerians is however mainly transmitted through the heterosexual route; this explains why the ABC method forms the basis for HIV control in Nigeria. The ABC method is an acronym that stands for; **a**bstinence from sex, **b**eing faithful in monogamous relationship between HIV-negative partners, and **c**ondom use for people not practicing abstinence.

Most discussants in the focus group discussions conducted in the communities have heard of HIV/AIDS and demonstrated good knowledge of the ABC methods of HIV prevention. The study noted that over 97 % of the households are aware of HIV/AIDS as a pandemic disease.

Presence of Risk Factors (Use of Alcohol and Cigarette)

Alcohol and cigarette were commonly used in the study area as observed during the fieldwork, like most riverine communities in Rivers State. Alcoholic beverages, including palm wine and the locally distilled gin called *kai*-kai or *ogogoro,* were freely available (though not for free) in the communities studied. Alcoholic beverages were used during social functions and even in ancestral worship; alcohol is also a ubiquitous solvent in several traditional medicine, ranging from pain relief to aphrodisiac. Binge drinking was however said to be high in the communities studied, especially during festive periods and burial ceremonies, when indigenous people converge from all works of life. However cases of alcoholism were said to be low, in spite of the large number of persons that take alcohol in the communities.

Smoking was not too common in the communities studied; about a fifth of the young adult males in the communities were said to smoke cigarette, but an average smoker took at most three sticks of cigarette a day. Women in most of the communities studied rarely smoke cigarette.

The commonest form of alcohol used in households was beer with 31% of households having at least a consumer and this was followed by hot drinks/spirits (29%). In general, it would appear that at least one out of every four households in the project area has alcohol consumers. It was noted that alcohol use has been associated with less care in sexual relationships and may therefore facilitate unprotected sexual intercourse and transmission of STDs.

Tobacco chewing/snuffing is practiced in 34% of the households while in 31% there was at least one member who smoked marijuana. Tobacco use has been associated with diseases such as Lung Cancer, Ischemic Heart Disease, Hypertension and bronchitis among others. The use of marijuana has been associated with withdrawal symptoms and increased criminality. The cost of maintaining the habit may also have significant impact on household expenditure and compromise the purchase of essential items like foodstuff and appropriate clothing.

Chronic Effects of Alcohol

Drinking too much alcohol can cause a wide range of chronic health problems including liver disease, cancer, heart disease, nervous system problem as well as alcoholism.

The summary of the chronic effects of alcohol in the study are:

- Liver Disease
- Hepato-toxic trauma
- Alcoholic Hepatitis
- Alcohol Cirrhosis
- Alcohol Pellagra
- Malnutrition
- Polyneuritis
- Liver Cancers

Availability of Healthcare Facilities

Health care provision in Nigeria is a concurrent responsibility of the three tiers of government in the country. However, because Nigeria operates a mixed economy, private providers of health care have a visible role to play in health care delivery. The study conducted an inspection on the existing health care facility in the study area and the result is presented in Table 4.27. It was gathered during discussion that the critical cases are referred to Bonny General Hospital.

Table 4.27: Available Healthcare Facilities in the Study Area

Community	Health care centre	Patent Medical Store	General Hospital	Cottage Hospital	Native Herbal Centre	Traditional Birth Attendance	Other	Total
Grand Bonny	**1**	**30**	**-**	**1**	**4**	**5**	**-**	**41**
Obogude	**-**	**11**	**-**	**-**	**-**	**2**	**-**	**13**
Oloma	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**5**
Finima	**-**	**25**	**-**	**1**	**2**	**4**	**-**	**32**

Analysis of Health Care Facilities in Study Area

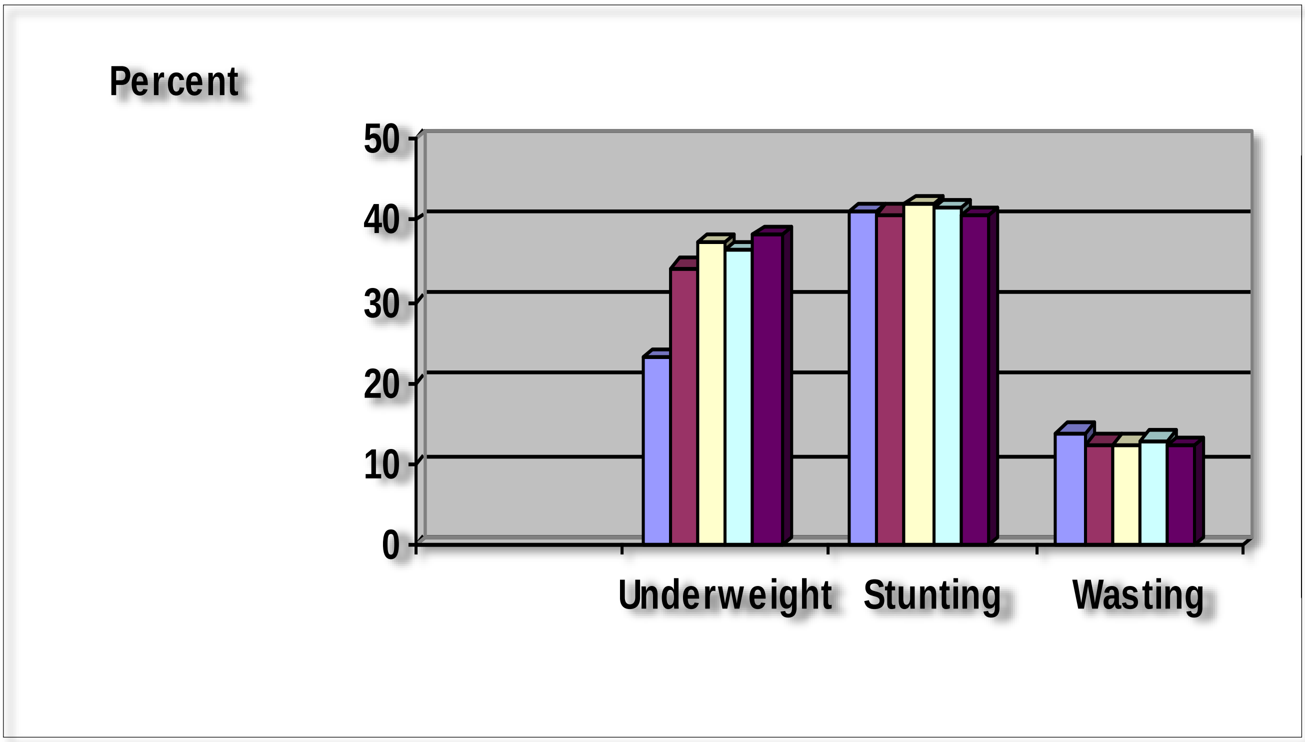
Accessibility to healthcare facility is a major concern among the communities studied, only Finima had basic healthcare facilities. It was noted during FGD that sick people die on their way to the clinic due to no availability of good healthcare in Oloma. For secondary health care, members of the communities are taken to Grand Bonny town where the Government General Hospital and a few private clinics are located. The hospital in Finma town were observed to have adequate bed space and person.

Medical Emergency Evacuation System

There was no formal medical emergency evacuation system in the Oloma communities expect by boat. Members of the communities make their own private arrangement in convening their sick by boat for appropriate treatment.

Household Food Security and the Nutritional Status of Under-five Children

Most members of the communities regularly eat the local staples of cassava and yam. These are starchy staples. They are however complemented with fish and vegetable, which are the major agricultural produce of the people. Household food security in the communities was said to be good. The prevalence of under-weight under-five children is one of the indicators for goal one of the Millennium Development Goals. The nutritional status of members of the communities was assessed during the field survey, through the anthropometric measurement of under-five children in the communities. The result of the anthropometric measurements of the under-five children is presented in Figure 4.39**.**



Morbidity Pattern (Under-five Children)

Rivers State's infant and maternal mortality rate has reduced by about 40 per cent in the last four years, from about 1000 deaths per 100,000 births to 600 deaths per 100,000 births. The reduction in the IMR/MMR came from the free health care programme for the infant (0-5years), ante natal and the aged (above 60 years) in the state (NDHS, 2008). In spite of this effort by the state Government, most of the pregnant women in the study area still patronized quacks and untrained traditional birth attendants. That notwithstanding, the average number of under-five deaths in the communities studied, in a year, was put at one. The morbidity rates (0-5years) in the study area were similar to those of other riverine communities of the State.

Diseases Prevalence

The diseases identified were malaria, typhoid, cholera, pneumonia, tetanus and measles among others. Various eye ailments have also been reported, arising from the exposure of unprotected eyes to fish processing (especially smoking) activities. From the finding, malaria and typhoid accounted for over 87% followed by cholera. Essentially, visits to health centres and hospitals for treatment is always the last resort of majority of persons who claim to be discouraged by the cost of treatment and long queues in general hospitals at Abonnema and by the official documentary procedures and processes that have to be observed in health centres, in order to access Medicare.

Patent medicine stores/itinerant drug vendors are therefore very popular Medicare avenues and thus enjoy a lot of patronage, even though the quality of dispensed drugs cannot be fully ascertained.

Plate 4.20: An Example of Patent Medicine Store in the Study Area

Malaria and Cholera

Like in tropical areas, Malaria seemed highly prevalent in the studied area, as gathered from both quantitative and qualitative data acquired during the survey. This is so because of the prevalence of mosquitoes in the area. And no distinct programs seem to exist yet in the communities to combat this disease. In all the communities visited with the exception of a few homes in Finima, most other respondents did not use treated/untreated mosquito nets or mosquito repellents. Respondents in all the communities visited claimed to have had suspected case fatalities of malaria and cholera.

Hypertension

High Blood Pressure (BP) is a disease condition that compels the heart to pump with more force and the arteries to carry blood moving under greater pressure than is normal. Persistence of this condition leads to heart and artery malfunctions, with consequential effects on other body organs thus creating an increased risk of heart failure, stroke, kidney failure and heart attack. Respondents were interviewed to determine whether any member of their households had been previously diagnosed as hypertensive and 45% of the households had one or more persons who had been previously diagnosed. Although, they were age related cases.

Indoor and Outdoor Air quality

Firewood was the commonest source of fuel for domestic use in the twenty-two communities studied. The level of use of firewood in the communities is however consistent with the findings of other related study in the area where an average of 73% of the households were noted to use firewood as their primary energy source. The use of firewood and other bio-mass as domestic fuel is a major cause of indoor air pollution, with wide-ranging health implications. Although the results of air quality measurement carried out during the field work showed that all the pollutants of interest were within regulatory limits, and therefore do not pose any serious health risks.

Access to Sanitation Facility

Sanitation facility was defined during the community survey as a private excreta disposal facility (that is either a toilet or a latrine, but not an overhung toilet, or a flush toilet without septic tanks that channels it effluents directly into the river). A household access was defined as a household having a private sanitation facility, or sharing a facility with not more than five other households in the building or compound.

Most of the toilet facility observed was the traditional open-to-river system. The study noted that this system of toilet is peculiar to riverine rural terrains. The health implication of this is that children swimming in nearby shallow waters may be infected with coliform bacteria with attendant outbreak of epidemic.

A few of the toilet facilities were observed to be poorly maintained, mainly due to lack of adequate water supply for the effective operation of the water closet. The septic tanks that serve these toilets were also noted to be located very close to the water borehole, and therefore likely to contaminate groundwater.

CHAPTER FIVE

ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS

5.1 Overview

The most critical basis for any Environmental and Social Impact Assessment (ESIA) studies is to effectively identify and as much as possible, quantify the environmental effects of any proposed project on the surrounding environment and the people. Basically, the ESIA seeks to assess the impacts that may be associated with a project, and determine whether or not these impacts are significant enough to modify a project or to determine measures to minimize the negative impacts. Impact assessment is usually based on a super-imposition of planned project activities on existing environmental conditions, such that the direct and indirect effect of each project activity on various environmental components are fairly easily elucidated.

In this chapter of the report, an overview of the methodology adopted for assessment of project impacts as well as a summary of the associated and potential impacts of the proposed project on the environmental and socio-economic conditions of the project area is presented. The assessment of impacts is as comprehensive as possible, within the limits of available information.

5.2 Impact Assessment Methodology

The effectiveness and acceptability of any impact assessment methodology is hinged on a number of key considerations:

- Simplicity (it must be simple enough to be easily understood by non-specialists);
- Comprehensiveness (in spite of its simplicity, an impact assessment method must be able to comprehensively cover all the aspects and possible extent of impacts that may be associated with a planned project);

- Objectiveness (an acceptable impact assessment method must be objective. Assessment and quantification of impacts must be based on scientific and rational considerations, rather than the subjective views of the person or persons undertaking the assessment);
- Selectiveness (despite the need for comprehensiveness, it is possible for impact assessment to become unnecessarily bulky and cumbersome, if attention is unduly paid to insignificant issues, thus, a sound impact assessment method must be selective by being able to eliminate those issues that are negligible and focus on the substantive ones); and
- Exclusiveness (it is easy to double-count impacts, if a methodology does not take cognizance of the need for exclusiveness. For instance, clearing of vegetation would necessarily mean a destruction of wildlife habitat, thus, there is no need to separate destruction of vegetation from destruction of wildlife habitat).

Impacts predictions were subjected to statistical tests as outlined by the ISO 14001 method of impacts assessment.

5.3 Screening of Impacts from the Proposed Project

5.3.1 Basis for Screening

In assessing the impacts of the proposed Bonny Deep Sea Port project, the following information was used:

(a) Knowledge of the proposed deep sea port activities, equipment types, procedures, and abandonment programme,

(b) The results of the environmental baseline studies (biophysical, socio-economic and health)

(c) Findings of other ESIA studies on similar areas and projects and other literature findings on the primary project activities,

(d) Comparison with FMEnv/ UNEP/WHO/World Bank guidelines and standards,

(e) Secondary data on similar existing projects,

(f) Series of resource persons (ESIA Preparers) discussions,

(g) Past experience on other ESIA projects by the ESIA preparers.

The criteria applied to the screening of various activities were:

i) Magnitude - probable level of severity;
ii) Prevalence - likely extent of the impact;
iii) Duration and frequency - likely duration; long-term, short-term or intermittent;
iv) Risks - probability of serious impacts;
v) Importance - value attached to the undisturbed project environment; and
vi) Perception of various stakeholders (regulators, operators, financier, community, etc.)

The various components of the proposed deep sea port that could have impacts on the biophysical, socio-economic and health environment of the project area were determined through an evaluation of the proposed project activities, the baseline of the project area that was reviewed, and the national/international legislative requirements. The activities of the proposed project with potential to have impacts on the environment include the following;

The project phases and its associated works essentially consist of:

Table 5.1: Project phases and associated activities

Phases	Activities
Pre-Construction	• Pre-mobilisation/Project design • Clearing of vegetation and other debris • Mobilisation of equipment and men to site • Dredging of channel for navigation and other reclamation works

Construction	• Construction of jetty including pilling/diaphragm wall works, capping beam works, deck works, intra port access roads linking the railway system
Operation	• Loading and offloading of materials at the jetty of the deep sea port • Transportation of materials along the jetty
Decommissioning and Closure	• Abandonment • Dismantling of structures

The associated impacts indicators were identified and are listed in Table 5.2 below.

Table 5.2: Impactable Components and Associated Impact Indicators

S/N	Impactable Components of the Environment	Impact Indicators
1	Air Quality	Particulates, NOx, SOx, CO, H_2S, HCs, Metals.
2	Soils/Agriculture/Topography	pH, Metals/Heavy metals, Conductivity, Soil micro fauna.
3	Surface Water	Dissolved/suspended solids, Dissolved Oxygen, turbidity, Nutrients, Metals/Heavy metals, Salinity, pH.
4	Fisheries/Aquatic Resources	Aquatic fauna diversity and abundance. Benthic organisms' habitats and presence.

5	Riverbed/Benthic Organisms	Benthic fauna, habitat presence, sediment chemical properties (pH, metals, heavy metals).
6	Ground water	Dissolved solids, Dissolved Oxygen, Nutrients, Heavy metals, Salinity, pH, Conductivity.
7	Vegetation	Species presence/diversity, Exotic species.
8	Wildlife (Biodiversity)	Species diversity/presence
9	Noise	Hearing impairment, Communication Interference, Disturbance of wildlife.
10	Socio-economic	Communal feuds over land ownership/compensation, Agitation for employments/contracts, Pressure on infrastructural facilities, youth agitations, increased social vices.
11	Health Safety and Security	Health and Safety of Personnel involved in carrying out the reclamation work.

Likewise, the sources of probable impacts from the various stages of the proposed deep sea port are also outlined in Table 5.3. below.

Table 5.3: Project Development Activities and Sources of Impact

S/No	Project Activities	Sources of Impact
1.	Mobilization of personnel and equipment to proposed project Site.	• Increased ambient noise level due personnel and vehicular movement. • Increased pressure on existing infrastructures. • Increased social vices. • Mishaps and incidents on water ways. • Surface water quality alteration.
2.	Clearing of the vegetation on the swamp areas.	• Injuries/incidents from wildlife attacks and equipment use. • Migration of wildlife. • Exposure of soil surface to the elements. • Increased potential for soil erosion.
3.	Sand winning for reclamation works in the project site area.	• Increased turbidity of water body. • Alteration of water quality. • Smothering of benthic and aquatic organisms.
4.	Sand filling of the project site area that requires filling (reclamation)	• Injuries/incidents from equipment use. • Soil quality and increased potential for topography alteration • Triggered erosion.
5.	Construction works	• Injuries/incidents from equipment use. • Air and noise pollution.

		• Surface water quality alteration. • Increased pressure on infrastructures. • Waste generation.
6.	Project operation	• Increased ambient noise level. • Pressure on existing infrastructures. • Increased social vices. • Limitation of fishing areas.
7.	Decommissioning and closure including demobilization of personnel and removal of equipment and structures from the project site after project lifespan	• Loss of revenue for both state and federal government. • Loss of jobs. • Increased social vices. • Surface water quality alteration.

5.3.2 Scoping

Scoping identifies the various aspects (activities) of the proposed project that could have significant impact on the environment. Scoping also enables proffering solutions to issues such as;

- What are the potential impacts from the execution of the project? ;
- What will be the magnitude, extent, and duration of the impacts? ;
- Of what relevance are the impacts on the environment within local, national, and international contexts?; and
- What mitigation or ameliorative measures can be put in place to reduce or avoid the adverse impacts or to enhance and maximize positive impacts?

Consequently scoping of the proposed Bonny Deep Sea Port was used to identify the components of the environment that will be significantly impacted to include air quality/climatic conditions, soil/Agriculture, vegetation/wildlife (biodiversity, surface/ground water, noise level, health and safety, socio-economic activities.

5.3.3 Scope of the Study (Spatial/Temporal)

Based on the identified activities likely to cause adverse significant impacts, the various indicator environmental parameters (Table 5.2) status was evaluated from the generated baseline to assess the impacts on them.

Air Quality/Climate

The air quality and climatic parameters of the proposed project area that were evaluated include particulates, SOx, NOx, CO, H_2S, and SPM.

Soils/Agriculture/Topography

The soil physico-chemical and microbial properties of the proposed project area were evaluated. These included pH, textural classification, Metals/Heavy metals, Conductivity, soil micro fauna.

Surface Water

Parameters evaluated were temperature, pH, BOD_5, COD, Heavy metals: Cd, Cu, Pb, Mn, Zn, Cr, Fe, and V. Other parameters evaluated were TDS, Conductivity, and THC. The microbiological characteristics of the surface water were also outlined.

Fisheries/Aquatic Resources/Sediment Characteristics

The various fish and fisheries resources found in the proposed project site area were also evaluated. Details of the plankton, benthos, macro fauna, and sediment physico chemical and microbiological characteristics were also evaluated.

Ground water

Ground water from boreholes were sampled/analyzed and the following parameters evaluated: Dissolved/suspended solids, Dissolved Oxygen, nutrients, Heavy metals, salinity, pH, Conductivity.

Vegetation/Wildlife (Biodiversity)

The various vegetation types, their structure, and economic uses in the proposed project area were evaluated. Also the various species of wildlife in the area were studied and evaluated.

Ambient Noise

The ambient noise level of the proposed projected area was evaluated. Noise is of importance in the assessment because of its immediate effects on wildlife as well as the nuisance, impaired hearing and discomfort it causes to humans.

Socio-economics and Health Conditions

The socio-economic and health conditions of the proposed project area host/beneficial community was evaluated. Particularly the perceptions of the various groups in the community towards the proposed project were also noted and evaluated. The consultation and discussions held with the various stakeholders were noted with the backdrop of gauging the perception and importance attached to the proposed deep sea port project.

Waste

The various waste types, handling and disposal methods in the proposed project area was evaluated.

5.4 Impacts Identification

The anticipated associated and potential impacts of the proposed Bonny Deep Sea Port activities on the biophysical, social and human health environment were identified based on the interaction between project activities and environmental sensitivities identified in the baseline (Table 5.4). The interactions among the environmental sensitivities were also considered for impact evaluation and categorization.

The ISO 14001 requires identification, evaluation and registration of environmental aspects associated with project activities. Health, Safety and Environment Management System (HSE MS) is the tool for meeting ISO 14001 requirements.

The impacts associated with activities of the proposed project were identified through many sources of documentation including:

(a) Knowledge of the proposed project activities, equipment types, procedures, and abandonment programme;
(b) The results of the environmental baseline studies (biophysical, socio-economic and health);
(c) Findings of other ESIA studies on similar areas and projects and other literature findings on the primary project activities;
(d) Comparison with FMEnv/ UNEP/WHO/World Bank guidelines and standards;
(e) Secondary data on similar existing projects;
(f) Series of resource persons (ESIA Preparers) discussions; and
(g) Past experience on other ESIA projects by the ESIA preparers.

Using the above documentation, the checklist of potential/associated impacts for the project phases/activities of the project is presented in Table 5.4 below.

Table 5.4: Associated and potential impacts of the proposed project

Project Phase	Project Activities	Environmental/Socio-economics Aspect	Potential/Associated Impacts
Pre-construction	Consultation with stakeholders	Socio-economics	▪ Lobbying, agitations/feuds for contractual agreements/ jobs by local workers. ▪ Compensation for farm/tree crops. ▪ Increased income generation.
	Employment of skilled and unskilled labour	Socio-economics	▪ Creation of employment for skilled and unskilled workforce.
	Mobilization of equipment and personnel to site	Air Quality/Noise	▪ Emission of exhaust fumes/noxious gases from vehicles into the atmosphere. ▪ Increased ambient noise level. ▪ Increased water traffic
		Surface Water	▪ Increased turbidity of water along route.

		Socio-Economics	▪ Increased income and improved local economy. ▪ Increased social vices.
		Human Health	▪ Increased Water Traffic Accidents (WTAs)
		Waste/Environmental Aesthetics	▪ Reduction in environmental aesthetics value due to indiscriminate deposition of base camp-associated wastes.
	Clearing of vegetation and other debris	Vegetation	▪ Loss of vegetation in the project site area.
		Wildlife	▪ Loss of wildlife habitat and emigration of wildlife.
		Soils	▪ Exposure of soil surface to the elements. ▪ Exposure of soil surface to wind and sheet erosion.

		Human Health	▪ Injuries from wildlife attacks (snakes bites and insects stings). ▪ Injuries from machete and other equipment during vegetation clearing. ▪ Domestic and sanitary waste generation.
	Removal of sand from the sea (Dredging) adjoining river floor especially around the coastal areas to increase draft and open up vessel navigation channel.	Fisheries and benthic organisms/water quality	▪ Alteration of water quality. ▪ Suspension and re suspension of river bed materials. ▪ Smothering of benthic and other aquatic organisms.
		Socio-Economics	▪ Disruption of fishing activities on the River
		Human Health	▪ Increased risk of water traffic accident.
	Deposition of dredged sand materials along shoreline of the	Soils	▪ Topography alteration and triggered erosion.

	port area to be reclaimed. Compaction of the deposited sand material.	Human Health	▪ Risk of personnel falling into uncompacted swampy areas. ▪ Improper waste management at base camp and worksite.
		Waste/Environmental Aesthetics	▪ Reduction in environmental aesthetics value due to indiscriminate deposition of project activity-associated wastes.
Construction	Pilling/ diaphragm wall works, capping beam works, deck works, intra port access roads linking warehouse and the administrative building.	Human health, Air quality/Noise, Socio-economics, Water quality	▪ Increase in ambient noise levels in the area due to construction equipments' usage. ▪ Injury/death due to work place incidents. ▪ Localized increase in ambient levels of air pollutants from trucks and equipment.

			▪ Contamination of surface water/sediments by accidental fuel release from equipment. ▪ Interference with water traffic by project watercrafts. ▪ Community conflicts arising from disagreement over contracts and recruitment.
Project operation	Shipping and Cargo handling	Water quality Human Health	▪ Pollution of surface water/sediment from improper discharge of waste and effluent into water body. ▪ Increased noise level due to port activities.
		Socio-economics	▪ Increased economic activities. ▪ Employment for both skilled and unskilled labour. ▪ Pressure on infrastructures.

			▪ Revenue generation for both state and federal governments. ▪ Increased social vices.
Decommissioning and closure	Demobilization of equipment and personnel from project site after project lifespan	Air quality/Noise	▪ Emission of exhaust fumes/noxious gases from vehicles into the atmosphere ▪ Increased ambient noise level during equipment removal and transportation. ▪ Increased water traffic
		Surface water	▪ Increased Turbidity of water and shoreline erosion.
		Socio-economics	▪ Loss of jobs ▪ Loss of revenue earner for state and federal governments. ▪ Reduced pressure on infrastructures.

5.5 Impacts Quantification, Determination and Ranking

The identified potential and associated impacts of the proposed project were quantified using the Risk Assessment Matrix (RAM) and the International Standard Organization (ISO) 14001 criteria for identifying and quantifying environmental aspects /impacts.

The following are the ISO 14001 based criteria and ratings for identifying significant environmental impacts of the proposed project.

LEGAL/Regulatory Requirements (L)

Is there legal/regulatory requirements, or permit requirement?

0 = There is no legal/regulatory requirement

3 = There is legal/regulatory requirement

5 = There is a permit required

RISK (R)

What are the Risk/ Hazard rating based on Risk Assessment Matrix?

1 = Low Risk

3 = Medium/Intermediate Risk

5 = High Risk

Environmental Impact Frequency (F)

What is frequency rating of impact based on RAM?

1 = Low Frequency

3 = Medium/Intermediate Frequency

5 = High Frequency

Importance of Affected Environmental Component and Impact (I)

What is rating of importance based on consensus of opinion?

1 = Low Importance

3 = Medium/Intermediate

5 = High Importance

Public Perception (P)

What is the rating of public perception and interest in proposed project and impacts based on consultation with stakeholders?

1 = Low Perception and Interest

3 = Medium/Intermediate perception and interest

5 = High Perception and interest

The significant potential impacts of the project activities were identified as those impacts outlined in Table 5.4.

Impacts Weighting:

The total weighting of L+R+F+I+P is 25

The benchmark for impact quantification for this study is as follows;

If the sum of **L+R+F+I+P = <10,** then the impact is rated **LOW**

If the sum of **L+R+F+I+P is between 10-17,** then the impact rating is **MEDIUM**

If the sum of **L+R+F+I+P is >17,** then the impact rating is **HIGH**

Table 5.5: The Risk Assessment Matrix (RAM) for Environmental Consequences

CONSEQUENCE					INCREASING PROBABILITY				
					A	B	C	D	E
Severity	People	Assets	Environment	Reputation	Never heard of incident in Const. industry	Incident has occurred in Const. industry	Incident has occurred	Happens several times per year	Happens several times per year at Project Site
0	No injury	No damage	No effect	No impact					
1	Slight Injury	Slight damage	Slight effect	Slight impact			Low Risk		
2	Minor Injury	Minor damage	Minor effect	Limited impact					
3	Major Injury	Localized damage	Localized effect	Considerable impact				Medium Risk	
4	Single Fatality	Major damage	Major effect	National impact					
5	Multiple Fatalities	Extensive damage	Massive effect	International impact				High Risk	

Low Risk Medium Risk High Risk (Intolerable)

Table 5.6: Further Definitions of Consequences on the Risk Assessment Matrix

Severity	Potential Impact	Definition
0	Zero Effect	No environmental damage. No change in the environment. No financial consequences.
1	Slight Effect	Local environmental damage within the fence and within systems. Negligible financial consequences
2	Minor Effect	Contamination, damage sufficiently large to affect the environment, single outdo of statutory or prescribed criteria, single complaint.
3	Localized Effect	Limited discharges of known toxicity. Repeated outdo of statutory or prescribed limit. Affecting neighbourhood.

4	Major Effect	Severe environmental damage. The company is required to take extensive measures to restore the contaminated environment to its original state. Extended outdo of statutory or prescribed limits.
5	Massive Effect	Persistent severe environmental damage or severe nuisance extending over a large area. In terms of commercial or recreational use or nature conservancy, a major economic loss for the company. Constant high outdo of statutory or prescribed limits.

The identified associated and potential impacts from the various activities of the proposed project as outlined in Table 5.4 are determined, quantified, and ranked as outlined in Table 5.6 below.

Table 5.7: Impacts quantification and Ratings of the proposed project

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
Pre-construction	Consultation with regulators and stakeholders	▪ Lobbying, agitations for jobs, employment and contractual agreement by local workers	+	ST		R	3	3	3	3	5	17	MEDIUM
		▪ Compensation for farm/tree crops loss. ▪ Increased income generation	+		LT	R	3	1	3	5	5	17	MEDIUM
	Employment of skilled and unskilled labour	▪ Creation of employment of skilled and unskilled work force	+	ST	LT	R	3	1	3	5	3	12	Low

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
	Mobilization of equipment and personnel to site	▪ Emission of exhaust fumes/noxious gases from vehicles, and increased ambient noise level	-	ST		R	3	1	1	3	1	10	MEDIUM
		▪ Increased turbidity of surface water and shoreline erosion	-	ST		R	3	3	3	3	1	13	MEDIUM
		▪ Increased Income and local economy.	+	ST		R	3	5	5	5	5	23	HIGH
		▪ Increased social vices.	-	ST		R	3	3	3	1	1	11	MEDIUM
		▪ Increased Water Transport Accidents (WTAs)	-	ST		R	3	3	1	5	3	15	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
		▪ Reduction in aesthetics of environment due to indiscriminate waste disposal.	-	ST		R	3	1	1	1	3	9	LOW
Vegetation Clearing	Clearing of vegetation and other debris	▪ Loss of vegetation in the project area.	-		LT	R	5	5	3	5	5	23	HIGH
		▪ Loss of wildlife, their habitat and emigration of wildlife.	-		LT	R	5	3	3	5	3	19	HIGH
		▪ Exposure of soil surface to the elements and triggering of erosion	-	ST		R	3	5	3	1	1	13	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
		▪ Injuries from wildlife attacks (snakes bites and insects stings). Injury from equipment usage during vegetation clearing.	-	ST	LT	I	3	5	3	3	3	17	HIGH
	Waste Generation	▪ Domestic and Sanitary Waste Generation	-	ST		R	3	5	3	1	1	13	MEDIUM
	Removal of sand from the sea adjoining river floor especially around the	▪ Alteration of water quality	-		LT	I	3	5	5	3	3	19	HIGH
		▪ Suspension and re suspension of river bed materials	-		LT	R	3	5	5	3	3	19	HIGH

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
	coastal areas to increase draft and open up vessel navigation channel.	▪ Smothering of benthic and other aquatic organisms	-	ST	LT	I	3	5	5	3	3	19	HIGH
		▪ Disruption of fishing and water transport activities on the River.	-	ST	LT	I	3	5	5	5	3	21	HIGH
		▪ Increased risk of water transport accident (WTA).	-	ST		R	3	3	1	3	1	11	MEDIUM
	Deposition of dredged sand materials along	▪ Topography alteration and triggered erosion.	-	ST		R	3	3	3	3	3	15	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
	shoreline of the port area to be reclaimed. Compaction of the deposited sand material	▪ Risk of personnel falling into uncompacted swampy areas.	-	ST		R	3	1	1	5	3	13	MEDIUM
		▪ Reduction in environmental aesthetics due to indiscriminate disposal of project activity-associated wastes.	-	ST		R	3	1	1	1	3	9	LOW

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
Construction	Pilling/diaphragm wall works, capping beam works, deck works, intra port access roads linking the warehouse and the administrative building.	▪ Increase in ambient noise levels in the area due to construction equipment' usage. ▪ Contamination of surface water/sediment by accidental fuel release from equipment. ▪ Interference with water traffic by project water crafts.	**-**	**ST**		**R**	**3**	**1**	**1**	**1**	**3**	**9**	LOW

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
		▪ Localised increase in ambient levels of air pollutants from trucks and equipment.	-	ST		R	3	1	1	1	3	9	LOW
		▪ Injury and death due to work place incidents.	-	ST		I	3	3	1	1	3	11	MEDIUM
		▪ Community conflicts arising from disagreement over contracts and recruitment.	-	ST		R	5	3	1	3	5	17	HIGH

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Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
Project operational	Shipping and Cargo handling	▪ Pollution of surface water/sediment from improper discharge of waste and effluent into river channel.	-		LT	R	3	1	1	1	3	9	LOW
		▪ Increased noise level due to port activities.	-		LT	R	3	1	3	3	3	13	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
		▪ Increased economic activities. ▪ Revenue generation for both state and federal governments. ▪ Employment for both skilled and unskilled labour.	+		LT	R	5	3	5	5	5	23	HIGH
		▪ Pressure on infrastructure.	-		LT	R	3	5	3	3	1	15	MEDIUM
		▪ Increased social vices.	-		LT	R	5	5	3	5	3	21	HIGH

Project Phase	Project Activities	Potential/Associated Impacts	*Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium/Low)
Decommission-ing and closure	Demobilization of equipment and personnel from site after project lifespan.	▪ Emission of exhaust fumes/noxious gases from vehicles, and increased ambient noise level.	-	ST		R	3	1	1	3	1	10	MEDIUM
		▪ Increased turbidity of surface water and shoreline erosion.	-	ST		R	3	3	3	3	1	13	MEDIUM
		▪ Loss of Jobs. ▪ Loss of revenue earner for state and federal government. ▪ Reduced pressure on infrastructure.	-		LT	R	3	5	5	5	5	23	HIGH

KEY: * - (Adverse), + (Beneficial); Short Term (< 3 months), Long Term (>3 Months); R = Reversible, I = Irreversible.

5.6 Description of Impacts

5.6.1 Pre-mobilization/Project design

Prior to commencement of mobilization of personnel and equipment to the proposed Bonny Deep Sea Port site, there will be agitations, discussions and agreements for jobs, contracts and employment by the local hosts/beneficial community members. There will also be requisitions for compensations for farms and economic trees that will be lost due to the proposed project execution. This impact was described as positive, short term, reversible and was ranked high.

There shall also be employment of skilled and unskilled labour to carry out the proposed deep sea port project. This impact was described as positive, short term, reversible and was ranked high.

5.6.2 Mobilization of Personnel and Equipment to Site

Personnel and equipment for the construction works of the proposed deep sea port project shall be mobilized to the project location partly via water transport crafts as well as cleared access tracks on land. The potential and associated impacts from these activities are as follows:

Emission of exhaust fumes, noxious gases and increased ambient noise level

Personnel and equipment shall be transported to the project location using water transport crafts and land vehicles that use hydrocarbon fuels. The combustion of these fuels shall result in the production of noxious gases and fumes such as carbon monoxide, oxides of sulphur, lead, etc. into the atmosphere. There shall also be increased noise above the ambient level from the crafts movement and personnel activities while in transit. This impact was described as adverse, short term, reversible, and was ranked medium.

Increased Turbidity of Surface Water and Shoreline Erosion

The action of the fast moving water crafts shall result in the agitation of the water body thus increasing the turbidity. The action of the generated wave against the shoreline of the creeks shall also result in the loosening of soil materials and denudation into the water body. This impact was described as adverse, short term, reversible, and was ranked medium.

Increased Income and Local Economy

Mobilized workers (which include members of the host/beneficial community) shall be paid mobilizing fees prior to commencement of actual project execution. The workers shall spend part of the earnings in the host community thereby increasing the micro economy of the community. This impact was described as positive, short term, reversible and was ranked high.

Increased Social Vices

Developmental activities often times lead to increased population and job seeking migrant seekers into such communities. This phenomenon is attendant with increased social vices such as alcoholism, drug abuse, feuds among youths especially and prostitution. This impact was described as adverse, short term, reversible, and was ranked medium.

Kidnapping of workers and visitors on site

The kidnapping of workers and visitors on site are among the major security concerns in Nigeria now. During movements as required in mobilisation, personnel and company contractor may be victims of kidnappers. Some of these attacks may result in the death of victims which is negative, direct, and irreversible, thus rated high.

Increased Water Traffic Accidents (WTAs)

Movement of personnel and equipment to the project location shall partly be by water transport along water ways. Such movement shall increase traffic flow thereby having the potential of accident with other less careful and well trained water ways users. This impact was described as adverse, short term, reversible, and was ranked medium.

5.6.3 Vegetation Clearing

There shall be clearing of the vegetation presently occupying the proposed project site area. This shall be carried out by workers using heavy machines, equipment and even simple implements like machetes. The potential and associated impacts from these activities are as follows:

Loss of Vegetation of the Project Area

The vegetation thriving on the site shall be removed. This impact was described as adverse, long term, reversible, and was ranked high.

Migration and Death of Wildlife

The removal of vegetation will lead to the loss of habitat places for the native animal species. This shall result in the animals migrating to other areas where they can find new habitat. Also during vegetation clearing there could be poaching and killing of the wildlife by site workers. This impact was described as adverse, long term, reversible, and was ranked high.

Exposure of Soil Surface to Weather Elements and Triggering of Erosion

The removal of vegetation cover will leave the soil surface bare and exposed to the agents of denudation. Erosion could also be triggered off when soil surfaces are left bare. This impact was described as adverse, short term, reversible, and was ranked medium.

Injuries from Wildlife Attacks

Vegetation removal will result in native wild animals become agitated and could lead to attacks on workers. The baseline data revealed the presence of poisonous species of snakes. Thus there could be snake bites and insects stings during vegetation clearing especially if the workers wear body colognes that could attract insects as well as not use proper PPE kits. This impact was described as adverse, short term, irreversible, and was ranked high.

Domestic and Sanitary Waste Generation

Vegetation removal will lead to the generation of wastes and debris. Also, the personnel engaged to work during this project phase will constitute a source of sanitary wastes including indiscriminate defecation around the proposed project area. This impact was described as adverse, short term, reversible and ranked medium.

5.6.4 Dredging of Channel for Navigation and other Reclamation works

Sand shall be dredged from the river along the proposed port's shoreline adjoining the Atlantic Ocean. The reason for dredging is to increase draft and open up vessel navigational channel. The potential and associated impacts from these activities are as follows:

Alteration of Water Quality

Dredging activities will affect and impact adversely on the quality of water especially on the physico-chemical properties of the water as well as its microbiology. This impact was described as adverse, long term, irreversible and high.

Suspension and Re-suspension of River Bed Materials

The removal of sand from the river bed shall lead to the suspension of river bed materials thereby leading to increased turbidity and alteration of the surface water quality. This impact was described as adverse, long term and long term, reversible, and was ranked high.

Smothering of Benthic and Other Aquatic organisms

The removal of sand materials from the River shall also lead to the smothering of benthic organisms. This impact was described as adverse, short and long term, irreversible, and was ranked high.

Disruption of Fishing and Water Transport Activities on the River

The River is a major resource used for both fishing, water transportation, and other domestic use. Sand winning activity will lead to disruption of these activities. The sand winning activity will also increase the risk of water transport accident especially due to the recklessness of local boat drivers. These impacts were both described as adverse, short and long term, reversible, and ranked high.

Increased Risk of Water Transport Accident (WTA)

The dredging activities will result in busy water transport route which could result in increased risk of water transport accidents. This impact was described as adverse, short term, reversible, and was ranked medium.

5.6.5 Sand Filling along Shoreline Areas (Reclamation)

The sand materials collected from the river floor shall be used to reclaim the swampy land areas along the shoreline of the port area. Thereafter the area shall be compacted. The potential and associated impacts from these activities are as follows:

Topography alteration and Triggered Erosion

The deposition of the sand materials into the swamp area shall alter to some extent the topography of the area thereby triggering erosion. This impact was described as adverse, short term, reversible, and was ranked medium.

Risk of Personnel Falling into Uncompacted Areas

Swampy areas are known to having areas that are not consolidated. Personnel who mistakenly step on such areas while carrying out the sand filling activities could fall into such unconsolidated swampy areas and sustaining injuries or fatalities. This impact was described as adverse, short term, reversible, and was ranked medium.

Reduction of Environmental Aesthetics due to Indiscriminate Waste Disposal

The indiscriminate deposition and poor handling of the project associated wastes could result in the reduction of the aesthetic value of the environment. This impact was described as adverse, short term, reversible, and was ranked low.

5.6.6 Construction and Operational Phase

- Increase in ambient noise levels in the area due to construction equipment usage; was ranked adverse, short term, reversible and low.
- Contamination of surface water/sediment by accidental fuel release from equipment during construction; was ranked adverse, short term, reversible and low.
- Interference with water traffic by project water crafts; was ranked adverse, short term, reversible and low.
- Localized increase in ambient levels of air pollutants from trucks and equipment during construction; was ranked adverse, short term, reversible and low.

- Injury/death due to work place incident during construction; was ranked adverse, short term, irreversible and medium.
- Community conflicts arising from disagreement over contracts, recruitment; was ranked adverse, short term, reversible and high.
- Pollution of surface water/sediment from improper discharge of waste and effluent into river channel during project operational phase; was ranked adverse, long term, reversible and low.
- Increased noise level due to port activities; was ranked adverse, long term, reversible and medium.
- Increased economic activities during project operation; was ranked beneficial, long term, reversible and high.
- Revenue generation for both state and federal government at operation phase; was ranked beneficial, long term, reversible and high.
- Employment for both skilled and unskilled labours during project operation; was ranked beneficial, long term, reversible and high.
- Pressure on infrastructures during project operation stage; was ranked adverse, long term, reversible and medium.
- Increased social vices during project operation; was ranked adverse, long term, reversible and high.

5.6.7 Demobilization of Personnel and Equipment to Site

After the useful lifespan of the project, it may be subjected to decommissioning. The potential and associated impacts from these activities are as follows:

Emission of exhaust fumes, noxious gases and increased ambient noise level.

Dismantled equipment and machines from the port shall be transported away from the project location using partly, water transport crafts that use hydrocarbon fuels. The combustion of these fuels shall result in the production of noxious gases and fumes such as carbon monoxide, oxides of sulphur, lead, etc into the atmosphere. There shall also be increased noise above the ambient level from the crafts movement and personnel activities while in transit. This impact was described as adverse, short term, reversible, and was ranked medium.

Increased Turbidity of Surface Water and Shoreline Erosion

The action of the fast moving water crafts shall result in the agitation of the water body thus increasing the turbidity. The action of the generated wave against the shoreline of the creeks shall also result in the loosening of soil materials and denudation into the water body. This impact was described as adverse, short term, reversible, and was ranked medium.

Loss of Jobs and Revenue earner for both State and Federal Governments

Decommissioning a project of this magnitude will result in massive loss of jobs for project staff, clients and customers. It will also lead to loss of revenue for both the state and federal governments. Both impacts being closely related were described as negative, short term, reversible and was ranked medium.

Reduced Pressure on Infrastructure

Decommissioning the proposed Bonny Deep Sea Port will surely result in reduced pressure on infrastructural resources as there will be mass exodus of people away from the project area (for both those directly and indirectly connected to the project). This impact was described as adverse, long term, reversible, and was ranked high.

CHAPTER SIX

MITIGATION MEASURES/ALTERNATIVES

6.1 Introduction

Adequate planning and proper implementation of appropriate mitigation measures for adverse environmental impacts represent important activities in the ESIA process. Typically, the acceptability and/or suitability of a particular project is premised on several considerations, not the least of which is the reduction of adverse environmental and social impacts to tolerable levels. Impact significance reduction is usually achieved by introducing mitigation/amelioration measures to cater for the adverse impacts identified.

In this section of the report, we present a summary of those measures that are deemed adequate to achieve this objective. The mitigation measures proposed are in keeping with the following:

- Environmental laws in Nigeria, with emphasis on permissible limits for waste streams FMEnv (formerly FEPA, 1991);
- Best Available Technology for Sustainable Development;
- International Environmental laws/conventions for environmental conservation and ensured sustainable development which Nigeria is signatory to;
- Preservation and conservation of natural environment and resources;
- Social well-being; and
- Concerns of all stakeholders.

Also, a sequential consideration of the under listed steps as suggested by Canter *et al* (1991) was adopted in arriving at the most suitable intervention necessary to offset the negative impacts of the proposed project:

- Avoiding the impact altogether by not taking a certain action or parts of an action;

- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitation or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and
- Maintenance operations during the life of the action; and
- Compensating for the impact by replacing or providing substitute resources or environments.

All significant adverse impacts and issues identified and presented in chapter five are considered for mitigation. Specific mitigation measures are proposed, where practicable (avoid, reduce, remove or compensate for the various impacts).

The highlights of the mitigation measures proffered for the various phases of the proposed Bonny Deep Sea Port project are summarized as shown in Table 6.1, while the details of the mitigation measures for the various activities at the various project phases are described herein:

6.2 Impacts and Mitigation Description

6.2.1 Pre-mobilization/Project design

Prior to commencement of mobilization of personnel and equipment to the proposed Bonny Deep Sea Port site, there will be agitations, discussions and agreements for jobs, contracts and employment by the local hosts/beneficial community members. There will also be requisitions for compensations for farms and economic trees that will be lost due to the proposed project execution. This impact was described as positive, short term, reversible and was ranked high.

The enhancement measures proffered for this beneficial impact include the following:

- Federal Ministry of Transportation and the Bonny Deep Sea Port project EPC contractors (CCECC Nigeria Limited) shall ensure that they involve members of the host/beneficial communities in the skilled and unskilled work force required for this project.
- Contracts for provision of minor raw materials shall also be awarded to the members of the host communities.
- Adequate compensations shall also be paid to owners of farms, economic trees and fish ponds (if any) that will be lost due to the project execution.

6.2.2 Mobilization of Personnel and Equipment to Project Site

Personnel and equipment for the construction works of the proposed deep sea port project shall be mobilized to the project location partly via water transport crafts as well as cleared access tracks on land. The potential and associated impacts from these activities are as follows:

6.2.2.1 Emission of Exhaust Fumes, Noxious Gases and increased Ambient Noise level

Personnel and equipment shall be transported to the project location using water transport crafts and land vehicles that use hydrocarbon fuels. The combustion of these fuels shall result in the production of noxious gases and fumes such as carbon monoxide, oxides of sulphur, lead, etc. into the atmosphere. There shall also be increased noise above the ambient level from the crafts movement and personnel activities while in transit. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigative mesures proffered for this adverse impact include the following:

- All water crafts and vehicles shall be kept by periodic and regular maintenance in good working condition.
- Traffic caution signs shall be mounted in strategic locations along the selected route esecially on land.

- Only well trained, experienced, physically and mentally fit craft and vehicle drivers shall be employed to convey personnel and equipment.

6.2.2.2 Increased Turbidity of Surface Water and Shoreline Erosion

The action of the fast moving water crafts shall result in the agitation of the water body thus increasing the turbidity. The action of the generated wave against the shoreline of the creeks shall also result in the loosening of soil materials and denudation into the water body. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigation measures proffered for increased turbidity of surface water and shoreline erosion include:

- All boat drivers shall maintain minimum speed to reduce turbulent wave generation.
- Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods to forestall mishaps.

6.2.2.3 Increased Social Vices

Developmental activities often times lead to increased population and job seeking migrant seekers into such communities. This phenomenon is attendant with increased social vices such as alcoholism, drug abuse, feuds among youths especially and prostitution. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigation measures proffered for the increased social vices include:

- There shall be enlightenment and awareness campaign to all workers to eschew social vices.

- Alcohol and drug use policy shall be enforced by site supervisors.

6.2.2.4 Increased Water Traffic Accidents (WTAs)

Movement of personnel and equipment to the project location shall partly be by water transport along water ways. Such movement shall increase traffic flow thereby having the potential of accident with other less careful and well trained water ways users. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigation measures proffered for Increased water transport accidents (WTAs) include:

- All boats shall be ensured to be in good working condition
- There shall be no night sailing during the project construction work execution.
- Traffic caution signs shall be put in strategic locations along the selected route.
- Only well trained, experienced, physically and mentally fit boat drivers shall be employed to convey personnel and equipment to construction site.
- Boat drivers shall adhere to speed limit guides at all times to reduce turbulent wave generation while in transit.
- Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods to forestall mishaps.

6.2.3 Vegetation Clearing

There shall be clearing of the vegetation presently occupying the proposed project site area. This shall be carried out by workers using heavy machines, equipment and even simple implements like machetes. The significant adverse potential and associated impacts from these activities are as follows:

6.2.3.1 Loss of Vegetation of the Project Area

The vegetation thriving on the site shall be removed. This impact was described as adverse, long term, reversible, and was ranked high.

The mitigation measures proffered for vegetation loss include:

- Vegetation clearing shall be restricted to only the desired area.
- Any vegetation that is cleared outside the project area shall be replanted using same species of plants that were removed.

6.2.3.2 Migration and Death of Wildlife

The removal of vegetation will lead to the loss of habitat places for the native animal species. This shall result in the animals migrating to other areas where they can find new habitat. Also during vegetation clearing there could be poaching and killing of the wildlife by site workers. This impact was described as adverse, long term, reversible, and was ranked high.

The mitigation measures proffered for migration and death of wildlife include:

- There shall be awareness campaign on no poaching or hunting of wild life in the area through out the period of the project execution.
- Young or incapacitated wild life seen shall be returned to the bush.

6.2.3.3 Exposure of Soil Surface to Weather Elements and Triggering of Erosion

The removal of vegetation cover will leave the soil surface bare and exposed to the agents of denudation. Erosion could also be triggered off when soil surfaces are left bare. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigation measures proffered for exposure of soil to weather elements and erosion include:

- Vegetation clearing shall be restricted to only the desired area.
- Any vegetation that is cleared outside the project area shall be replanted using same species of plants that were removed. This will protect the cleared soil surface.

6.2.3.4 Injuries from Wildlife Attacks

Vegetation removal will result in native wild animals become agitated and could lead to attacks on workers. The baseline data revealed the presence of poisonous species of snakes. Thus there could be snake bites and insects stings during vegetation clearing especially if the workers wear body colognes that could attract insects as well as not use proper PPE kits. This impact was described as adverse, short term, irreversible, and was ranked high.

The mitigation measures proffered for injuries from wildlife attacks include:

- All workers shall wear adequate protective gear and clothing (PPE) while at work.
- There shall be no wearing of perfume while working in the field.
- Anti venoms and first aid services shall always be provided at worksite.
- There shall be no wearing of perfumes or colognes by workers while carrying out work in the bush.
- All personnel shall be adequately inducted on safety rules and procedures for carrying out work.
- A stand-by ambulance for immediate evacuation to hospital for serious medical services shall be provided at worksite.

6.2.3.5 Domestic and Sanitary Waste Generation

Vegetation removal will lead to the generation of wastes and debris. Also, the personnel engaged to work during this project phase will constitute a source of sanitary wastes including indiscriminate defecation around the proposed project area. This impact was described as adverse, short term, reversible and ranked medium.

The mitigation measures proffered for domestic and sanitary waste generation include:

- There shall be mobile tiolets provided for construction works to discourage open defecation.
- All solid wastes generated shall be properly sorted and promptly disposed by the Rivers State Environmental Protection Agency in collaboration with Rivers State Urban Development Authority at government approved dumpsites.

6.2.4 Dredging of Channel for Navigation and other Reclamation works

Sand shall be dredged from the river along the proposed port's shoreline adjoining the Atlantic Ocean. The reason for dredging is to increase draft and open up vessel navigational channel.

The potential and associated impacts from these activities are as follows:

6.2.4.1 Alteration of Water Quality

Dredging activities will affect and impact adversely on the quality of water especially on the physico-chemical properties of the water as well as its microbiology. This impact was described as adverse, long term, irreversible and high.

The mitigation measures proffered for alteration of water quality include:

- All boat drivers carrying dredging equipment and personnel shall maintain minimum speed to reduce turbulent wave generation which may adversely affect water turbidity.
- Personnel working with the dreging machines shall eschew throwing wastes directly into the water.

6.2.4.2 Suspension and Re-suspension of River Bed Materials

The removal of sand from the river bed shall lead to the suspension of river bed materials thereby leading to increased turbidity and alteration of the surface water quality. This impact was described as adverse, long term and long term, reversible, and was ranked high.

The mitigation measures proffered for suspension and re suspension of river bed materials include:

- Sand winning activity shall be restricted as much as possible to the already marked out route.
- Sand winning activity shall be completed in the shortest possible to allow the ecosystem to quickly rejuvenate.
- Sighted breeding grounds for fish and other aquatic resources shall be avoided.

6.2.4.3 Smothering of Benthic and Other Aquatic organisms

The removal of sand materials from the River shall also lead to the smothering of benthic organisms. This impact was described as adverse, short and long term, reversible, and was ranked high.

The mitigation measures proffered for smothering of benthic and other aquatic organisms include:

- Sand winning activity shall be restricted as much as possible to the already marked out route.
- Sand winning activity shall be completed in the shortest possible to allow the ecosystem to quickly rejuvenate.

6.2.4.4 Disruption of Fishing and Water Transport Activities on the River.

The River is a major resource used for both fishing, water transportation, and other domestic use. Sand winning activity will lead to disruption of these activities. The sand winning activity will also increase the risk of water transport accident especially due to the recklessness of local boat drivers. These impacts were both described as adverse, short and long term, reversible, and ranked high.

The mitigation measures proffered for disruption of fishing and water transport activities on the river include:

- There shall be notification/sensitization of the community members on the project prior to commencement of the activity.
- Sand winning activities shall be carried out in areas of the river with least human presence and activities.
- There shall be caution signs, beacons and cordoning of the sand winning area.
- Water craft drivers shall always look out for fishing activities and gears, and be mindful of disrupting activities and destroying gears.

6.2.5 Sand Filling along Shoreline Areas (Reclamation)

The sand materials collected from the river floor shall be used to reclaim the swampy land areas along the shoreline of the port area. Thereafter the area shall be compacted.

The potential and associated impacts from these activities are as follows:

6.2.5.1 Topography alteration and Triggered Erosion

The deposition of the sand materials into the swamp area shall alter to some extent the topography of the area thereby triggering erosion. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigation measures proffered for topography alteration and triggered erosion include:

- Sand filling shall be restricted to only the area to be reclaimed to allow for minimal erosion effects.
- The deposited materials shall be compacted and allowed enough time for the soil aggregates to properly settle.

- Drainage courses around the sand-filled area shall not be blocked with the sand filling materials.

6.2.5.2 Risk of Personnel Falling into Uncompacted Swampy Areas

Swampy areas are known to having areas that are not consolidated. Personnel who mistakenly step on such areas while carrying out the sand filling activities could fall into such unconsolidated swampy areas and sustaining injuries or fatalities. This impact was described as adverse, short term, reversible, and was ranked medium.

The mitigation measures proffered for personnel falling into uncompacted swampy areas include:

- Only experienced persons shall be involved in carrying out the sand filling activities.
- All sand filling works was be carried out by at least two persons.
- Workers to be involved in carrying out the sand filling activity shall be intimated of the associated risks and the need to work with professional dexterity and observe all safety.
- Emergency plans for swift recovery of fallen persons shall be put in place.
- There shall be a site clinic and an ambulance for immediate evacuation of injured persons.

6.2.5.3 Reduction in Environmental Esthetic Value

The indiscriminate deposition and poor handling of the project associated wastes could result in the reduction of the aesthetic value of the environment. This impact was described as adverse, short term, reversible, and was ranked low.

The mitigation measures proffered for reduction in environmental esthetic value include:

- All non hazardous wastes generated shall be inventoried, segregated and properly contained in specific colour coded bins and disposed to government approved waste dumpsites.
- Hazardous wastes shall be contained in special industrially approved containers and handled only by concerned experts in line with approved standards.
- Base Camp and residential areas shall be periodically fumigated to forestall breeding of harmful organisms.
- All wastes shall be managed and disposed of in line with Rivers State and the FMEnv waste management guidelines and procedures.

6.2.6 Construction and Operational Phase

The impact other this phase and their respecitve mitigation are as highlighted below :

6.2.6.1 Increase in Ambient Noise Level

Increase in ambient noise levels in the area due to construction equipment usage; was ranked adverse, short term, reversible and low.

Mitigation includes:

- Periodic and regular servicing of vehicles, machines and equipment used during construction.
- Use of sound proof generators at the construction phase.

6.2.6.2 Contamination of Surface Water

Contamination of surface water/sediment by accidental fuel release from equipment during construction; was ranked adverse, short term, reversible and low.

Mitigation includes:

- Care shall be taken when fuelling or oiling vehicles and machines used in construction works.

- Waste oils shall be collected with collection trays and stored in metallic drums with tight lids and sold off to other end users.

6.2.6.3 Increased Ambient Level of Air Pollution

Localized increase in ambient levels of air pollutants from trucks and equipment during construction; was ranked adverse, short term, reversible and low.

Mitigation includes:

- Regular servicing of trucks and equipment.

6.2.6.4 Death or Injury from Construction Activities

Injury/death due to work place incident during construction; was ranked adverse, short term, irreversible and medium.

Mitigation includes:

- Use of PPE while working on site shall be enforced.
- Strict adherence to all safety rules and instructions by all construction staff shall be HSE officer.
- Moderate speed limit on site shall be defined and enforced.

6.2.6.5 Community Conflicts

Community conflicts arising from disagreement over contracts, recruitment; was ranked adverse, short term, reversible and high.

Mitigation includes :

- The Federal Ministry of Transportation and the proposed Bonny Deep Sea Port management shall consider a reasonable number of indigenes of the project host community for employment.

6.2.6.6 Increased Social Vices

Increased social vices during project operation; was ranked adverse, long term, reversible and high.

Mitigation includes:

- There shall be enlightenment and awareness campaign to all workers to eschew social vices.
- Alcohol and drug use policy shall be enforced by port management.

6.2.7 Decommissioning and Closure

After the useful lifespan of the project, it may be subjected to decommissioning. The potential and associated impacts from these activities are as follows:

6.2.7.1 Emission of Exhuast Fumes and Increased Ambient Noise level

Dismantled equipment and machines from the port shall be transported away from the project location using partly, water transport crafts and vehicles that use hydrocarbon fuels. The combustion of these fuels shall result in the production of noxious gases and fumes such as carbon monoxide, oxides of sulphur, lead, etc into the atmosphere. There shall also be increased noise above the ambient level from the crafts and vehicles movement and personnel activities while in transit. This impact was described as adverse, short term, reversible, and was ranked medium.

Mitigation include :

- All water crafts and vehicles shall be kept by periodic and regular maintenance in good working condition.
- Traffic caution signs shall be mounted in strategic locations along the selected route esecially on land.
- Only well trained, experienced, physically and mentally fit craft and vehicle drivers shall be employed to convey personnel and equipment.

6.2.7.2 Increased Turbidity of Surface Water and Shoreline Erosion

The action of the fast moving water crafts shall result in the agitation of the water body thus increasing the turbidity. The action of the generated wave against the shoreline of the creeks shall also result in the loosening of soil materials and denudation into the water body. This impact was described as adverse, short term, reversible, and was ranked medium.

Mitigation includes:

- All boat drivers shall maintain minimum speed to reduce turbulent wave generation.
- Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods. This is to forestall mishaps.

Table 6.1: Significant Impacts and Mitigation Measures of the Proposed Bonny Deep Sea Port Project

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
Pre-Construction	Lobbying, agitations for jobs, employment and contractual agreement by local workers.	MEDIUM	• Federal Ministry of Transportation and the Bonny Deep Sea Port project EPC contractor shall ensure that they involve members of the host/beneficial communities in the skilled and unskilled work force required for this project. • Contracts for provision of minor raw materials shall also be awarded to the members of the host communities. • Adequate compensations shall also be paid to owners of farms, economic trees and fish ponds that will be lost due to the project execution.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
Mobilization of personnel and equipment to project site.	Emission of exhaust fumes, noxious gases and increased ambient noise level.	MEDIUM	• All water crafts and vehicles shall be kept by periodic and regular maintenance in good working condition. • Traffic caution signs shall be mounted in strategic locations along the selected route especially on land. • Only well trained, experienced, physically and mentally fit craft and vehicle drivers shall be employed to convey personnel and equipment.	LOW
	Increased turbidity of surface water and shoreline erosion.	MEDIUM	• All boat drivers shall maintain minimum speed to reduce turbulent wave generation. • Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods to forestall mishaps.	LOW
	Increased social vices.	MEDIUM	• There shall be enlightenment and awareness campaign to all workers to eschew social vices. • Alcohol and drug use policy shall be enforced by site supervisors.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Increased Water Traffic Accidents (WTAs).	MEDIUM	• All boats shall be ensured to be in good working condition. • There shall be no night sailing during the project construction work execution. • Traffic caution signs shall be put in strategic locations along the selected route. • Only well trained, experienced, physically and mentally fit boat drivers shall be employed to convey personnel and equipment to construction site. • Boat drivers shall adhere to speed limit guides at all times to reduce turbulent wave generation while in transit. • Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods to forestall mishaps.	LOW
Vegetation clearing.	Loss of vegetation of the project Area.	HIGH	• Vegetation clearing shall be restricted to only the desired area. • Any vegetation that is cleared outside the project area shall be replanted using same species of plants that were removed.	MEDIUM

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Emigration and death of wildlife.	HIGH	• There shall be awareness campaign on no poaching or hunting of wild life in the area throughout the period of the project execution. • Young or incapacitated wild life seen shall be returned to the bush.	MEDIUM
	Exposure of soil surface to weather elements and triggering of erosion.	MEDIUM	• Vegetation clearing shall be restricted to only the desired area. • Any vegetation that is cleared outside the project area shall be replanted using same species of plants that were removed. This will protect the cleared soil surface.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Injuries from wildlife attacks.	HIGH	• All workers shall wear adequate protective gear and clothing (PPE) while at work. • There shall be no wearing of perfume while working in the field. • Anti-venoms and first aid services shall always be provided at worksite. • There shall be no wearing of perfumes or colognes by workers while carrying out work in the bush. • All personnel shall be adequately inducted on safety rules and procedures for carrying out work. • A stand-by ambulance for immediate evacuation to hospital for serious medical services shall be provided at worksite.	MEDIUM
	Domestic and sanitary waste generation.	MEDIUM	• There shall be mobile toilets provided for construction works to discourage open defecation. • All solid wastes generated shall be properly sorted and promptly disposed by the Rivers State Environmental Protection Agency in collaboration with Accredited Waste Management Company at government approved dumpsites.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
Dredging of channel for navigation and other reclamation works.	Alteration of water quality.	HIGH	• All boat drivers carrying dredging equipment and personnel shall maintain minimum speed to reduce turbulent wave generation which may adversely affect water turbidity. • Personnel working with the dredging machines shall eschew throwing wastes directly into the water.	MEDIUM
	Suspension and re-suspension of river bed materials.	HIGH	• Sand winning activity shall be restricted as much as possible to the already marked out route. • Sand winning activity shall be completed in the shortest possible to allow the ecosystem to quickly rejuvenate. • Sighted breeding grounds for fish and other aquatic resources shall be avoided.	LOW
	Smothering of benthic and other aquatic organisms.	HIGH	• Sand winning activity shall be restricted as much as possible to the already marked out route. • Sand winning activity shall be completed in the shortest possible to allow the ecosystem to quickly rejuvenate.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Disruption of fishing and water transport activities on the river.	HIGH	• There shall be notification/sensitization of the community members on the project prior to commencement of the activity. • Sand winning activities shall be carried out in areas of the river with least human presence and activities. • There shall be caution signs, beacons and cordoning of the sand winning area. • Water craft drivers shall always look out for fishing activities and gears, and be mindful of disrupting activities and destroying gears.	MEDIUM
Sand filling along shoreline areas (reclamation)	Topography alteration and triggered erosion.	MEDIUM	• Sand filling shall be restricted to only the area to be reclaimed to allow for minimal erosion effects. • The deposited materials shall be compacted and allowed enough time for the soil aggregates to properly settle. • Drainage courses around the sand-filled area shall not be blocked with the sand filling materials.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Risk of personnel falling into uncompacted swampy areas.	MEDIUM	• Only experienced persons shall be involved in carrying out the sand filling activities. • All sand filling works was be carried out by at least two persons. • Workers to be involved in carrying out the sand filling activity shall be intimated of the associated risks and the need to work with professional dexterity and observe all safety. • Emergency plans for swift recovery of fallen persons shall be put in place. • There shall be a site clinic and an ambulance for immediate evacuation of injured persons.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Reduction in environmental aesthetic value.	LOW	• All non-hazardous wastes generated shall be inventoried, segregated and properly contained in specific colour coded bins and disposed to government approved waste dumpsites. • Hazardous wastes shall be contained in special industrially approved containers and handled only by concerned experts in line with approved standards. • Base Camp and residential areas shall be periodically fumigated to forestall breeding of harmful organisms. • All wastes shall be managed and disposed of in line with Rivers State and the FMEnv waste management guidelines and procedures.	LOW
Construction and operational phase.	Increase in ambient noise level.	LOW	• Periodic and regular servicing of vehicles, machines and equipment used during construction. • Use of sound proof generators at the construction phase.	LOW
	Contamination of surface water.	LOW	• Care shall be taken when fuelling or oiling vehicles and machines used in construction works. • Waste oils shall be collected with collection trays and stored in metallic drums with tight lids and sold off to other end users.	LOW

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
	Increased ambient level of air pollution.	LOW	• Regular servicing of trucks and equipment.	LOW
	Death or injury from construction activities.	MEDIUM	• Use of PPE while working on site shall be enforced. • Strict adherence to all safety rules and instructions by all construction staff shall be HSE officer. • Moderate speed limit on site shall be defined and enforced.	LOW
	Community conflicts.	HIGH	• The Federal Ministry of Transportation and the proposed Bonny Deep Sea Port management shall consider a reasonable number of indigenes of the project host community for employment.	MEDIUM
	Increased social vices.	HIGH	• There shall be enlightenment and awareness campaign to all workers to eschew social vices. • Alcohol and drug use policy shall be enforced by port management.	MEDIUM

Project Phase/project activities	Potential/Associated Impacts	Ranking Before Mitigation	Mitigation Measures	Ranking After (Residual Impact)
Decommissioning and closure.	Emission of exhaust fumes and increased ambient noise level.	MEDIUM	• All water crafts and vehicles shall be kept by periodic and regular maintenance in good working condition. • Traffic caution signs shall be mounted in strategic locations along the selected route esecially on land. • Only well trained, experienced, physically and mentally fit craft and vehicle drivers shall be employed to convey personnel and equipment.	LOW
	Increased turbidity of surface water and shoreline erosion.	MEDIUM	• All boat drivers shall maintain minimum speed to reduce turbulent wave generation. • Boats conveying equipment and personnel shall always slow down to almost a halt on sighting smaller boats commuting persons and goods. This is to forestall mishaps.	LOW

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Introduction

Environmental and Social Management Plan (ESMP) is an environmental management application tool used to monitor the effectiveness of the mitigation measures and project commitments in the ESIA report. The ESMP is incorporated into the project implementation process, to minimize or eliminate identified adverse impacts and maintain compliance with environmental regulatory standards and corporate safety policies.

The ESMP in this document highlights the commitments of the Federal Ministry of Transportation and the EPC contractor CCECC Nigeria Limited, to the implementation of the mitigation measures built into project design as well as the additional ones recommended in the ESIA, and the roles and responsibilities of other stakeholders. The ESMP also emphasizes all the biophysical and social environmental attributes that shall be monitored by the proponent throughout the lifecycle of the proposed project. This is to curtail associated adverse impacts and expose other impacts that have not been identified and elucidated in the ESIA report. In addition, the ESMP attempts to provide the most practicable methods to promote sound environmental management during the subsequent phases of the project where appropriate.

7.2 Objectives of the Environmental and Social Management Plan (ESMP)

The objectives of the ESMP contained in this section are as follows:

- To monitor compliance with all the mitigation measures and commitments as discussed in the ESIA report during the implementation of the proposed project;
- To ensure best practices management as a commitment for continuous improvement in environmental performance;
- To monitor compliance with legal standards and limits for wastes discharges;

- To provide early warning signals on potential environmental degradation for appropriate actions to be taken so as to prevent or minimize environmental consequences.

7.3 General Environmental Management Planning, Training and Responsibilities

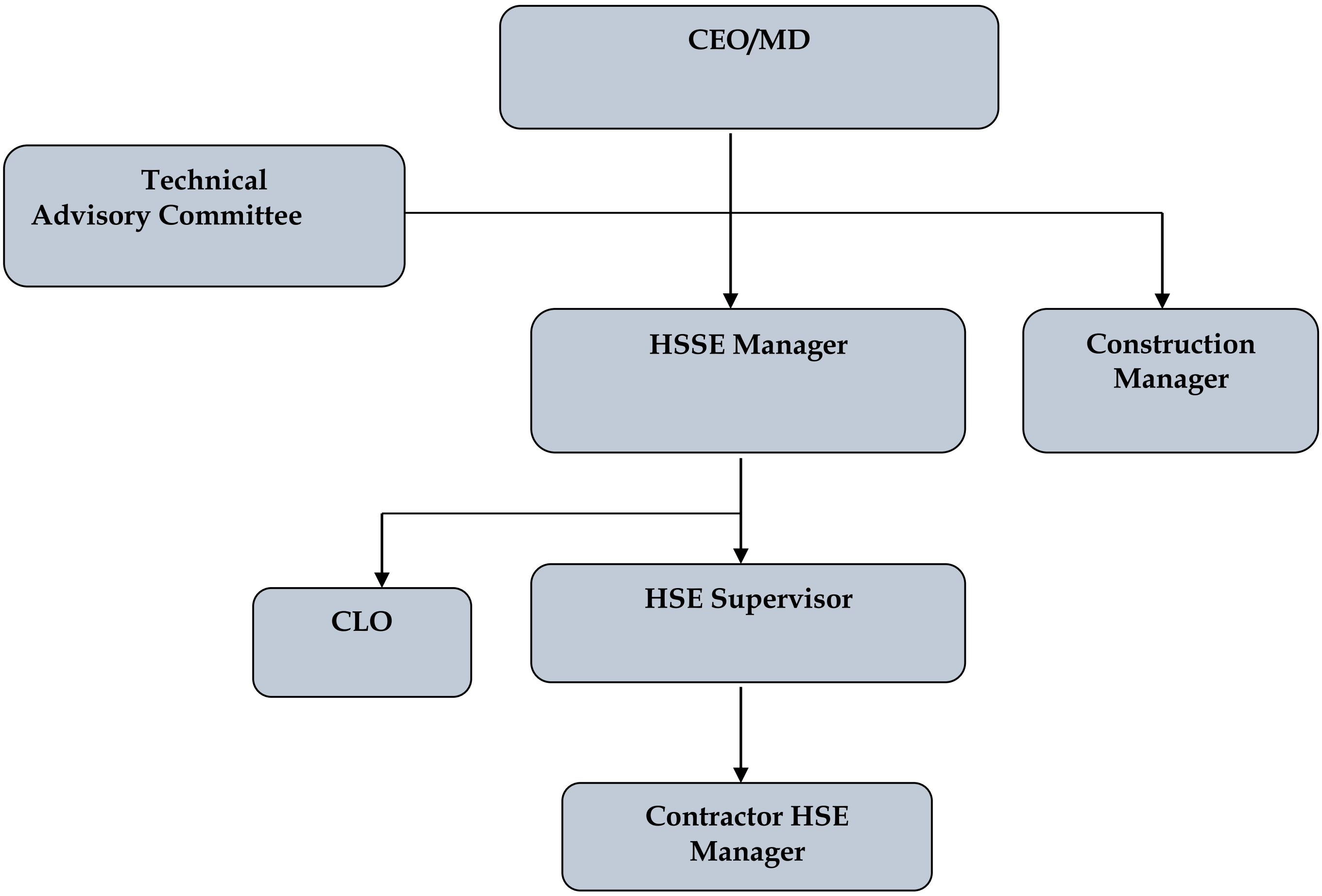

Figure 7-1: HSE Responsibility and Communication Organogram (Pre-Operations Phase)

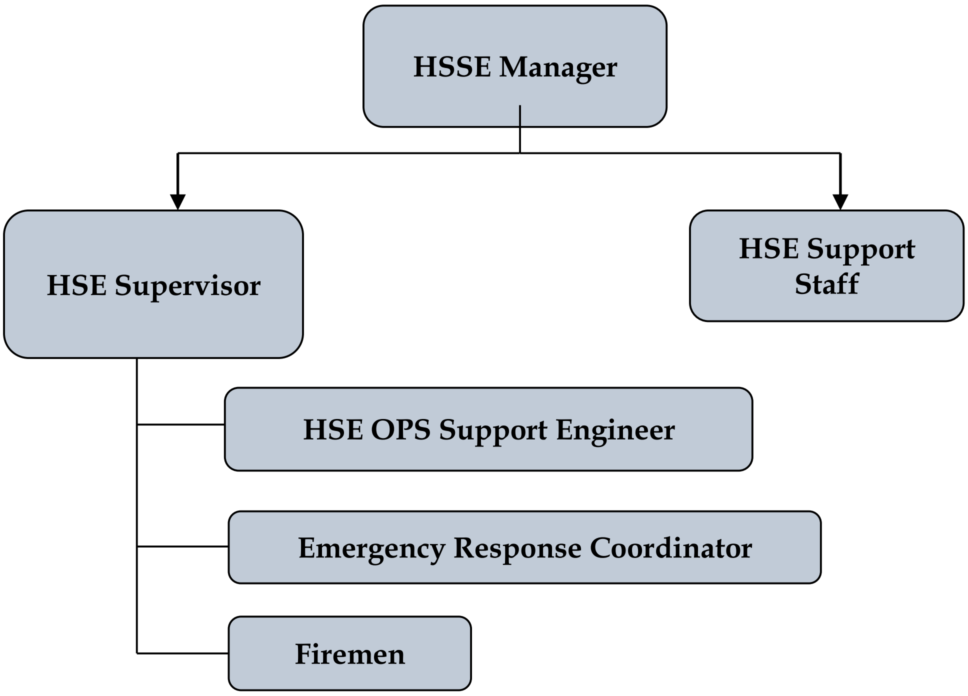

Figure 7-2: HSE Responsibility and Communication Organogram (Operations Phase)

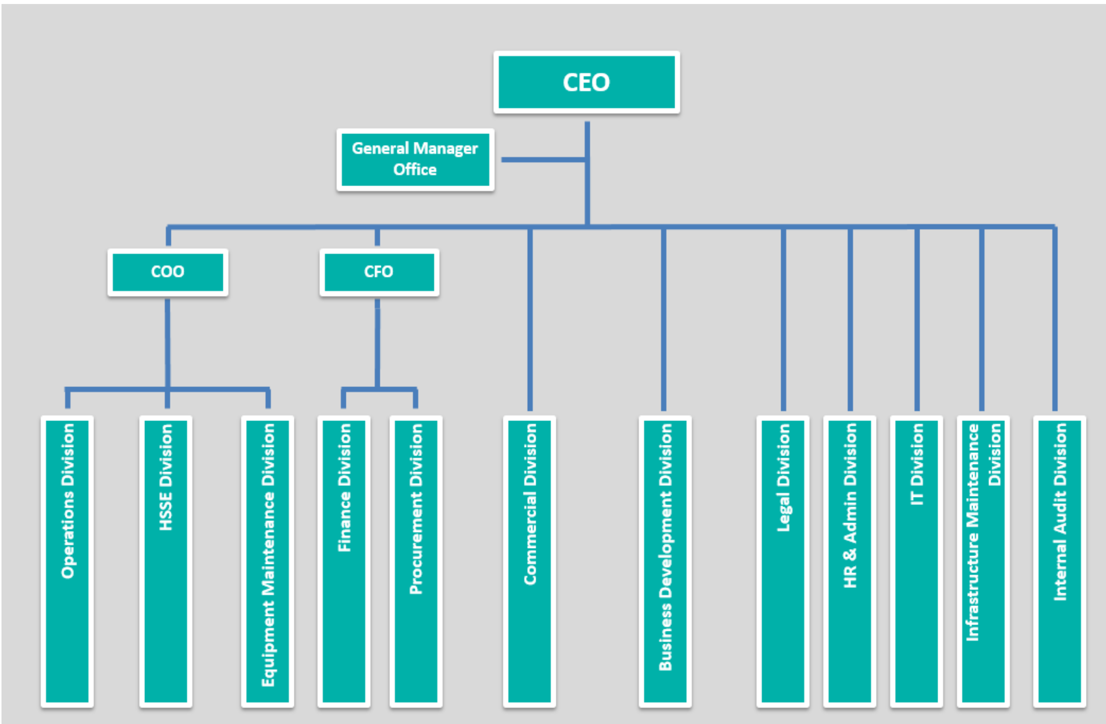

Figure 7-3: Bonny Deep Sea Port Project Organogram (Operations Phase)

7.3.1 Health Safety and Environment (HSE) Manager

The HSSE department of the Bonny Deep Sea Port project will be responsible for environmental management activities, and the implementation of relevant environmental management requirements.

The designated officer within the department will be responsible for monitoring the implementation of this environmental management plan. It may be different persons during the different phases of the project, but shall be someone who works for the HSE department or a designated representative by the project management who believes in the need to preserve the environment, in spite of the urgent need for project development.

The HSE Manager (referred to as HSEM in this document) shall have very good technical (construction) and environmental knowledge to understand and implement this management plan. The HSEM shall report to the BDSP management and, if the need arises, and with the prior consent of management, the Federal Ministry of Environment.

The HSEM has the authority to stop works during construction if in his/her opinion there is a serious threat to, or impact on the environment caused directly from the construction operations. This authority is to be limited to emergency situations where consultation with the project engineer or management is not immediately possible. In all such work stoppage situations the HSEM is to inform the contractor and management of the reasons for the stoppage as soon as possible.

Upon failure by the contractor or his employees to show adequate consideration to the environmental aspects of this contract, the HSEM may recommend to the engineer to have the contractor's representative or any employee(s) removed from the site or work suspended until the matter is remedied. No extension of time will be considered in the case of such suspensions and all costs will be borne by the contractor.

7.3.2 Contractor HSE Officer (HSEO)/Environmental Site Agent (ESA)

The EPC contractor shall appoint an HSEO or delegate this function to a specific site manager. The HSEO will be responsible for the implementation of the ESMP during the various phases of the project, and shall report directly to the HSEM.

7.3.3 Use of Local Labour and Women

Local unskilled/skilled labour, including women, shall as far as possible be used during the various phases of the project. The EPC contractor shall present the HSEM (representing BDSP management) with a local labour recruitment/utiliation plan for approval. The contractor shall ensure effective transfer of skills to the unskilled labourers, through proper training of all labourers hired.

7.3.4 Environmental Awareness Training and Skills Training for Site Personnel

All EPC contractor teams involved in work on the various aspects of the projects are to be briefed on their obligations towards environmental controls and methodologies in terms of this ESMP prior to work commencement. The briefing will usually take the form of an onsite talk and demonstration by the HSEM. The education/awareness programme shall be aimed at all levels of management within the contractor teams.

Workers shall also be given basic health awareness training to diminish the spread of diseases during the project phases. Local labourers hired for the construction period shall receive skills training to develop their skills. Such training shall where possible, include skills that can be used again by the person after the completion of the construction work.

7.3.5 Communication Procedures on Site during Construction Site Instruction Entries

The Site Instruction book entries will be used for the recording of general site instructions as they relate to implementation of the ESMP with regard to the works on site. It will also be used for the issuing of stop work orders for the purposes of immediately halting any particular activities of the EPC contractor in lieu of the environmental risk that they may pose.

HSEM Diary Entries

The purpose of these entries will be to record the comments of the HSEM as they relate to activities on the site. Each of these books shall be available in duplicate, with copies for the Chief Site Engineer and HSEM. These books shall be available to the relevant regulatory authorities such as FMEnv for inspection or on request. The EPC contractor site meeting minutes shall reflect environmental queries, agreed actions and dates of eventual compliance. These minutes form part of the official environmental records on site.

Method Statements

Method statements from the EPC contractor will be required for specific sensitive actions on request of the authorities. A method statement forms the baseline information on which sensitive area work takes place and is a "live document" in that modifications are negotiated between the Contractor/Engineer and HSEM, as circumstances unfold. All method statements will form part of the ESMP documentation and are subject to all terms and conditions contained within the ESMP main document.

A method statement describes the scope of the intended work, in a step-by-step description in order for the HSEM to understand the EPC contractors' intentions. This will enable them to assist in devising any mitigation measures, which would minimise environmental impacts during these tasks. For each instance wherein it is requested that the contractor submit a method statement to the satisfaction of the HSEM (if applicable), the format shall clearly indicate the following:

- What - Brief description of the work to be undertaken;
- How - Detailed description of the process of work, methods and materials;
- Where - Description/sketch map of the locality of work (if applicable); and
- When - Sequencing of actions with commencement dates and completion date estimates.

The Contractor shall submit the method statement before any particular construction activity is due to start. Work may not commence until the method statement has been approved by - the HSEM.

7.3.6 Personnel

- No trees or natural vegetation shall be permitted to be removed for the making of fires.
- The EPC contractor shall take all measures necessary to prevent his staff from hunting, capturing or destroying animals and birds in the vicinity of the construction camp or on site.
- The contractor shall take all necessary precautions against trespassing on adjoining properties and shall take care that no livestock or vegetation are interfered with.
- The EPC contractor shall comply with all safety regulations regarding the electricity supply and he shall take every precaution to ensure the safety of all the people on site.
- The contractor shall ensure that as far as practicable, suitable arrangements are made on site for the maintenance of health, the prevention and overcoming of outbreaks of disease and of adequate first aid services.

- The contractor shall be responsible for his own security arrangements and shall comply with any security instructions, which the Engineer may issue from time to time.
- The contractor shall ensure that suitable safety regulations and precautions are established and brought to the attention of the personnel. Safety helmets and other protective clothing shall be worn at all times whilst on site.
- The EPC contractor shall, at his own cost, provide for a constant supply of potable water for human consumption to the construction camp/houseboats and other domestic use on site.
- The contractor shall allow for chemical testing of water samples on a monthly basis, to be conducted at a Government-approved laboratory.
- EPC Contractor shall provide for sewage treatment facilities on houseboats, to treat domestic and sanitary wastes to regulatory standards before discharge.
- Monthly monitoring of effluent samples shall be undertaken at approved laboratories.
- Awareness training that includes health programmes containing as a minimum, HIV/AIDS and Malaria awareness training that focuses on the symptoms and effective control mechanisms for early detection and effective control, will be provided.
- The contractor will monitor his workforce for potential conflicts between the permanent staff and local labour, and assume the role of arbitrator between these parties shall the need arise.
- Conflict situations will be handled with extreme sensitivity.
- The EPC contractor shall ensure that his personnel are educated and informed as to the requirements of the ESMP. A copy of the ESMP shall be kept on site and the contractor shall endeavour to ensure that his staff complies with the ESMP requirements for best practice as described in this document.

7.3.7 Record Keeping

All records related to the implementation of this management plan (e.g. site instruction book, HSEM diary, and method statements during construction and other ESMP records during operation) shall be kept together in an office where it is safe and can be readily retrieved. These records shall be kept for at least two years and shall at any time be available for scrutiny by any relevant authority. It is recommended that photographs and video footages be taken of the site prior to, during and immediately after construction as a visual reference. The photographs and video footage shall be stored with other records related to this ESMP.

7.3.8 Environmental Completion Statement

An Environmental Completion Statement is a report by the HSEM to the relevant authorities such as the FMEnv, stating completion of the construction of the project and compliance with the ESMP and conditions. This statement will be issued after a final external audit of ESMP implementation.

7.3.9 Institutional Matters

The ESA (Environmental Site Agent – EPC contractor environmental representative) shall be responsible for the day-to-day implementation of the content of this ESMP on site on behalf of the contractor. The HSEM (BDSP environmental representative) will be responsible for the day-to-day monitoring of the implementation of the ESMP. The HSEM, on behalf, and with the full approval of the BDSP management, will commission external audits of the ESMP implementation by an independent environmental auditor (consultant) on a quarterly basis or biannual (twice a year) during the project operational phase. This external auditor will prepare a short audit report after each audit. These reports will be discussed at the various site meetings and will be retained for record keeping purposes.

7.3.10 Emergency Plan and Contingency Plans

The EPC contractor will prepare emergency plans for the typical emergencies. These plans will be submitted to the HSEM for approval and referred to the BDSP management, if required. These plans shall include any other contingency plans for events such as accidental cutting off of the water supply to a neighbourhood, or any other incidents as required by the HSEM and also include:-

- The command-and-control system for response and rapid dissemination of critical information to affected parties.
- Evaluate response preparedness including support facilities for firefighting, and operational procedures for the handling of equipment and chemicals.
- Clean up and disposal procedures.
- Coordination with mutual aid groups such as Police, and state fire service.
- Staff awareness and training.

7.4 General Environmental Management Practices

This section contains general environmental management practices and procedures applicable to the entire site throughout the construction period and pertains to the full spectrum of construction activities from the establishment and operation of the construction camp and the construction works itself, as well as operation of the temporary facilities.

7.4.1 Minimization of the Construction Area

The EPC contractor will minimize the area to be disturbed due to construction to what is absolutely required for the construction of the jetties and its associated facilities. As much as possible, the EPC contractor shall minimize the impact of its construction activities to the immediate vicinity and ensure that its activities do not interfere with normal navigational activities or other uses to which the waterbody is being put. Where there is likely to be a major impact on normal uses or the river (e.g. where dredging may interfere with routine activities such as fishing), adequate public enlightenment and notification shall be undertaken by the contractor before commencement of such activities. As may be necessary, compensation shall be agreed upon and paid, where it is proven that contractors' activities will significantly affect livelihood, before commencement of activities.

7.4.2 Noise Control

The majority of construction activities are associated with noise pollution. To limit the potential impact of this noise on neighbouring communities and on the construction workers, the following measures will be applied:

- No construction work will be allowed at night unless prior approvals have been obtained from both security operatives as well as residents of neighbouring communities. In all cases, working hours will be communicated to neighbouring communities.
- All machinery and plant will conform to the applicable noise standards, and plants will be provided with effective noise mufflers.
- The construction workers will adhere to the relevant health and safety standards pertaining to noise, such as wearing ear protection when operating plant or heavy machinery.

7.4.3 Dust Control

All activities that could lead to excessive dust generation during port facilities' construction/refurbishment works will be monitored by the EPC contractor for the generation of dust. Construction activities that generate dust such as mass earthworks to construct cuts and fills, the construction of layer works and the operation of the concrete batching activities, will not be allowed in excessively windy conditions. Unpaved construction roads will be wetted regularly to control dust due to traffic movement and trucks with construction material, topsoil or spoil will be covered with tarpaulins if required by the HSEM.

Construction workers will adhere to the relevant health and safety precautions when working in excessively fusty conditions, by wearing dust masks to cover their mouths and noses for protection from inhaling the dust. These precautions include applicable Nigerian occupational health and safety legislation and regulations, as well as the operational policy of the contractor, or operational guidelines for certain plant and machinery published by the suppliers of these equipment.

7.4.4 Erosion Control

EPC contractors shall carry out erosion control measures whenever the need arises. This will include, among others, proper protection of access roads and channelization of runoff from roads and site works.

No new erosion gullies will be allowed to form. If erosion is evident, it serves as an indication that additional protection measures are required. In order to curb the erosion, the required protection measures will be introduced as soon as possible by the contractor, and the erosion gully itself filled. The HSEM will specifically monitor the formation of erosion gullies, and make notes on the chainage and extent of the erosion. A photo record of erosion will also be kept on site.

7.4.5 Cultivated Fields, Fences and Properties along the Riverbank (Shoreline)

Care shall be taken to ensure that the minimum of cultivated fields and crops are damaged by construction activities such as access roads, warehouses, administrative block, jetty construction, etc. If it becomes absolutely necessary to impact on cultivated field or cropland, fences and grazing fields, or other land uses along the access roads and jetty sites, then the owners thereof shall be notified and the compensation plan be implemented.

Property owners shall be compensated for the loss of crops and fences and care shall be taken to ensure that they are not worse off as a result of the construction activities. Compensation plans would typically include relocation and/or resettlement. Care shall be taken during construction activities to ensure no livestock are injured or killed as a result of the construction activities (where applicable). If an incidence occurs, then proper compensation procedures shall be instituted.

Property Affected by Construction

Agreements will be reached with local community members who might be adversely affected by the project.

Accommodation of Traffic

The EPC contractor shall accommodate vehicular traffic safely at all times. Detours may in some instances be required, to allow for the accommodation of traffic. The contractor will be required' to rehabilitate and backfill with topsoil these areas to its original state after closure. Where these detours cross through cultivated fields, the contractor will have to compensate the owner for his/her loss. The contractor shall demarcate and/or fence unsafe areas to ensure that access is restricted until it is safe and shall post appropriate signages to indicate these areas. The contractor shall also ensure that the surrounding community is educated about the construction process and the constraints placed on them during this period.

Rehabilitation of Detours

After project activities have been completed the temporary detours constructed shall be rehabilitated according to the following procedure:

- The compacted soil below shall be ripped and covered with topsoil if available.
- The disturbed areas shall be revegetated to its original state.
- Topsoil stockpiled prior to the establishment of the detour, shall be used to rehabilitate the existing road section or detour, as construction continues.

7.4.6 Clearing and Grubbing

This section applies mainly to areas of new construction, especially for new jetties and associated facilities.

Topsoil

The following process shall be performed by the EPC contractor when stripping and stockpiling topsoil:

- Topsoil will be cleared prior to any other construction activity commencing in a specific area.
- The area of ground clearance shall be minimized as far as possible.
- Topsoil shall be cleared of woody vegetation before ripping and removing.
- The topsoil is regarded as the top 150 mm of the soil profile irrespective of the fertility appearance or physical depth.
- Topsoil is to be stripped when it is in as dry a condition as possible in order to prevent compaction.
- The topsoil, including the existing grass cover is to be shallowly ripped (only the depth of the topsoil) before removal. This is to ensure that organic plant material, and the natural seed base is included in the stripping process.
- No vehicles shall be allowed access onto the stockpiles after they have been placed.
- Stockpiles shall not be allowed to become contaminated with oil, diesel, petrol, garbage or any other material, which may inhibit the later growth of vegetation.
- The contractor shall apply soil conservation measures to the stockpiles to prevent erosion. This can include the use of erosion control fabric or grass seeding.
- If at any stage of the clearing operations archaeological artefacts are unearthed or identified the relevant authorities shall be immediately contacted to conduct thorough scientific investigation of the finds and work in the immediate area suspended until clarification is sought.

The contractor shall devise a soil conservation and stockpiling plan, to be approved by the HSEM on behalf of BDSP management, which shall detail:

- Stockpile sizes, layout and form - exact positions to be finalised on site, but no stockpiles are to be placed within drainage areas.
- Means of erosion (wind and water) prevention for stockpiles - to protect water sources from siltation.
- The rehabilitation measures to be taken for the area occupied by the stockpile, should the HSEM deem it necessary.
- A generic schedule of soil replacement for areas where work has been completed.
- Soil replacement shall preferably run in parallel (where feasible) with the construction process.
- Soil erosion prevention measures for general site use.
- Details of temporary or permanent soil stabilising and reinforcement works.
- Wind erosion prevention techniques (if applicable).
- Dust and erosion of topsoil from runoff shall be minimised through appropriate watering and the avoidance of windy or excessively rainy conditions during transport and application (where feasible).
- Topsoil from the construction of the road shall be made available to rehabilitate the construction campsites and cut or fill areas.
- Reduce environmental impacts on soil by replacing topsoil and replanting on disturbed areas immediately after disturbance has stopped, not after completion of the construction phase.

Fauna and Flora

The following procedure will be followed-up by the ESA on behalf of the contractor regarding fauna and flora to be affected by construction:

- Natural vegetation shall be kept in as undisturbed a state as possible. Special attention shall be paid to preserve large trees and plant communities such as wetlands and swamps, with the exception of those directly affected by the final alignments.

- Indigenous plants or wild animals (including reptiles, amphibians or birds etc.) shall not be damaged or harmed. Vegetation removals as part of the development requirement are excluded.
- All incidents of harm to any animal or natural vegetation (apart from the agreed areas) shall be reported to the HSEM representing the BDSP management.
- Local communities shall be given the option of using any plants of medicinal value. Specimens shall not, however, be given away for any other use e.g. firewood, structural purposes. The HSEM will oversee the distribution of these plants if necessary.
- Remaining plants shall be used in the rehabilitation phase.

Fencing

The purpose of fenced areas shall be to secure the contractor's equipment and to prevent the interference of domestic or wild animals. Temporary demarcation with white boulders or other suitable materials such as white painted wooden stakes of 1.5m high could also be considered if required by the contractor, to prevent construction damage. These boulders or other materials shall be removed when construction is complete.

Fencing at Construction Camps

- Fencing shall be suitably secured.
- No unauthorised pedestrian or vehicular access shall be allowed into fenced off-limits areas.
- Fencing shall be kept neat at all times.
- The contractor shall be responsible for the maintenance of all fences.
- Breaches in the fencing shall be repaired immediately.

- The clearing for permanent fencing shall be limited to the removal of shrubs within 1 m of the fence line.
- No grass cover and topsoil is to be removed within the fence alignment.

7.4.7 Construction Camps

- The planning and design for the construction camps shall be done to ensure there is minimum impact on the environment.
- Where possible existing infrastructure and/or disturbed areas shall be used.
- Local labourers shall be used as far as possible to minimise cultural intrusion into the communities in the area.
- The EPC contractor shall supply gas cooking materials to construction workers, as no gathering of firewood will be allowed on site. The use of these facilities will be limited to the construction camp areas.
- Welding, gas cutting or cutting of metal shall only be permitted inside the working areas.

7.4.8 Fuels and Oils at Construction Camps

- All above-ground petroleum product (diesel, oil and petrol) storage tanks shall be placed in bunds with sumps. The minimum bund capacity will be at least 110% of the storage capacity.
- In the event of a spill, pumping of the product, either for recovery or for disposal shall be done as quickly as possible to reduce the amount of vapours being released into the environment.
- All drainage from fuel storage areas shall be diverted to the separating facilities and settling ponds.
- Oils shall be stored in sealed drums in a bunded or containment area.

- Used oils shall be stored similarly and shall be recycled by private dealers identified by the EPC contractor or disposed of in a manner approved by the HSEM/ Environmental Consultant.

7.4.9 Cement at Construction Camps

- Cement shall be delivered in sound and properly secured bags or in approved bulk containers.
- Cement products in sacks shall be stored in an enclosed storage area underlain by a concrete platform with the bags themselves raised off the ground with the use of pallets.
- Waste cement shall be stored in a similar manner and disposed of in a manner approved by the HSEM in consultation with FMEnv/Rivers State Environmental Protection Agency.
- The storage facility and surrounding area shall be swept and cleaned regularly as required to ensure that cement products do not enter the surrounding environment.
- Where cement silos are used in temporary camps, the ground cover surrounding the silo and dispatch area shall be a well graded compacted surface to allow easy cleaning in the event of a spill.

7.4.10 Concrete Batching Plant

- The concrete plant shall be located on a compacted earth platform.
- Concrete shall only be mixed in areas which have been specifically demarcated and established for this purpose.
- Any large quantity of concrete spilt shall be promptly removed by the contractor to an approved disposal site or saved for possible later use.
- After mixing is complete all wastes shall be removed from the batching area. The contractor shall first seek means of reducing the waste through re-use on site e.g.

rubble or recycling. Disposal at government approved disposal site shall only be a last resort, after consultation with relevant agencies.

- No storm water shall be permitted to flow through the batching site.

7.4.11 Sanitation

- Adequate latrines (mobile inclusive) shall be provided for all staff at the camps and away from the main construction camp.
- The latrines and septic tank system shall be located away from such sensitive areas as swamps, waterbodies and areas of cultural and historical importance.
- Laterines and associated facilities shall be serviced regularly so as to prevent overflowing.
- Night-soil shall be removed to a waste water treatment plant (WWTP) or disposed of in any other manner acceptable to the HSEM/ Environmental consultants to the BDSP management.
- All fees in this regard, whether it be to the WWTP or to the transporter shall be payable by the EPC contractor.
- The contractor's staff (Muslims) shall use only the latrines for ablution.
- Water used for sanitation purposes e.g. washing facilities, shall be released into the septic tank system.

7.4.12 Temporary Storage of Waste

7.4.12.1 Construction Waste

- As much construction waste as possible shall be re-used or recycled. The EPC contractor shall be responsible for removing and transporting all remaining waste materials off site to approved government dumpsite in collaboration with the Rivers State Environmental Protection Agency as well as Accredited Waste Management Companies.

7.4.12.2 Domestic Waste

- Recyclable waste, including glass, paper and plastic shall be sorted, stored and recycled, where economically feasible.
- Waste shall: be disposed of on a weekly basis in a manner approved of by the HSEM at the Contractor's expense. No burning of waste shall be allowed.
- Personnel shall be informed about the necessity to refrain from littering and about the need to keep hazardous substances separate from the domestic wastes.
- The contractor shall, on alternating days, conduct site clean-ups for litter other than construction spoil, and dispose of it in refuse bins provided on site.

7.5 Social Management Plan

Social indices are usually very difficult to measure and control, because they depend, to a large extent, on the nuances and idiosyncrasies of human beings. However, certain basic social components need to be adequately managed, to minimize negative social outcomes for project activities. For the current project, a number of key social management issues need to be taken into due cognizance. They include the following:

7.5.1 Social Management of Pre-construction and Construction Phase

During pre-construction and construction, mobilization of men and machinery are likely to upset the regular social equilibrium of project locations. Therefore, there is a need to take key steps to minimize the magnitude of such upsets. Among others:

- The BDSP management will require EPC contractor to provide a detailed community/stakeholder engagement plan. This plan shall be approved by management, prior to its implementation by the contractor. Such plans will include local labour recruitment plans.
- Adequate traffic management plans, specific to this project shall be developed to manage traffic that will be associated with mobilization and construction phases of the project.

- No construction activity shall be allowed to commence until adequate consultations and agreements have been reached with the host communities.
- Adequate notice shall be given to host communities prior to the commencement of activities that may infringe on their usage of the waterways. This will include some dredging close to jetty locations.
- Adequate enumeration and valuation of affected properties will need to be carried out and compensation paid where due, prior to the commencement of construction activities, in order to avoid conflicts that could arise from such activities.

7.5.2 Social Management of Operations Phase

Operational activities will primarily involve haulage or rocks by road from quarry to the project site. The main social effects of these activities are expressed on regular traffic. Therefore, the following measures will be put in place:

- Comprehensive traffic management program for operational phase of the project shall be prepared. Such traffic management program will focus on ensuring that project transportation are planned to dovetail into routine local transportation activities. Bulk of the operational transportation shall be timed to avoid peak periods. For transportation along water ways, safe speed limits shall be adhered to by barges, especially when approaching natives commuting/or fishermen, particularly those who use paddle canoes.
- Regular meetings and discussions shall be held with host communities during project operations, so that any potential conflict can be identified and resolved, before it becomes full blown.

7.5.3 Social Management of Closure/Decommissioning Phase

No significant issues are expected to emanate from this phase, especially if the jetties will not be dismantled but will be abandoned. However, should a decision be made to dismantle loading jetties, then there will be need to incorporate certain social management plans. These will include:

- Dismantling of jetty structures can generate conflict, if not properly handled. Therefore, adequate consultations and agreements shall be reached with host communities before the commencement of decommissioning activities.

7.6 Environmental Monitoring Plan

This aspect of environmental management is specifically designed for the identification of associated project impacts, equipment malfunction/failure and remedial action. It is in line with regulatory requirements of the FMEnv. Therefore, for the purpose of monitoring, the management of BDSP shall focus mainly on those environmental attributes that can be affected by project activities at various phases. Based on impact assessment, presented in chapter five (5) of this report, there are no really sensitive ecosystems within the project area. However, for the identified adverse impacts (ranked as High, Medium and Low), the monitoring will enable the project team to follow the trends and ensure impacts do not escalate. In addition, monitoring during all phases of project implementation is a regulatory requirement of the FMEnv, and shall therefore be incorporated into project plans. Environmental monitoring shall encompass, at a minimum, the following:

- Water and sediment quality;
- Hydrobiology;
- Soil and vegetation;
- Air Quality and Noise level Monitoring.

Monitoring shall be for the purpose of verifying the effectiveness of mitigation and management plans indicated above. Therefore, monthly sampling during construction, and quarterly monitoring during operations, shall be undertaken. Detailed sampling and analyses will be undertaken after visit. An overview of the planned monitoring will be as shown in Tables 7.2-7.3 for Pre-construction and construction, operations, and closure/decommissioning phases of the project.

Table 7.1: Environmental Monitoring Requirements for the Project

S/N	Environmental Attribute	Impact Indicators	Monitoring Locations
1.	Air Quality and Noise Levels	• TSP, • Gases (CO, NO_X, SO_X, CO_2 THC) • Noise levels	• At each of the shoreline locations and along the waterbodies, around where dredging operations are taking place. • For ease of comparison, monitoring locations shall be the same as around those where samples for this ESIA were collected.
2.	Water/sediment Quality	• Salinity • Conductivity • Turbidity • DO • pH • TDS • Temperature • Anions • Cations • Heavy metals • Microbiology	• 10 water sampling points will be collected during each monitoring. • These samples will be spread as follows: 2 samples at each of the loading and offloading jetties, and 6 other points spread on the waterway between the two jetties.

S/N	Environmental Attribute	Impact Indicators	Monitoring Locations
3.	Hydrobiology	• Plankton (phytoplankton and zooplankton) biomass • Macrobenthic fauna(species composition, diversity and abundance	• Hydrobiology samples will be collected at each water sampling location, as described above.
4.	Soil and Sediment Quality	• pH • TOC • Texture • Heavy metals • Total hydrocarbons • Microbiology	• Soil samples will be collected around each jetty. • 2 locations will be designated around each jetty. • Sediment samples will be collected around each water sampling location as described in 2 above.
5.	Wildlife and Vegetation	• Species compositions and diversity • Biomass productivity • Pathological assessment • Inventory of economic crops	• Sampling locations will be around each of the loading and offloading. • There will be a total of 25 points across the entire study area.

Table 7.2: Overview of Monitoring Requirements for Pre-Construction and Construction phase

S/N	Environmental Attribute	Impact Indicators	Objective of Monitoring	Monitoring Locations	Monitoring Frequency	Responsible Party
1.	Air Quality and Noise Levels	• TSP, • Gases (CO, NO_X, SO_X, CO_2 THC) Noise levels	• To establish conditions of these environmental attributes during construction, and identify negative changes, compared to baseline as documented by this ESIA. • To highlight changes that could be attributed to construction activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Loading and offloading area. • Within port site yard. • Control points (outside of Area of Potential Project Influcence-APPI).	Monthly during Construction.	Bonny LGA, Rivers SMEnv, Bonny DSP HSEM and Bonny DSP Environmental consultant
2.	Water/sediment Quality	• Salinity (water only) • Conductivity (water only) • Turbidity (water only) • DO (water only) • pH • TDS (water only) • Heavy metals • Texture (sediment only) • TOC (Sediment only)	• To establish conditions of these environmental attributes during construction, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to construction activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Loading and offloading jetties; • Around locations where dredging is taking place	Monthly during construction	Bonny LGA, Rivers SMEnv, Bonny DSP HSEM and Bonny DSP Environmental consultant

S/N	Environmental Attribute	Impact Indicators	Objective of Monitoring	Monitoring Locations	Monitoring Frequency	Responsible Party
3.	Hydrobiology	• Plankton (phytoplankton and zooplankton) biomass • Macrobenthic fauna (species composition, diversity and abundance	• To establish conditions of these environmental attributes during construction, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to construction activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Loading and offloading jetties; • Around locations where dredging is taking place	Monthly during Construction.	Bonny LGA, Rivers SMEnv, Bonny DSP HSEM and Bonny DSP Environmental consultant
4.	Soil Quality	• pH • TOC • Texture • Heavy metals • Total hydrocarbons • Microbiology	• To establish conditions of these environmental attributes during construction, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to construction activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Around loading and offloading jetty areas. • Control points outside APPI.	Once during entire construction period.	Bonny LGA, Rivers SMEnv, FMEnv, FMoT, Bonny DSP HSEM and Bonny DSP Environmental consultant

Table 7.3: Overview of Monitoring Requirements for Closure/Decommissioning phase

S/N	Environmental Attribute	Impact Indicators	Objective of Monitoring	Monitoring Locations	Monitoring Frequency	Responsible Party
1.	Air Quality and Noise Levels	• TSP, • Gases (CO, NOX, SOX, CO2 THC) • Noise levels	• To establish conditions of these environmental attributes during decommissioning, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to decommissioning activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Around any jetty to be dismantled. • Control points (outside of APPI.	One-off	Bonny LGA, Rivers SMEnv, FMEnv, FMoT, Bonny DSP HSEM and Bonny DSP Environmental consultant
2.	Water/sediment Quality	• Salinity (water only) • Conductivity (water only) • Turbidity (water only) • DO (water only) • pH • TDS (water only) • Heavy metals • Texture (sediment only) • TOC (Sediment only	• To establish conditions of these environmental attributes during decommissioning, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to decommissioning activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Around any jetty to be dismantled. • Control points (outside of APPI).	One-off	Bonny LGA, Rivers SMEnv, FMEnv, FMoT, Bonny DSP HSEM and Bonny DSP Environmental consultant

S/N	Environmental Attribute	Impact Indicators	Objective of Monitoring	Monitoring Locations	Monitoring Frequency	Responsible Party
3.	Hydrobiology	• Plankton (phytoplankton and zooplankton) biomass • Macrobenthic fauna (species composition, diversity and abundance	• To establish conditions of these environmental attributes during decommissioning, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to decommissioning activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Loading and offloading jetties. • Around locations where dredging shall take place	One-off	Bonny LGA, Rivers SMEnv, FMEnv, FMoT, Bonny DSP HSEM and Bonny DSP Environmental consultant
4.	Soil Quality	• pH • TOC • Texture • Heavy metals • Total hydrocarbons • Microbiology	• To establish conditions of these environmental attributes during decommissioning, and identify negative changes, compared to baseline as documented by this EIA. • To highlight changes that could be attributed to decommissioning activities and determine the efficacy of mitigation measures. • To recommend additional mitigation measures (if necessary).	• Around loading and offloading jetty areas • Control points outside APPI.	One-off	Bonny LGA, Rivers SMEnv, FMEnv, FMoT, Bonny DSP HSEM and Bonny DSP Environmental consultant

7.7 Management Review and Auditing

This is also a key component of environmental management plan, which requires project management attention to existing environmental management policies and practices to assess its effectiveness and achievement of the desired goal. The project management shall periodically review the existing environmental policy to ensure conformity with state and national environmental regulation's goal, effectiveness and adequacy.

During this period, any areas of lapses would be corrected while new strategies and measures shall be introduced to take care of any obsolete technology or to meet new innovation in international environmental technology. Auditing and reviews of the activities included in this document shall be undertaken regularly by BDSP management or its designated contractor.

7.8 Reporting

The HSE department of the contractor shall make periodic report of monthly internal audit and send the report to the project management engineer every three months for review, comments, advice and possibly, effect a change in strategy to achieve the best environmental practice in the project's activities. Other hazards such as fire, accidents etc. shall be promptly responded to through well-institutionalized contingency plan to be developed by the contractor.

7.9 Conclusion

The management of the Bonny Deep Sea Port project is committed to sustainable development and will ensure that all relevant regulations are complied with. In addition, the management will ensure that periodical reporting of its ESMP implementation are made to the FMEnv. Specifically:

- A designated officer referred to as the HSEM, will be in charge of implementing this ESMP from the BDSP project team.
- The HSEM will ensure that the EPC contractor appoint a designated HSEO for this project.
- Monitoring, as indicated above, will be carried out at the specified frequency. Monitoring reports shall be kept but quarterly reports shall be submitted to the FMEnv.
- Periodic internal audit of management systems will be carried out on a needs basis.

Overall, it is the expectation that if the foregoing are carefully implemented, an environmentally and socially sustainable project implementation shall be achieved.

CHAPTER EIGHT

REMEDIATION PLANS AFTER DECOMMISSIONING /CLOSURE

8.1 Introduction

This Environmental and Social Impact Assessment report will be incomplete without the integral parts of decommissioning and abandonment/closure programmes. The main aim of decommissioning process is to restore the project area to its original state. An abandonment plan is developed to conform with the national statutory requirements contained in the Federal Ministry of Environment sectoral guidelines applicable to the project, as well as international standards. The plan includes an abandonment execution strategy to identify the components of the project that would be decommissioned and the sequence to be adopted.

All projects and/or activities, no matter how durable they are, usually have life spans. The lifespan of any project is primarily hinged on a number of considerations, including: the design basis and construction materials; availability of raw materials and feedstock; acceptability of the end-product; maintenance and technological development. For this project, the jetties shall be designed as structures which can be removed with relative ease, should the need arise. Given the known and acknowledged fact that projects necessarily impact the environment, either positively and/or negatively, it is important to put in place plans to recover and/or restore the project site to its original state after the project is closed or decommissioned. This requires a good understanding of all the environmental components of the project on the ecosystem during its lifespan. It is therefore environmentally wise to take into cognisance, this component during the planning stage.

This section of the report provides an overview of the various decommissioning activities that will accompany this project and therefore need to be planned for from this preliminary stage.

8.2 Decommissioning and Remediation Activities

There are two (2) options for decommissioning:

- To abandon the facilities; and
- To restore to pre-project conditions.

In the event that the abandonment option is chosen due to beneficial impact on communities, the jetties, administrative building, warehouses, intra port road network and other project associated facilities will be left in-situ subject to agreements with communities. The dredged channel will also be left and gradual siltation will take place, until the bathymetry realigns with that of surrounding area.

For removal and restoration, rehabilitation activities will have to be undertaken in the following areas:

- All platforms will need to be broken up and rubble taken to an approved waste disposal site or used as fill materials in other places. The exposed surface must be tested for contaminant at an accredited laboratory. If any contaminants are found, the contaminated soil is to be removed along with the concrete to a site acceptable based on regulatory requirements. Revegetation must then take place.
- Fences shall be removed and their locations restored to pre-project conditions.
- Administrative buildings and warehouses shall either be demolished or transferred to the host communities for other uses.
- Intra port link roads may be removed or left behind for the continuous use of the local communities.

- Waste management facilities will be disposed off and affected areas cleaned up.
- The contractor shall maintain a record of the abandoned facilities and a copy will be given to the management of Bonny Deep Sea Port, relevant Government agencies such as the FMEnv, and other stakeholders if requested.

8.3 Re-vegetation

Areas developed, paved, concretised and tarred shall have all such earth works removed so as to allow for revegetation, unless there is reason to leave them as they are (i.e. community use). The basic revegetation steps, which may need to be adapted to the project-specific environmental conditions, are detailed below.

1) Prepare the area to be revegetated for topsoiling - this may require soil ripping and/or scarifying, and digging of steps or terraces. The scarification shall take place to a depth of 150mm. If ridges are made, they shall be about 100mm high and about 400mm wide.
2) Replace stored topsoil on the slope to be revegetated to a depth of between 75mm and 150mm (depending on the soil and slope conditions). The topsoil shall then be spread when it is dry by means of hand raking or mechanical blading and trimmed to a uniform thickness of not less than 100mm.
3) Apply seeds or grass sods according to the supplier's specifications. The seed shall be fresh, good quality seed as specified in the seed mix, certified by the supplier and free from contamination by seeds of other species. Seed harvested from the site shall be substituted only with the approval of the relevant authorities and/or agencies. If indigenous grass sods are used, they shall be placed close together and level with each other. Gaps between the sods shall be filled in with topsoil. A light cover of topdressing may be required to encourage growth and establishment.
4) Mulch shall be applied to protect the seeded area from erosion. The mulch shall be composed of straw or other material of cellulose origin and free of undesirable

seeds. The mulch shall not be excessively fresh and green or in an advanced state of decomposition as it could smother growth. It shall be applied to a depth and density that will prevent erosion by wind and water, but not completely block out the access of sunlight to the soil or prevent penetration by young plants.

5) Protect the revegetated area from excessive trampling and any other factors that might cause erosion or compaction. No equipment, trucks or other heavy equipment shall be allowed onto revegetated areas.
6) Ensure that suitable temporary and permanent drainage protection is installed ahead of or in parallel with the revegetation process.
7) Water the seeded/planted area on a regular basis (according to need, but on average twice per week).
8) Institute an appropriate maintenance and monitoring program for a minimum of 1 year. This program shall include monitoring of the success of seed germination, growth of the plants, removal of invasive; weeds, replanting of areas where revegetation has not been successful once the cause of the inhibiting factor has been identified and remedied, and repair of any funnels or erosion channels. The contractor shall not allow erosion to develop on a large scale before implementing repairs.

CHAPTER NINE

CONCLUSIONS AND RECOMMEDATIONS

9.1 Conclusion

This report presented an assessment of the Environmental and Socio-Economic components of the proposed Bonny Deep Sea Port project. The assessment here has painstakingly examined the anticipated and potential positive and negative impacts of the project. The beneficial potentials of the project outweighs the conceivable adverse effects, nevertheless, mitigation measures were developed for the adverse impacts based on best industrial practices. In addition, the measures developed are aimed at ensuring that the impacts on land use, vegetation, air quality, socio-economic and health are mostly localized and can be controlled and remediated to a level reasonably tolerable.

Based on the findings of the ESIA study the following conclusions are made:

- The activities related to the project will not pose any irremediable major threat to human lives in the host community as it is a deep sea port project that will be designed, constructed and operated in compliance with international standards following best industrial practices.
- The choice of the project location in Bonny Local Government Area of Rivers State is very strategic in that it will make the port accommodate heavy vessel traffic and volume with minimal works required in the area of dredging navigable channel since the port is along a water body adjacent the Atlantic Ocean with natural deep floors.
- The baseline ambient air, soil and water quality of the immediate environment of the project area largely conforms to national regulatory standards and efforts shall be made at keeping to these standards all through the project lifespan.

- The project has more beneficial impacts on the immediate host communities, Rivers State and Nigeria as a whole than negative local effects.

9.2 Recommendations

Based on the conclusions summarized above, the following recommendations are made for implementation:

- The content of this ESIA report document be incorporated to form the basic guideline for implementing this project from construction to decommissioning stage.
- The proposed mitigation measures, monitoring plans and overall environmental management plans be implemented to the latter.
- The office of the HSEM proposed be implemented to coordinate all matters relating to environmental protection, monitoring and management at all stages of the project.