ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

DRAFT REPORT

FOR

THE PROPOSED PORT FACILITY

AT
KIRIKIRI, AMUWO-ODOFIN LGA, LAGOS STATE

BY

BESTAF MARINE SERVICE LIMITED

SUBMITTED TO

FEDERAL MINSITRY OF ENVIRONMENT ABUJA

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ABBREVIATION AND ACRONYMS

%	Percentage
AIDS	Acquired Immunodeficiency Syndrome
ALARP	As Low As Reasonably Practicable
AOI	Area of Influence
As	Arsenic
BAT	Best Available Technology
BH	Borehole
BMSL	Bestaf Marine Services Limited
BWN	Building With Nature
Cd	Cadmium
CDR	Crude Death Rate
CEMA	Customs & Excise Management Act
CHEW	Community Health Workers
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLO	Community Liaison Officer
CO	Carbon monoxide
CSD	Cutter Suction Dredger
Cu	Copper
dB	Decibel
DD	Data Deficient
DG	Diesel Generators
DIL	Dangote Industries Limited
DO	Dissolved Oxygen
DPR	Department of Petroleum Resources
DWT	Deadweight Tonnage
EBS	Environmental Baseline Survey
ECO	Environmental Consultancy Outfit
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMT	Environmental Monitoring Team
EPC	Engineering, Procurement and Construction
EPMG	Engineering Project Management Guide
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
Fe	Iron
FEPA	Federal Environmental Protection Agency
FGD	Focus Group Discussion
FMEnv	Federal Ministry of Environment
GDP	Gross Domestic Product
GM	General Manager
GMT	Greenwich Mean Time
GOG-LME	Gulf of Guinea Large Marine Ecosystem Project
GPS	Global Positioning System
H_2S	Hydrogen sulphide
HAZID	Hazard Identification

HAZOP	Hazard Operability Study
HC	Hydrocarbon
HEMP	Hazards and Effects Management Process
Hg	Mercury
HIA	Health Impact Assessment
HIV	Human immunodeficiency virus
HSE	Health, Safety and Environment
Hz	Hertz
IDIs	In-Depth Interviews
IDSR	Integrated Disease Surveillance and Response
IFC	International Finance Corporation
IMM	Impact Mitigation Monitoring
IMR	Infant Mortality Rate
ISO	International Organization for Standardization
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for Conservation of Nature and Natural Resources
JHA	Job Hazard Analysis
kg	Kilogram
Kw	Kilowatt
LASEPA	Lagos State Environmental Protection Agency
LAWID	Lagos State Waterfront Infrastructure Development
LAWMA	Lagos Waste Management Authority
LC	Least concern
LFN	Laws of the Federation of Nigeria
LGA	Local Government Area
LSMoE	Lagos State Ministry of Environment
m/s	Meter per second
m^3	Cubic meter
m^3/h	Cubic meter per hour
MARPOL	The International Convention for the Prevention of Pollution from Ships
mg/l	Milligram per Litre
MMR	Maternal Mortality Ratio
MOU	Memorandum of understanding
MWID	Lagos State Ministry of Waterfront Infrastructure Development
NESREA	National Environmental Standards and Regulation Enforcement Agency
NFE	No Formal Education
NGOs	Non-Governmental Organizations
NH_3	Ammonia
NHA	Nigeria's National Health Act
NIHS	National Institute of Health Sciences
NIMASA	Nigerian Maritime Administration and Safety Agency
NIWA	National Inland Waterways Authority
NOx	Oxides of Nitrogen
NPA	Nigerian Port Authority
NTU	Nephelometric Turbidity Units
OBM	Oil based mud
OCIMF	Oil Companies International Marine Forum
OILPOL	The International Convention for the Prevention of Pollution of the Sea by Oil

PAH	Poly Aromatic Hydrocarbon
Pb	Lead
PCB	PolychloroBiphenyl
PHCs	Primary Health Care Clinics
PIANC	World Association for Waterborne Transport Infrastructure
PID	Pelvic Inflammatory Disease
PM	Project Manager
PPE	Personal protective equipment
PRA	Participatory Rural Appraisal
PTW	Permit to Work
QA/QC	Quality Assurance/Quality Control
QCC	Quayside Container Cranes
QRA	Quantitative Risk Assessment
R/H	Relative Humidity
RTGC	Rubber Tyred Gantry Cranes
RTI	Respiratory tract infection
SARS	Severe Acute Respiratory Syndrome
SHE	Safety, Health and Environment
SOW	Scope of Work
SOx	Oxides of Sulphur
SPM	Suspended Particulate Matter
SPT	Standard penetration test
SS	Suspended Solids
SSF	Small Scale Fisheries
STIs	Sexually Transmitted Infections
TCIP	Tin Can Island Port
TDS	Total Dissolved Solid
TEUs	Twenty-foot Equivalent Unit
THC	Total Hydrocarbon Content
TL	Total Length
TOR	Terms of Reference
U-5MR	Under-five mortality Rate
ULCS	Ultra Large Container Ships
UNCTAD	United Nations Conference on Trade and Development
V	Volt
V	Vanadium
VES	Vertical Electrical Sounding
VG	Vegetation Zone
WHO	World Health Organization
WIs	Work Instructions
WMO	World Meteorological Organization

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LIST OF EIA PREPARERS

The Metaspec Consult Limited EIA project team includes the following team members

NAME	QUALIFICATION	AREA OF SPECIALIZATION
Engr Wai Ogosu	PhD Biological Sciences	Environmental Management
Adeyemi Adewale	M.Phil. Environmental Mgt	Waste Management
Dr Christopher Anyanwu	PhD Public Health	Occupational & Public Health
Dr David Edokpa	PhD Meteorology	Air quality /Climate/Meteorology
Engr. Udoji Nwanne	MSc. Geology	Geology & Hydrogeology
Engr. Segun Ogunjimi	HND Civil Engineering	Water Engineering
Nsikakabasi Etim	MSc Ecology	Vegetation & Wildlife
Dr Raphael Offiong	PhD Geography & Env. Science	Soil
Dr Okotie Amo	BSc Sociology	Socio-economics
Dr Shola Ojesanmi	PhD Marine Biology	Hydrobiology
Dr Ewa Eze Ewa	PhD Marine Biology	Water Chemistry
Adeyeye Kunle	BSc Pure & applied Chemistry	Water Chemistry
Michael Oladeji	MSc. Sociology	Interface Administrator
Cornelia Inoh	PGD Analytical Chemistry	Administrator

EXECUTIVE SUMMARY

ES 1.1 Introduction

Bestaf Marine Services Limited (BMSL) proposed port facility is to serve the robust growth in demand for container port infrastructure and delivery upland through inland waterways thereby avoiding the traffic congestion of downtown Lagos. The BMSL proposed port facility shall offer activities and support services as a custom bonded area and Free trade zone. Messer Metaspec Consult Limited an FMEnv accredited Environmental Consultant prepared this report on behalf of Bestaf Marine Services Limited. The Environmental Impact Assessment (EIA) report presents the findings of the technical studies conducted to evaluate the proposed project's environmental and social impacts. The EIA report describes the affected environment, identifies anticipated and potential environmental and social impacts, and provides recommendations for impact mitigation. The report also includes a detailed synopsis of the proposed Environmental Management Plan (EMP) that will govern the construction and operation of the port facility throughout its life cycle. The EIA and the EMP will apply to all marine and terrestrial environments within the project's Area of Influence (AOI).

ES 1.2 Proponent

Bestaf Marine Services Limited (BMSL) the Project Proponent is a leader in rendering and performing Marine and Container Logistic Services to numerous sectors of the Nigerian economy. BMSL is a subsidiary of Bestaf Trading Company Limited a Nigerian indigenous company.

ES1.3 Study area

The site for the BMSL proposed port facility is approximately 49,900.758 square metre (4.99 hectares) and situated along the bank of the Badagry creek also known locally as Imore creek situated south west of Tin Can Island Port (TCIP) in the Apapa region which lies near the mouth of Lagos Lagoon and is Seven (7) kilometers due west of the center of Lagos across Lagos Harbour**.** The project site location and its water channel is under the jurisdiction of the Nigerian Port Authority (NPA) and it is purely an industrial and commercial environment. The site for BMSL proposed port facility is located at Kirikiri Amuwo-Odofin Local Government Area, Lagos State**.**

ES1.4 Objectives of the EIA

The objectives of the EIA study are to:

- Determine and evaluate the potential positive and significant negative impacts of the jetty sweeping (dredging) activities;
- Proffer appropriate mitigation measures for the negative impacts;
- Provide mechanism for public disclosure of project information.
- Integrate the opinions and views of all stakeholders particularly host communities into the project in order to ensure that the dredging project is both environmentally and socially sustainable;
- Develop an appropriate Environmental Management Plan (EMP); and
- Ensure compliance to relevant statutory requirements and Company good practices.

E1.5 Scope of the EIA

The key premises that affect EIA process were established from the initial stages of the project and have provided the general guidance, framework, and commitment to standards acceptable nationally and internationally.

E1.6 Benefits of the EIA

The benefits of conducting an EIA will among other things include:

- Obtaining authorization; this is required by regulatory authorities prior to commencement of port facility project;
- Providing a forward planning tool for proper environmental accounting with other issues early enough, so as to allow for important decisions to be built into the project design;
- Serves as an adaptive, organizational learning process, in which the lessons of experience are feedback into policy, institutional and project design - enhancement of positive aspects;
- Providing a designing tool that will allow a systematic evaluation of potential environmental problems and risks from the proposed activity and identification of key issues that require special consideration for effective environmental management and controls;
- Guides formal approval, including the establishment of terms and conditions of port facility project implementation and follow-up;

- Incorporate stakeholder analysis by involving all stakeholders through consultation so as to address common problems, impacts and mitigation measures that might be proposed; and
- Informing and assisting management with a view to establishing and achieving long term management objectives and plans associated with specific activities, in order to minimize associated financial and environmental risks.

E1.7 Institutional and Legislative Framework

The regulatory framework that shall guide the implementation of the proposed project include Nigerian statutes such as EIA Act CAP LFN E12 2004, Nigerian Ports Authority (NPA) Act No 38 of 1999, National Inland Waterways Authority (NIWA) Act 2004, Nigerian Maritime Administration and Safety Agency (NIMASA) Act. 2007, Customs & Excise Management Act 2004, Lagos State Environmental Protection Agency (LASEPA) Edict Number 2 of 1994, Lagos State Waterfront Infrastructure Development Law 2009, Lagos State Physical Planning & Urban Development law 2010, BMSL Community Affairs, Safety, Health, Environment and Security policy and the guidelines of Bestaf Trading Company Limited. In addition, the project shall comply with the International Finance Corporation (IFC) Performance Standards for Social and Environmental Sustainability, and other international standards.

ES2.0 Project Justification

ES2.1 Need for the Project

The Lagos Ports are the most functional and busiest Ports in Nigeria. The proposed port facility development is therefore set to reduce the burden of activities in the existing jetties and promote economic business activities. The proposed project will promote and accelerate export and import, boost manufacturing, agricultural production, food security in Nigeria and offer job opportunities in various categories to a number of Nigerian professionals' skilled and semi-skilled craftsmen.

ES2.2 Project Justification

Transport of freight in containers is developing spectacularly. Increasing container transport volumes also put higher demands on the performance of container ports. In view of the current situation of the road traffic congestion in Lagos State and the deplorable condition of the road network in Nigeria diversifying and improving the hinterland accessibility through inland waterways has become a strategic issue for this port as well. The ability to offer cheap and reliable services has attracted the interest of

shippers and carriers in barge transport and this explains the significant growth of container barge transport with the dredging of the Niger River by the Federal Government of Nigeria, creation of inland water ports in Onitsha, Anambra State and in Lokoja, Kogi State, favorable natural circumstances, such as the presence of extensive national and international waterway network with good navigable conditions, have also stimulated the strong development of hinterland transport by barge.

ES2.3 Value of the Project

The value of the proposed port facility project consisting of land acquisition, construction, personnel, equipment, approvals, corporate social operation is put at approximately Ten Billion Naira (N10,000,000,000). A higher percentage of the project amount would be injected into the Nigerian economy through contracts, subcontracts and purchase of construction materials and labour. Consequently, the cost of the port facility with its attended custom bonded activities, free trade zone and container transit will boost industrialization.

2.4 Envisaged Sustainability

2.4.1 Economic sustainability

The port facility project will reduce down time of delivery of containers from overseas vessel in the waters of Nigeria to customers. It shall create a boost in import and export of goods. Thus, the project will be sustainable as funds will be available to operate and maintain the project.

ES2.4.2 Technical sustainability

Innovative technologies such as port digitalization, internet-of-things, augmented reality, use of smarter and fast cranes, application of drones in monitoring the port activities/security that are economically viable and having minimal environmental, social and health impacts shall be utilised in the execution of the proposed facility. The technical sustainability of the proposed project stems from the application of the best available technology (BAT).

ES2.4.3 Environmental Sustainability

The project's activities are guided by national and international environmental regulatory and guidelines and standards. The incorporation of the findings and recommendations of this EIA at various stages of the project shall be strictly ensured so as to guarantee that the project is environmentally sustainable.

The facility is designed and will be constructed to be eco-friendly based on the concept of building with nature (BWN).

ES2.4.4 Social Sustainability

The port facility project has elaborate Social Action Plan and continues consultation with relevant stakeholders throughout the life cycle of the project.

ES2.5 Project Options and Alternatives

ES2.5.1 Do nothing Option

The option will reduce and stunt effective economy and infrastructural development of the nation. This option was rejected because the down time in delivery of containers to customers will persist due to road traffic congestions and it under-exploits a proven strategy to empower the people and the nation.

ES2.5.2 The 'Delayed' Option

This option is usually taken when conditions are unfavourable to project implementation such as in war situation, or where the host community is deeply resentful of the project. The consequence of any delay is that it would be a discouragement for private/local investors.

2.5.3 Modified Project Option

The option of project development is thus the best of all the possible options considered economically, technologically, logistically and environmentally.

ES2.5.3.1 Location Alternative

The location of the site along the Badagry creek helps to focus on building or working with nature rather than counteracting it. The site possesses a naturally favourable conditions for port functioning. The important factors that influence the site selection for the port facility include land availability, availability of water with adequate draught, availability of skilled manpower and availability of infrastructure and utilities.

ES2.5.3.2 Technology Alternative

This alternative implies the application of different technologies that are considered to have better advantages and yet produce similar effects.

E3.0 Project Description

ES3.1 Project Components

The proposed BMSL port facility shall consist of port structures such as a wharf, berth, quay, pier and an existing 206 meters Jetty with intention to construction an additional 125 meters is to be used as a container terminal, custom bonded facility, and a Free trade zone. The Port facility shall comprise of port structures such as a wharf, berth, quay, pier and other infrastructure. The project will have the following facilities and components:

- Concrete quay (340 meters)
- Foundation (Precast driven or bored cast – in-situ concrete piles)
- Construction of open piled quay deck size – 7680m^2
- Truck unloading area
- Container and break bulk storage yard
- Material handling system e.g Cranes (1 unit each of 240 tons, 220 tons, 200 tons and 180 tons) forklift (2 units each of rotary and fixed head), gantry type ship loader etc
- Workshop
- Machine Plant
- Fuel dump (33,000 litres diesel capacity)
- Administrative (8 offices) and Accommodation (10 living quarters) building (860 m^2)
- Security /gate house (53.42m^2)
- Utilities (e.g. Power generation (1 Megawatt 2 units, 500 Megawatts 4 unit, 250 Megawatts 1 unit and 100 Megawatts 1 unit), Borehole (220 metres depth), Water Treatment Plant, lighting, Storm Water drainage system)

ES3.2 Project Phases

The various activities of the Port facility operation can be divided into phases:

1. Pre-Construction/Mobilisation phase;
2. Construction phase;

3. Operation phase; and
4. Decommission phase

ES3.3 Project Schedule

The port facility which is proposed to commence operation in June 2021 with construction phase expected to last six (6) months (November 2020 to April 2021) provided no hi-coughs are experienced along the way.

ES4.0 Baseline Environnemental Conditions

ES4.1 Study Approach

The EIA Biophysical study was based on existing information of the study area, site-specific data gathering fieldwork and laboratory analysis of samples. Judgmental sampling was applied in the selection of study stations, taking into account ecological features, geographical location of communities and past studies in the study area. A total of 7 stations for soil and air quality/noise, 6 stations for surface water and sediment and 3 groundwater stations were sampled. A control was sampled for all biophysical components. The baseline was produced based on a one-season (wet season) field exercise carried out between 26thand 28th August, 2020. A past approved FMEnv Environmental Impact Assessment study report within the project area served as second season (Dry Season) for biophysical parameters.

ES4.2. Bio-Physical Environment

ES4.2.1 Meteorology and Air quality

Five microclimatic parameters were observed and their average measurements were 28 ^{o}C, 84%, 2.3 m/s, 1011 mbar and 6 Oktas for ambient temperature, relative humidity, wind speed, atmospheric pressure and cloud cover, respectively. The dominant wind direction was west-south-westerly. The emission dispersion prospective of the atmosphere within the study regarding the wind profile is modest. A micro weather observation station was set up in an open space representative of the study area and observed for a 24-hour period. Secondary data for 30 years (1989-2019) was obtained from the Nigerian Meteorological Agency in Lagos and literature sources for the study area. The weather situation during field survey showed moderately sunny, cloudy and moderate windy condition. The area features a tropical wet climate zone and falls under the bi-modal rainfall regime with the first phase of rains from March to July and second phase from September to November when the ITD returns

southward from the northern axis. The main dry season is from December to February and is complemented by the Harmattan winds from the Sahara Desert. Average monthly rainfall for 30 years for the project environment (1989-2019) indicates that June and July are the peak rainy periods with average 374 mm and 237 mm respectively, while that of the dryer months December-January falls below 22 mm. The highest maximum temperature for the area was in February and March i.e. 31°C and lower from July - September i.e. 27 °C. The south-westerly wind is the prevailing wind direction between March and October, while the north-easterly prevails between December and February. The average annual wind speed for the area is between 1-4m/s while relative humidity is high all-round the year i.e. within a range of 70 - 89 %.

ES4.2.2 Air quality

Ambient air quality for the study area monitored shows that there were low levels of suspended particulate matter i.e. PM2.5 and PM10 (between 10- 32 $\mu g/m^3$) for all the station sampled. Analysis show that the WHO and World Bank acceptable daily average limit was not exceeded. Nitrogen dioxide (<0.01 ppm), sulphur dioxide (<0.01ppm), ammonia (<0.01 ppm), hydrogen sulphide (<0.01ppm) were well below the national and international permissible limits across the survey stations. Ambient background noise level ranged from 40 to 69 dB (A). Higher levels were recorded during times of reasonable noise from human activities, vehicular movement and generating sets used by construction workers around project environment. The average elevation for the project site range between 0 - 6 m. Ambient air quality measured for observed pollutants indicated a very low concentrations and far below set limits. Noise levels monitored were moderate and within ambient standards, except for periods of increased human activities which increases the noise levels.

ES 4.2.3 Vegetation

It is a mangrove swamp vegetation belt characterized by ecological stressors such as fluctuating salinity, periodic inundation, muddy soil etc with minimal anthropogenic disturbance. Typical of the vegetation is the dominant *Avicennia germinans* (Black mangrove) that has developed a very specialized root system with the pneumatophore for life in this tough ecosystem making over 85% of the total plant cover. The site is a brownfield undergoing continuous development and almost devoid of vegetation except for scanty grass community at the fringes and two stand-alone economic trees with insignificant ecosystem services. The Kirikiri town area is originally characterized by the riparian vegetation, however developmental activities going on has obliterated major signs of the original vegetation except

for a few herbs and grass community along the fence area and just around the drainage. The only significant Vegetation cover is at the Prison Barrack which is over 1km away from the project site and will not be impacted by project activities since the barrack infrastructure is not accessible for business use. The vegetation here is abandoned and fallowing farmlands, grass/herb community and a few community of economic trees. There are a total of 33 species, comprising 13 tree/Shrub species most of which are economic trees, 13 herbaceous plants, and 7 grass/sedge species all belonging to a total of 20 families with Asteraceae and Poaceae having 4 species each as the dominant families. The conservation status clearly shows that all surveyed species were either of least concern to conservation threats or they are Data deficient (DD).

ES4.2.4 Wildlife

The fauna in the study area have largely been hunted, displaced and persecuted by human activities. The diversity indices for the entire study area was conducted across all faunal groups. The avi-fauna group was the richest, recorded a total of 14 species, followed by the mammalian and reptilian group with 8 species each.

ES4.2.5 Soil

The pH of the moist soils ranged from 5.86 to 8.06 for top-soils with mean of 7.3 and control at 6.23 in wet season compared to the DIL EIA 2018 dry season result range from 4.34 – 5.24 and mean of 4.79. The subsurface soils with means of 8.1 ranged from 7.14 – 8.93 and control station at 8.22 in wet season compared to DIL EIA 2018 dry season mean of 4.67 with range at 4.28 -5.16 respectively. The soils of the study area show considerable low concentration of iron, lead, zinc, nickel. The mean concentrations of oil and grease for topsoil 0.4 mg/kg for subsoils, 1.4 mg/kg and 1.22 and 0.83 mg/kg for the control soils in the rainy season. The values obtained in the DIL EIA 2018 dry season were 0.22 and 0.16 mg/kg soil in the top and sub soil horizons respectively) were lower. The soil macro-fauna identified through visual observation in the study area include various arthropods (*Myricaridstriata*, *Dorylusfimbriatus, Glomensmarginata*), Annelids (Earthworms) and Nematodes (*Acanthamoebapolyphaga, Acrobeloidessp, Porcelliascraber*). These organisms are primary consumers; decomposers, mixers and utilizers of energy stored in plants and plant residues, and contribute to the recycling of nutrients.

ES4.2.6 Land Use /Cover

The land within the facility and its surrounding is used solely for commercial and residential purposes. The information obtained from the land cover/land use satellite imagery of the project area of the port facility project showed that the area (spatial boundary of 2 km) measured about 12.6 km^2. The primary forests (mangrove) occupied approximately 40%, secondary forest 0%, Sparse vegetation and bare soil constituted 0% built up area (urban/industrial) 55%, water constituted about 5% of the land area as meandering Badagry creek channel.

ES4.2.7Geology/Hydrogeology

ES4.2.7.1 Geomorphology

The study area lies in the creek zone of tropical Southwestern Nigeria situated within the lagoon-beach belt. The dominant properties of the soils are thick layer of poorly consolidated organic soil that shows no evidence of soil structure and coarse soil particles. Dark greyish brown colour of the sub-surface (>60cm) soil which is a reflection of the permanent water regime of the deeper layers due to the dominance of anaerobic conditions.

ES4.2.7.2 Groundwater

The hydrogeological findings indicated that the aquifer in the area is porous, permeable and prolific. The observed wide ranges and high standard deviations and mean in the geochemical data are evidence that there are substantial differences in the quality/composition of the groundwater within the study area. Groundwater sample pH ranged from 6.5 to 6.9, control was 6.90 indicating slightly acidic to neutral and the EIA 2018 dry season mean was slightly alkaline at 8.4. Total Dissolved Solids (TDS) ranged from 227 to 642 with mean at 492 compared to the control at 310 and EIA 2018 result of 137 in dry season. The results all compiled to FMEnv drinking water limit of 500mg/l. Turbidity values did not comply to FMEnv and WHO limit of 1 NTU and 5 NTU respectively in rainy season ranged from 2.27 – 6.42 NTU with 3.6 NTU mean and dry season EIA result of 14.24. Total hydrocarbon content (THC) for the groundwater within the study area and hand dug wells sampled within the community were <0.1mg/l indicating absence of hydrocarbon contamination. The values recorded for wet season were relatively lower probably due to dilution from availability of rainwater compared to the secondary data values (DIL EIA 2018) obtained during dry season.

*ES4.*2.8 Aquatic Environment

ES4.2.8.1 Surface water

The average pH for Badagry creek was 7.40 and control was 7.38 respectively indicating being neutral characteristic. The average TDS of the creek was 5012 μS/cm and 4628 μS/cm for the control respectively. Nutrient status of the water is primarily productivity index and gives a true indication of abundance and activity of aquatic life. The high level of total hydrocarbons in the creek is a reflection of human inputs associated with shipping/boating, surface run-off and oil production activities within the zone. Data on the microbiology of the surface water samples collected from the area are summarized in Table 4.21 shows Total heterotrophic bacterial (THB) load ranged from 2.0-2.5 x 10^3 cfu/ml with a mean of 2.2 x 10^3 cfu/ml and (THF) load ranged from 1.0-1.5 x 10^3 cfu/ml with a mean of 1.2 x 10^3 cfu/ml. The percentage of hydrocarbon utilizing bacteria (HUB) and hydrocarbon utilizing fungi (HUF) are however high suggesting a high level of hydrocarbon pollution in the creek. The faecal coliforms ranged from 16 to 31 MPN/100ml and 9.0 MPN/100ml at the control station respectively.

ES4.2.8.2 Sediments

The average sediment pH was 6.50<pH>6.50 in the entire project study area. The nature and quality of sediment is determined from information on the status of the physico-chemical properties.

ES4.2.8.3 Hydrobiology

ES4.2.8.3.1 Phytoplankton

The phytoplankton community were represented by five (5) taxonomic groups in the wet and dry season; Bacillariophyceae, Dinophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae with a total number of fifty-nine (59) species.

ES4.2.8.3.2 Zooplankton

The zooplankton fauna comprised of Rotifers, Molluscs, Crustaceans (Cladocera, Copepods and decapods) and Pisces in both climatic regimes. The Crustaceans were the most dominant occupying >50% of the zooplankton community.

ES4.2.8.3.3 Benthic fauna

The benthic fauna was represented by four (4) major taxonomic groupings: Polychaetes, Crustaceans, Gastropod Molluscs and Bivalve Molluscs and comprised of eighteen (18) species. The Polychaeta

dominated the benthic fauna population comprising of 48.11% and suggestive of biodegradable organic matter inputs in the sediment.

ES4.2.8.3.4 Fish and Fisheries

Fishery resources along the Badagry creek are multi-species stock largely exploited by fisher folks predominantly artisanal fishers operating dug-out wooden canoes of various sizes. The major fish communities exploited by the artisanal fisher folks is the estuarine and creek sciaenid sub-community. The demersal target species exploited are: brackish water catfish (*Chrisichthys*), grunters (Pomadasyidae), groupers (*Epinephelus*), and the estuarine white shrimp (*Palaemon*). Thirty-one (31) fishery resources were recorded from the study area using various fishing gears comprising Gill net, Fish fence, Cast net, Hook and line, Drag net, Wire mesh basket and basket trap. A checklist of the fishery resources sighted and confirmed by fisher folks, preferred fishing location and peak periods of exploitation. The artisanal canoe fleets of the study area comprise mainly of the dug-out canoes without engines which were observed to be the most predominant fishing craft in the study area with sizes ranging from 2 to 5m. One to three fisherfolks on board the dugout boats extending fishing gears along fishery resources hotspots along the riparian mangrove vegetation. Fishing folks were observed to have a variety of fishing gears due to seasonal changes in both species and abundance status. Survey of the fishing gear used in the study area indicates the use of Gill nets, Fish fence, Cast nets, Hook and lines and Seine net.

ES4.3 Socioeconomics

ES4.3.1 Community History, Religion and Social Organisation

An estimated three hundred (300) people made up of indigenes, residents, women, men and youths were randomly interviewed. A total of a Sixty (60) questionnaires were distributed, filled and retrieved. This was done to validate and/or complement the information given by the general respondents. The ancestral owners of the host community (Kirikiri) are the Awori Family-the family of Imore and Apapa Beach who later sold the land to Alhaji Nurudeen Lasis Shokunbi family and Alhaji Babatunde Cardoso. After the Land use decree of 1978, all lands were vested on the government, holding same on trust for the people by either the federal, state or local government depending on where the land situates. Kirikiri Town is under Amuwo-Odofin Local Government Area of Lagos State, Nigeria. According to the Key informants over 70% of the total internally generated revenue for the Local government of Amuwo Odofin comes from Kirikiri. It is the industrial and business hub of Apapa

area with hundreds of companies operating in the area. These included but not limited to the following—Swift Oil, Techno Oil, Bovas, Total, Chisco Oil, MRS Oil, Henry & Henry, SCOA Motors, Taraba Fishing, Karflex Fishing, Vanguard Newspaper, The Sun Newspaper, Sara phone, Elega Stiff to mention but a few. It is unfortunate to note however that despite the fact that Kirikiri can be compared to the proverbial bird that lays the golden egg, Kirikiri Town has nothing to show for it especially in terms of both social and physical infrastructural facilities. The roads leading into the Town and the link roads are in very deplorable conditions. Traffic congestion/jam is a regular feature as tankers belonging to NUPENG and major oil companies located in the area block the entire roads which is further compounded by container terminals and car sellers.

ES4.3.2 Settlement Size and Demography

The population of Kirikiri Community, a subset of Lagos is broad at the bottom with children and adolescent 14 years and below comprising 36 percentage of the total population. The working population class/ age of 15-65 years comprised of 66%. Almost 90% of the people that live and work in the area are children or young adults on the age bracket of 0-40, estimated at 250,000. The population is therefore very young and the implication is that it will continue to grow rapidly in the near future. The household size was estimated at 6.1, which is about the same as the National average with 50 households surveyed in the study and they reported 328 household members. The wide disparity from demographic perspective in the sexes is explained by the large proportion of migrants in the community who are more likely young males who have come to look for greener pastures. The 1996 projection of the population was 13,999 while 2020 when this survey was carried out, it was 21,166.

ES4.3.3 Public Consultations

The primary concerns of the people focus on the quick construction of the international standard port facilities (container terminal) considering the enormous benefits they have been getting from similar projects. Their suggestions therefore, bother on how this proposed project will improve their socioeconomic conditions and lessen the negative impacts on their livelihoods. Community members appreciated and gave several instances of how they have been under-developed suffered from the activities of other companies without much benefits to show for their operations, its social responsibilities, carrying the communities along. However, all have high expectations that the project under consideration will turn things around for them the need for development is therefore,

imperative. It is against this backdrop that communities that are stakeholders and hosts to the project come with a long list of suggestions, some usually outside the scope and budget of companies that are put in place to maximize opportunities available. The Expectations, Priority Needs/Demands and Fears of the people are:

- Provision of scholarships, toilet facilities and assistance with fishing occupation (gears and equipment)
- Upgrading of the existing health centers.
- Provision of credit facilities for the women folk.
- Provision of employment and youth empowerment
- Provision of potable water
- Building of a more befitting Town hall/civic hall
- Monitoring and subsequent reduction of environmental nuisance.
- The road built by the government should have overlay and a good drainage system and construction of new ones.
- Building of more schools.

ES4.3.4 Road traffic Study

Over the 7-day survey period, the highest volume of traffic was recorded on a Monday with a total of 1619 units with other vehicles comprising private cars, small buses, tricycles and vans having the highest number of 611 units. The lowest was recorded on a Sunday with a total of 886 units due to minimal activities on this day being a weekend and work-free day for most people. The weekly average time interval volume of traffic was highest between 6:01hr – 9:00hr and 9:01hrs – 12:00hr with 2219 unit and 2199 units respectively. Container trucks and tanker make up 15% and 9% of the total vehicular traffic respectively surveyed for this period. Motoring accident constitutes a grave problem in the community and adjoining Apapa Oshodi express way. A problem in the study community because there are no paved, good and fast road transport developments in the communities due to the rugged nature and hydrology of the terrain due in part to lack of maintenance and industrial congestion in the area.

ES4.3.5 Marine Traffic study

The highest volume of traffic was recorded on a Monday with a total of 499 units with speedboat which is used majorly for the transportation of passengers having the highest number of traffic count of 429units. The lowest was on a Sunday with a total of 49 units which is due to minimal activities on this day being a weekend and work-free day for most people. The weekly average time interval volume of traffic was highest between 6:00hr – 9:00hr and 15:01hrs – 19:00hr with 711 units and 687 units respectively. These periods are the time that passengers are either going to work or returning. Speedboat had 87% of the total waterway traffic surveyed while vessels and barges which are the traffic of major interest in this study both had <2% of the total waterway traffic volume.

E.4.4. Human Health Environment

ES4.4.1 Health Care Facilities

In the communities assessed, there were few health facilities/ centers, one private primary health centre run by the catholic church, the saint, Josephs Primary Health centre, Kirikiri, the public primary Health Centre compound has been taken over by the Nigerian Police Force. There is no General Hospital in Kirikiri, the nearest is the Apapa General Hospital not far from Kirikiri town. Major cases are referred to Apapa General Hospital, Lagos University Teaching Hospital Lagoon Hospital; Ajoromi General Hospital, The General Hospitals handle more cases that are difficult. The Model Health centre at Saint Joseph's Catholic Church was established primarily to help parishioners. An outpatient consultation, observation and treatment centre handles cases like, delivery, health education, immunization, treatment of minor injuries, provision of drugs. It is to be noted that the Model Health centre is newly commissioned and well equipped to provide quality Health care services. The community members agree that they are satisfied with the services. Doctor patient/contact time is short but some people live further than 1.5km to the hospital which is the recommended travel distance. The health center is an NIHS accredited model/ National health insurance accredited centre. Traditional Medical practitioners are many and readily come to aid orthodox medical practice. These people lack adequate training in hygienic procedure. Although some TBA has been trained by NGOS, some by Oil giants, only few of them are resident in the host community.

ES5.0 Associated and Potential Impacts

The impacts of the various aspects of the project were classified as positive (beneficial) impacts, negative impacts; long/short term impacts, reversible/irreversible impacts, direct/indirect impacts; and

the risks and hazards associated with these impacts were also assessed and evaluated. The ISO 14001 and Leopold guidelines were used for impact identification and evaluation. The proposed port facility project will have potential impacts that are both positive and negative. The identified impacts for the port facility activities are.;

Pre-construction phase

The potential impacts from the various activities of the pre-construction phase are as follows:

• Vehicular Emission: The emission of noxious substances that could occur from vehicles used in supplies might cause local air quality impairment.

• Traffic: Increase in traffic in and around the project area as a result of project activities and population influx is considered medium impacts.

Construction phase

The potential impacts from the various activities of the construction phase are as follows:

• Air Pollution: The use of construction equipment will lead to air pollutant emission. The generation of dust from construction activities at the onsite fabrication yard and the construction/installation areas will lead to visibility reduction.

• Noise: Noise from construction operations such as piling, power generation, and other related activities such as short-term Jetty floor sweeping exercise are considered to have an impact on hearing and health.

• Effluent Discharge: The discharges of ballast water into the sea during construction activities from barges could also lead to sea pollution. Hazardous and non-hazardous solid wastes, sewage and spillages from spent oil will also have a medium environmental impact. Storm water discharge will also cause degradation of marine water quality. The discharge of sanitary effluent will lead to shoreline surface water contamination and sea pollution with possible impact on the benthic communities.

• Traffic: Increase in traffic in and around the project area as a result of project activities is considered medium with associated air and noise pollution, with socio-economic impacts.

• Waste Generation: Waste disposal (sewage), spillages from spent oil and other solid waste will also have a medium environmental impact.

• Socioeconomic impact: Increased pressure on existing infrastructure, and diffusion of culture and traditions, which might result from an increase in population, cost of living and inflation. These impacts have negative, local and short-term effects, which are reversible.

Operation and maintenanace phase

• Waste Generation (emissions, effluents and solids): Emissions from operational activities could impair air quality which could pose a serious health threat.

• Solid Waste: The management of solid wastes could provide opportunities for employment and contract resulting in increased income. Improper management of the solid wastes could result in contamination of surface and groundwater, impairment of health of aquatic life, increase in the level of disease vectors and increase in morbidity rate thereby putting pressure on existing healthcare facilities.

• Effluent Discharge: The discharges of ballast water into the sea during construction activities from barges could also lead to sea pollution. Hazardous and non-hazardous solid wastes, sewage and spillages from spent oil will also have a medium environmental impact. Storm water discharge will also cause degradation of marine water quality.

• Oil Spillage: Improper/accidental discharges of waste oils into water resulting from operational activities, vessel discharges and leakages could deteriorate the recipient environments and the health of aquatic life.

Positive Impacts:

Some positive impacts of the project activities include:

• Utilization of inland waterways for delivery of containers upland

• further decongestion of the Apapa port and reduction of cargo transit time to upland ports

• increase in revenue generation for Federal Government of Nigeria, the Lagos State Government and the Amuwo-Odofin LGA

• increasing rate of employment / contracting opportunities

• future industrial and maritime business opportunity growth.

Demobilization

The potential impacts at the expiration of the life span of the project include emission of exhaust fumes/ noxious gases to the atmosphere, erosion of river banks from increase in water traffic and disruption of fishing and water transportation. Movement on water could also result in water traffic accidents resulting in Injuries, drowning and death as well as insecurity.

Cumulative Impacts

In this instance the cumulative impacts may arise from the operation of other companies operating along the Badagry Creek and those within the Kirikiri Lighter Terminal area. The construction and operation of the port facility simultaneously with the operations of existing facilities shall also create cumulative impacts in-terms of area and fixed point project.

E6.0 Mitigation measures

By clearly establishing a cause and effect relationships based on an integrated list of significant impacts appropriate mitigation measures for significant negative impacts have been developed. The significant negative impacts have been mitigated from either high or medium significant impact to either medium or as low as reasonably practicable (ALARP). Practical proposals for the enhancement of significant positive impacts have also been made.

E7.0 Environmental Management Plan

An environmental management plan has been designed for the Port facility project to guide the implementation and assessment of the effectiveness of the mitigation measures in controlling identified moderate/major impacts. The plan provides for management commitment/ responsibility, training/ awareness programmes for the workforce, audit and compliance monitoring of the various environmental components.

E8.0 Conclusion

The environmental impact assessment has identified the adverse environmental, social and health impacts associated with the Port Facility project. The implementation of the proposed mitigation measures and strict adherence to the environmental management plan shall guarantee the environmental sustainability of the project. The economic, social, technological and environmental gains for the local community and governments (LGA, State and Federal) from the Port facility project and for BMSL outweigh any residual impacts.

CHAPTER ONE
INTRODUCTION

1.1 Background Information

Maritime transport (shipping) conveys over Eighty-two (82) percent of world trade, therefore port and harbour development projects (terminal, berthing facilities, turning basins) are usually associated with long-term economic benefit for development (Review of Maritime Transport 2019 by United Nations Conference on Trade and Development (UNCTAD) October 2019). Technological advancement in marine transport and the integration of transport by land, sea and air have increased the complexity of the port and harbour development. Construction and operation of new port and terminal facilities or the expansion of existing facilities involves the reclamation, clearing and paving (or compacting) of land for loading/unloading zones, bulk dry/liquid and containerized cargo storage areas, fuel depots, buildings, and roads; the alteration of coast lines for construction of breakwaters, shipyards, dockyards, wharves, piers, vessel berths, and the transformation of the seabed to establish vessel basins (including areas for vessel turning) and navigation channels through dredging. The Bestaf Marine Services Limited (BMSL) proposed port facility is to serve the robust growth in demand for container port infrastructure and distribution upland through inland waterways thereby avoiding the traffic congestion of downtown Lagos. In recent years, container demand has increased at a rate 2.5 times Nigeria's GDP growth or around 13 percent annually (Nigeria's renewal: Delivering inclusive growth in Africa's largest economy by McKinsey Global institute July 2014). The BMSL proposed port facility shall offer activities and support services as a custom bonded area and Free trade zone.

The Environmental Impact Assessment (EIA) report presents the findings of the technical studies conducted to evaluate the proposed project's environmental and social impacts. The EIA report describes the affected environment, identifies anticipated and potential environmental and social impacts, and provides recommendations for impact mitigation. The report also includes a detailed synopsis of the proposed Environmental Management Plan (EMP) that will govern the construction and operation of the port facility throughout its life cycle. The EIA and the EMP will apply to all marine and terrestrial environments within the project's Area of Influence (AOI).

1.2 Proponent

Bestaf Marine Services Limited (BMSL) the Project Proponent is a leader in rendering and performing Marine and Container Logistic Services to numerous sectors of the Nigerian economy. BMSL is a subsidiary of Bestaf Trading Company Limited an indigenous company incorporated as a limited liability company under the Companies and Allied Matters Act 1990 in May 2008. The company under its corporate Head office is located at No 2, Tin Can Island Port Road, Apapa –

Lagos, Nigeria and the proposed port facility at G-Cappa Yard, off Cardoso Street, Kirikiri Lighter Terminal zone.

1.3 Project Location

The site for the BMSL proposed port facility is approximately 49,900.758 square meters (4.99 hectares) and situated along the bank of the Badagry creek also known locally as Imore creek situated south west of Tin Can Island Port (TCIP) in the Apapa region which lies near the mouth of Lagos Lagoon and is Seven (7) kilometers due west of the center of Lagos across Lagos Harbour. (See Figure 1.2) The project site is situated in an area under the jurisdiction of the Nigerian Port Authority (NPA) and it is a purely industrial and commercial environment. The site for BMSL proposed port facility is located in Amuwo-Odofin local government area in Lagos state which shares its boundaries with Ajeromi/Ifelodun Local Government to the East, Ojo Local Government to the West, the Badagry Creek to the South and Isolo/Alimosho and Shomolu Local Government to the North. (see Figure 1.1) It has two distinct geographical spheres of upland and riverine areas. The Site is located within the geographic area of the three busiest port facilities in Nigeria namely Apapa, Tin Can Island and Snake Island port facilities.

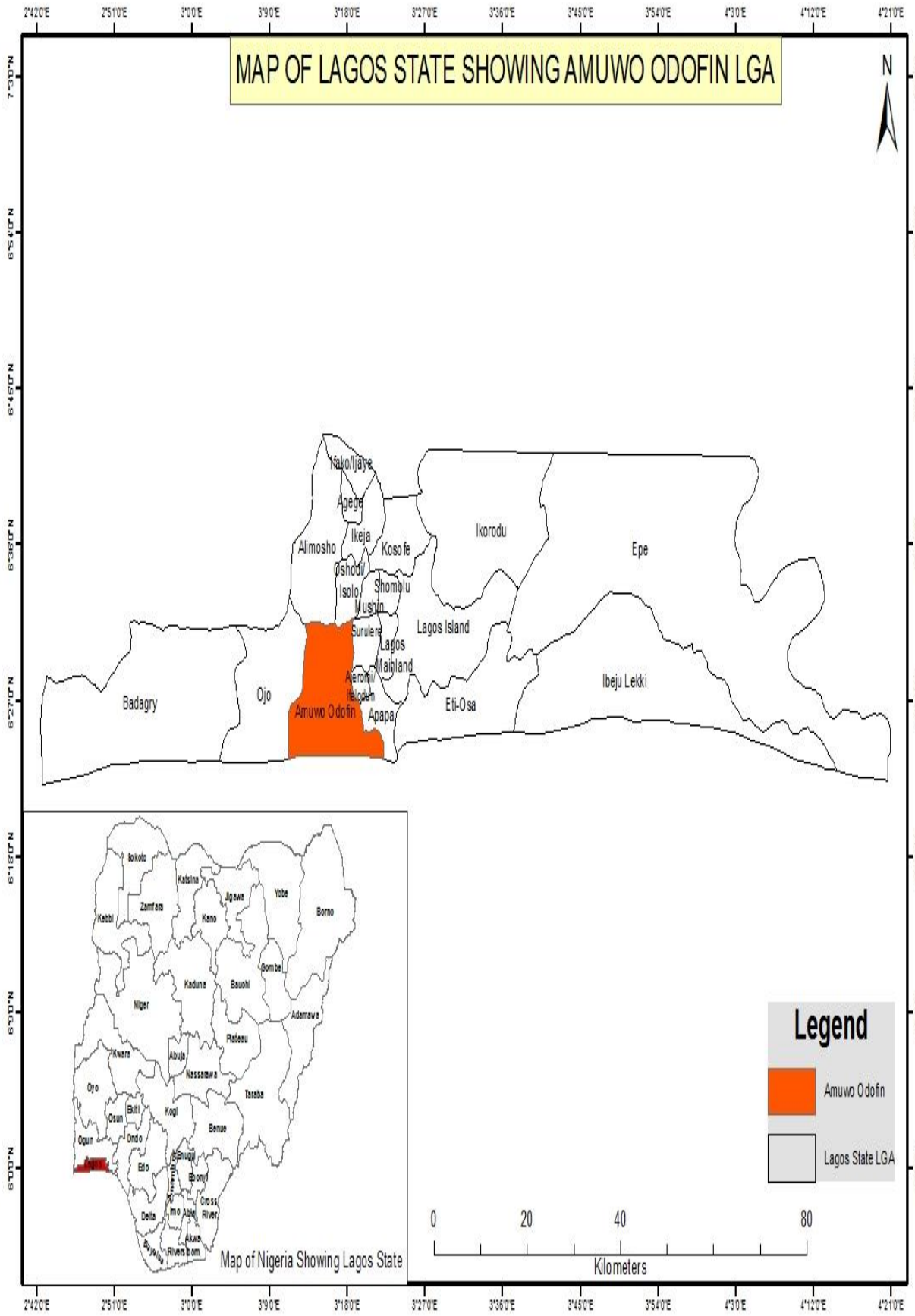


Figure 1.1: Map of Nigeria showing Lagos State and Lagos State showing Amuwo-Odofin LGA

Figure 1.2: Proposed port facility site

1.4 Objectives of the EIA

The objectives of the EIA study are to:

- Determine the baseline conditions of the environment (biophysical, socio-economic and health);
- Determine and evaluate the potential significant positive and significant negative impacts of the port facility project activities on the identified environmental sensitivities as well as the interactions between the sensitivities in relation to the biophysical, socio-economic and health aspects of the receiving environment;
- Proffer cost-effective mitigation measures for the negative impacts, and where possible, enhance the positive impacts that will further assure the environmental, technological, economic and social sustainability of the project;
- Integrate the opinions and views of all stakeholders particularly host communities into the project in order to ensure that the port facility project is both environmentally and socially sustainable;
- Develop an appropriate and cost effective Environmental Management Plan (EMP);
- Incorporate the recommendations of the EIA process into detailed project decisions.

1.5 Scope of the EIA

The general scope of the EIA covers all the activity that constitutes this project. It will outline the techniques and methodologies to be used in generating data, including the description of the data sources. The following broad categories will be covered:

- Literature review;
- Baseline data acquisition;
- Prediction and evaluation of potential impacts;
- Determination of appropriate mitigation measures;
- Environmental management plan;
- Consultation/stakeholder engagement;
- Report preparation.

1.5.1 Terms of Reference (TOR)

The Terms of Reference (TOR) for this EIA is based on standard requirements of Federal Ministry of Environment (FMEnv) and international standards. The EIA establishes the environmental issues that will result from the operation of the proposed facilities within the study area, quantify and

evaluate their impacts, suggest and evaluate alternatives with regard to cost effectiveness and environmental friendliness. In addition, it will recommend mitigation measures and put in place an Environmental Management Plan (Post-EIA). BMSL recognizes the importance of comprehensive environmental planning and management to the success of this project and is committed to undertaking the necessary studies needed to understand the environmental system of the project in order to address areas where significant impacts (physico-chemical, ecological, and socio-cultural) may be experienced. Accordingly, the Terms of Reference (TOR) for the EIA are tailored towards achieving the following:

- Establish a baseline database covering detailed ecology, meteorology and socio-economic condition of the project area, via a statutorily required environmental assessment;
- Identify, evaluate and predict the potential environmental impacts of the port facility project development plan;
- Develop control strategies with a view to mitigating and ameliorating significant impacts the project would have on the totality of other measurable environmental characteristics;
- Identify the best practicable environmental options or alternatives to execute the project;
- Identify relevant regulations, local and international, including protocols and treaties signed by the Nigerian Government;
- Carry out an inventory and consultation of stakeholders in relation to the project and ensure they are carried along on major decisions; and
- Prepare a detailed EIA report, which will form the basis for the issuance of the necessary approvals by the Federal Ministry of Environment (FMEnv) as well as the incorporation of EIA recommendations into the port facility project detailed design and other stages of the project development.

1. 6 Benefits of the EIA

The advantage or gains of conducting an EIA will among other things include:

- Obtaining authorization required by regulatory authorities prior to commencement of port facility project;
- Providing a forward planning tool for proper environmental accounting with other issues early enough, so as to allow for important decisions to be built into the project design;
- Serves as an adaptive, organizational learning process, in which the lessons of experience are feedback into policy, institutional and project design - enhancement of positive aspects;
- Providing a designing tool that will allow a systematic evaluation of potential environmental problems and risks from the proposed activity and identification of key issues that require special consideration for effective environmental management and controls;
- Guides formal approval, including the establishment of terms and conditions of port facility project implementation and follow-up;
- Incorporate stakeholder analysis by involving all stakeholders through consultation so as to address common problems, impacts and mitigation measures that might be proposed; and
- Informing and assisting management with a view to establishing and achieving long term management objectives and plans associated with specific activities, in order to minimize associated financial and environmental risks.

1.7 FMEnv EIA Premises/ Process

The key premises that affect EIA process were established from the initial stages of the project and have provided the general guidance, framework, and commitment to standards acceptable nationally and internationally. The premises include:

- The area is within the exclusive jurisdiction of the Federal Government of Nigeria. Therefore, Federal laws, including the Environmental Laws apply;
- The project recognizes the laws and regulations of the Federal Republic of Nigeria as represented by the Federal Ministry of Environment, the State and the Local Governments Environmental Agencies, and insist that best options will be adopted for the project execution;
- The work will be designed and operated to comply with local, national laws and guidelines together with all the international protocols, agreements and conventions which Nigeria is signatory to;
- The agreements and understanding reached with third parties including government officials during the course of the EIA process will be respected and honoured;
- Extensive consultations have and will continue to be held with Federal, State, and Local Governments together with the host communities and

- An Environmental Management Plan (EMP) was developed and shall form the cornerstone for managing the significant impacts.

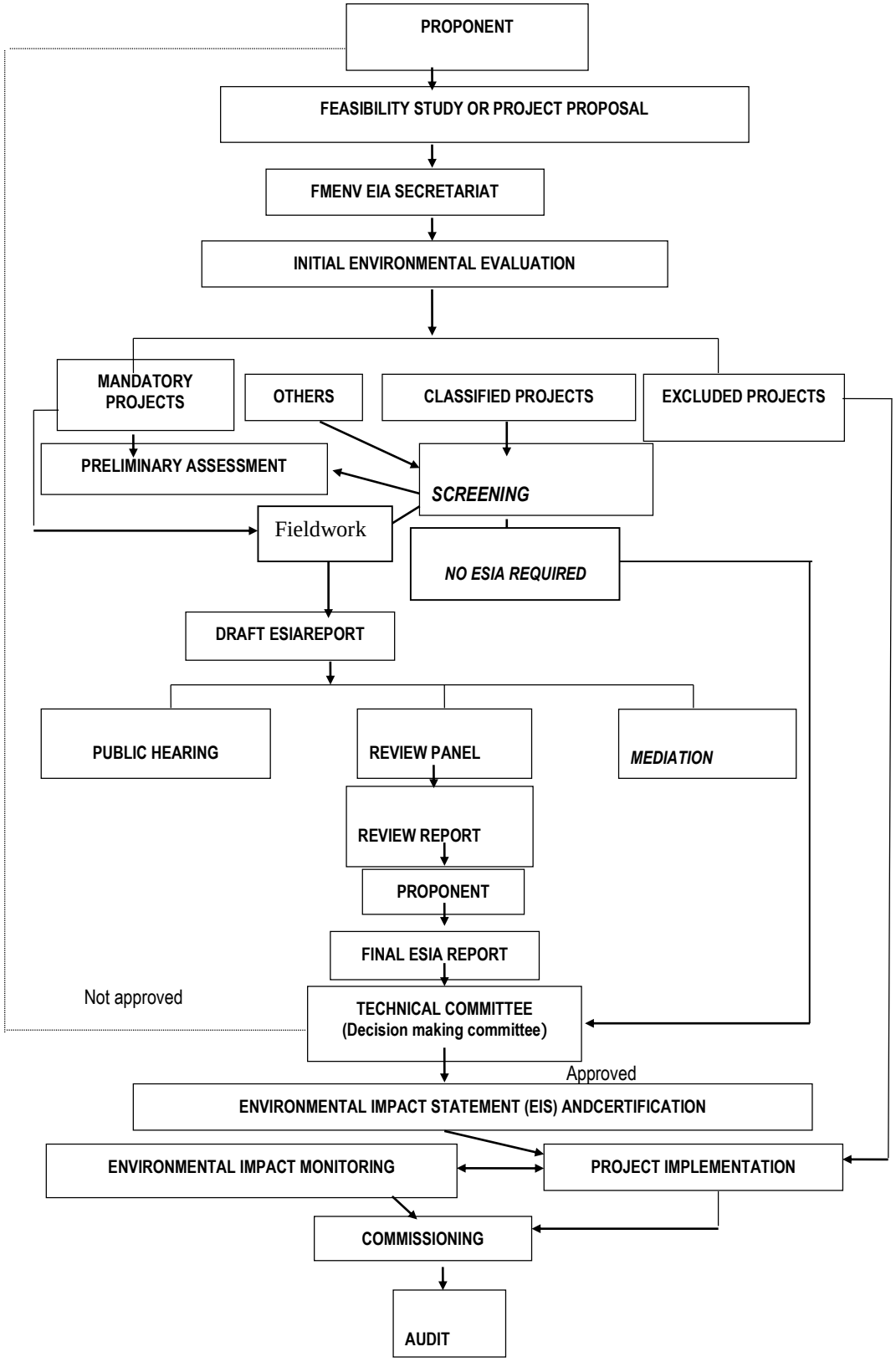


Figure 1.3: Flow Chart of the FMEnv EIA Procedure

(Source: EIA Procedural Guidelines, 1995)

1.8 Policy, Legal and Administrative Framework

Operations and all forms of development activities in the Nigerian Maritime sector are regulated by several specific laws, guidelines, and standards. These statutes together with applicable International Conventions and with Company health, safety and environment (HSE) Policy provide a basis for the EIA of the Port Facility project.

1.8.1 Federal Regulations/Guidelines

1.8.1.1 The Environmental Impact Assessment Act CAP LFN E12 2004

The Environmental Act makes EIA mandatory for all new major public and private projects in Nigeria. It sets out to:

- Consider the likely impacts and the extent of these impacts on the environment before embarking on any project or activity;
- Promote the implementation of appropriate policy in all federal lands consistent with all laws and decision making processes through which the goal of this Act may be realized; and
- Encourage the development of procedures for information exchange, notification and consultation between organizations and persons when the proposed activities are likely to have significant environmental effects.

1.8.1.2 National Environmental Protection (Effluent Limitations) Regulations (S.I.8) of 1991

This regulation makes it mandatory for industries generating wastes to install anti-pollution and pollution abatement equipment on site. The regulation is specific to each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the ecosystems. Appropriate penalties for contravention are also specified in the regulation.

1.8.1.3 National Environmental Protection (Pollution Abatement in Industries Producing Waste) Regulation (S.I.9) of 1991

The National Environmental protection (Pollution Abatement in Industries Producing Waste) Regulation of 1991 regulates the release of toxic substances, requirement for pollution monitoring unit, machinery for combating pollution and contingency plan by industries. It also provides that industries producing wastes should submit lists and details of chemicals used by such industries to FMEnv as well as permissible limits of discharge into public drains.

1.8.1.4 Federal Ministry of Environment (FMEnv) National Guidelines for Environmental Audit in Nigeria 1999.

Guidelines prepared by Federal Ministry of Environment to assist operators, environmentalists and other stakeholders to conduct effective environmental compliance audits.

1.8.1.5 Guidelines and Standards for Environmental Pollution Control in Nigeria 1991

The FMEnv Guidelines and Standards for Environmental Pollution Control in Nigeria Part I, Chapter 2 contains the water quality guidelines for various industries. Section 2.2 of the same chapter states requirements for water and wastewater monitoring. The Ministry requires that industries monitor their effluents in-house while FMEnv will also crosscheck the effluent characteristics to ascertain the degree of compliance with the guidelines. Contained in Chapter 3 are interim gaseous emission and ambient air quality limitations. Section 3.1 of this chapter states "Guidelines for emission limits from stationary sources represent maximum allowable levels of pollutants from a site, process, stack, vent, etc. with the objective of achieving a desired air quality". The prescribed emission limits depend on social and political considerations.

Section 3.2 pertains to ambient air standards and states. "Since emissions from industries and other sources have impact on ambient air, it is of utmost importance to prescribe guidelines for safe levels of air pollutants tolerable to humans, aquatic organisms and vegetation". Guidelines for Nigerian ambient air limits for conventional pollutants and specific substances in the air are listed.

1.8.1.6 The National Environmental Protection Management of Solid and Hazardous Wastes Regulations (S.I.15, 1991)

Management of Hazardous and solid wastes regulation defines the requirements for groundwater protection, surface impoundment, land treatment, waste piles, landfills, incinerators, etc. It also describes the hazardous chemical products and dangerous waste constituents.

This Regulation provides that the objective of solid and hazardous waste management shall be to:

- Identify solid, toxic and extremely hazardous wastes dangerous to public health and environment,
- Provide for surveillance and monitoring of dangerous and extremely hazardous wastes and substances until they are detoxified and safely disposed,
- Provide guidelines necessary to establish a system of proper record keeping, sampling and labelling of dangerous and extremely hazardous wastes,
- Establish suitable and provide necessary requirements to facilitate the disposal of hazardous wastes;
- Research into possible re-use and recycling of hazardous wastes.

1.8.1.7 Forestry Law, CAP 51, 1994

The Forestry Act 1958 which was amended as the Forestry Law CAP 51 (1994) prohibits any act that may lead to the destruction of or cause injury to any forest produce, forest growth or forestry property in Nigeria. The law prescribes the administrative framework for the management, utilization and protection of forestry resources in Nigeria, which is applicable to the mangrove and other forests of the Niger Delta.

1.8.1.8 Land Use Act of 1978

This law was enacted on 28th March, 1978, principally to facilitate the availability of development land to individuals, groups, institutions and governments. The law provides for the granting of statutory rights of occupancy over urban land and of customary rights of occupancy over rural land. Both types of rights require the issuance of certificates of occupancy. Furthermore, the law specifies the maximum sizes of land which may be granted to each applicant for various reasons-crop farming (500 ha.); livestock grazing (5,000 ha); quarrying of building materials (400 ha). The law forbids the surrender or alienation of rights of occupancy or even the certificates conveying those rights, except under very stringent conditions.

1.8.1.9 Nigeria's National Health 2014 Act 2014 (NHA)

Nigeria's National Health 2014 Act 2014 (NHA) was signed into law on October 31, 2014. It provides a legal framework for the regulation, development, and management of Nigeria's Health System. This study assessed the knowledge and perception of the NHA 2014 by health professionals.

1.8.1.10 National Environmental Standards and Regulation Enforcement Agency (NESREA) Act 25 of 2007

This National Environmental Standards and Regulation Enforcement Agency was established with the responsibility to ensure the regulated community complies with all environmental laws and regulations in Nigeria.

- **S.1.22 National Environmental (Surface and Groundwater Quality Control) Regulations 2011.**

As the title indicates, it is meant to restore, enhance and preserve the physical, chemical and biological integrity of the Nations water (Surface and groundwater) The waters shall be maintained in a safe and satisfactory condition from all manner of industrial and anthropogenic activities such

that the water can be used for various uses spanning from industrial, agricultural, recreation, public water supplies, hydro-energy etc.

- **S.I.26 National Environmental (Wetlands, River banks and lake shores) Regulations, 2009**

The Regulation amongst other objectives specifically relates to this project by (a) ensuring conservation and wise use of the waterbodies, (b) Control pollution of the river (c) ensure that the wetlands of the community are protected as habitats for flora and fauna species.

- **S.I.28 National Environmental (Sanitation and Waste Control) Regulations 2009**

The purpose of this regulation is to ensure that management of the company applies the regulations in all issues of sanitation and all categories of wastes generated by the project. Secondly ensures the adoption of sustainable and environment friendly practices in environmental sanitation and waste management in order to minimize pollution.

- **S.I.35 National Environmental (Noise Standards and Control) Regulations, 2009**

The Regulation seeks to ensure maintenance of a healthy environment, tranquility of the project surroundings and their psychological wellbeing by: regulating noise levels for optimum standard of living; prescribing maximum permissible noise levels to which persons may be exposed and providing technologies/methods for control, and mitigating measures for reduction of noise.

1.8.1.11 Factory Act 1992

The Act covers registration of factories, health matters, including hygiene, overcrowding, lighting, and ventilation. It also covers safety matters in relation to machinery, fumes, vapours, boilers, and prevention of fire. It also provides for employee welfare (washing facilities, first aid). It contains special provisions regarding health, safety and welfare. It requires employers to notify inspectors of serious employment accidents and cases of industrial diseases.

1.8.1.12 National Inland Waterways Authority (NIWA) Act 2004

The National Inland Waterways Authority Act CAP 47, Laws of the Federation of Nigeria (LFN), 2004 (Decree No. 13 of 1997), established with the primary responsibility to improve and develop Nigeria's inland waterways for navigation, provide an alternative mode of transportation for the evacuation of economic goods and persons; execute the objectives of the national transport policy as they concern inland waterways and subject to the provisions of the EIA Act, carry out

environmental impact assessment of navigation and other dredging activities within the inland water and its right-of-ways.

1.8.1.13 Nigerian Ports Authority (NPA) Act No 38 of 1999

Nigerian Ports Authority Act 1999, Cap. 126 Law of the Federation of Nigeria, 2004 Nigerian Ports Authority (NPA) with the responsibilities and "functions of providing and operating necessary facilities in ports, maintaining, improving and regulating the use of the port and to provide for matters connected therewith". Having evolved from an Operating Port into a Landlord Port Authority by virtue of the Federal Government's Port Reform programme of 2006, NPA remains the technical regulator anchor point for the port community, under the supervision of the Federal Ministry of Transportation, providing the enabling environment for the operations.

i. Provide and operate port facilities and services;
ii. Maintain, improve and regulate the use of the ports;
iii. Ensure efficient management of port operations; and
iv. Control pollution arising from oil or any other from ships using the port limits or their approaches.

Section 8 of the Act gives the Authority very wide powers. These include power to:

i. Build and develop port docks, harbours, piers, wharves, canals, jetties, embankment and water courses;
ii. Invest the funds of the Authority;
iii. Act as consultants in relation to port and port operations in Nigeria or any part of the world;
iv. Act as carrier by land or sea, stevedore, wharfinger, warehouse man or lighter man
v. Appoint, license and manage pilots of vessels;
vi. Reclaim, excavate, enclose, raise or develop any of the lands acquired by or vested in the authority; and
vii. Win sand from the ports and their approaches for such purposes as it may deem fit.

1.8.1.14 Customs & Excise Management Act 2004

Customs & Excise Management Act (CEMA) Cap 45, Law of the Federation of Nigeria, 2004 vests Legal Authority in the Nigeria Customs Service to act on behalf of the Federal Government of Nigeria in all Customs matters.

1.8.1.15 Nigerian Maritime Administration and Safety Agency (NIMASA) Act. 2007

The Nigerian Maritime Administration and Safety Agency, NIMASA, focal areas include effective maritime safety administration, maritime labour regulation, marine pollution prevention and control,

search and rescue, cabotage enforcement, shipping development and ship registration, training and certification of seafarers, and maritime capacity development.

In summary, some relevant functions of the Agency are to:

i. Pursue the development of shipping and regulate matters relating to merchant shipping and seafarers;

ii. Administering the registration and licensing of ships;

iii. Regulate and administer the certification of seafarers;

iv. Regulate the safety of shipping as regards the construction of ships and navigation;

v. Provide directions and ensure compliance with vessel security measures;

vi. Carry out air and coastal surveillances;

vii. Control and prevent maritime pollution

viii. Enforce and administer the provisions of the Cabotage Act 2003;

ix. Receive and remove wrecks; and

x. Provide National Maritime Search, Rescue Services and Maritime Security.

1.8.1.16 Water Resources Act CAP W.2 Laws of the Federation of Nigeria (LFN) 2004.

The Water Resources Act is targeted at developing and improving the quantity and quality of water resources. The following sections are pertinent: Section 2 – made provisions for the rights to take and use water generally in Nigeria.

i. Section 3- provides for acquisition of rights to use or take water in any part of the country.

ii. Section 5 and 6 provides authority to make pollution prevention plans and regulations for the protection of fisheries, flora and fauna.

1.8.1.17 Sea Fisheries Act, CAP S4, LFN 2004.

The Sea Fisheries Act makes it illegal to take or harm fishes within Nigerian waters by use of explosives, poisonous or noxious substances. Relevant sections include the following:

i. Section 1 prohibits any unlicensed operation of motor fishing boats within Nigerian waters;

ii. Section 14 (2) provides authority to make for the protection and conservation of sea fishes.

1.8.1.18 Inland Fisheries Act, CAP I10, LFN 2004.

The Inland Fisheries Act focused on the protection of the water habitat and its species, the following sections are useful:

i. Section 1 prohibits unlicensed operations of motor fishing boats within the inland waters of Nigeria;

ii. Section 6 prohibits the taking or destruction of fish by harmful means.

1.8.2 State Regulations

1.8.2.1 **Lagos State Environmental Protection Agency** (LASEPA) Edict Number 2 of 1994 came into operation. The Edict clearly spells out the functions of the agency as far as the protection of the environment for sustainable development is concerned.

1.8.2.2 Lagos State Environmental Management and Protection Law 2017

1.8.2.3 The Lagos State Urban and Regional Planning Regulations 2005 Gazette No 25 Vol. 38

1.8.2.4 Lagos State Physical Planning & Urban Development law 2010

1.8.2.5 Lagos State Environmental (Sanitation and Waste Control) Regulations 2014

1.8.2.6 Lagos State Environmental (Noise Standards and Control) Regulations 2014

1.8.2.7 Lagos State Waterfront Infrastructure Development Law 2009

A law to provide the regulation of waterfront development in Lagos State and for connected purposes. The Lagos State House of Assembly passed a bill in 2008 for a law to provide for the regulation of waterfront infrastructure development, sand dealing and dredging operations in the state. The LAWID Law empowered Lagos State Ministry of Waterfront Infrastructure Development (MWID) to regulate sand dredging in two (2) distinct areas. MWID is empowered to grant permit for sand dredging or dealing within, around and on waterfronts and embankments according to Sections 3(e), 4 and 1(2) of the LAWID Law. Waterfront is defined as land at the edge of a stream, creek, lagoon, coastal area, shoreline, harbour, wharf, dock, bar beach and other beaches within Lagos State – section 23 of the LAWID Law Embankment simply means bank of wall of waterways. Sections 3, 4 and 1(2) of the LAWID law empower MWID to grant permit for sand dealing or sand dredging around waterfronts. MWID is statutorily empowered to regulate not only the transportation of granite, laterite etc. but also those who buy and sell it. Sand stockpiles fall into the category of those who buy and sell sand

1.8.3 Local Government Council Regulations

Amuwo-Odofin Local Government has no specific bye-laws relating to the wetlands, flood shelters, open spaces, evacuation routes and the conduct of environmental impact assessment. It does make byelaws but cannot exercise the powers because they are not gazetted. Notwithstanding the Local Government Council as the third tier of Government helps to implement Federal and State laws within its jurisdiction.

1.8.4 International Conventions and Guidelines

Nigeria has ratified or acceded to numerous International treaties and conventions, as described below:

1.8.4.1 Convention on the 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's) and management of migratory species.

1.8.4.2 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.

1.8.4.3 Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (or World Heritage Convention, 1978)

The convention sets asides 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.

1.8.4.4 Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal (1987)

The convention focuses attention on the hazards of the generation and disposal of hazardous wastes. The convention defines the wastes to be regulated and control their trans-boundary movement to protect human and environmental health against their adverse effects.

1.8.4.5 United Nations Framework Convention on Climatic Change (1992)

In order to achieve sustainable social and economic development, Port development in developing countries needs to grow taking into account the possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general. This also includes the application of new technologies on terms that made such an application economically and socially beneficial, determined to protect the climate system for present and future generations.

1.8.4.6 African Convention on the conservation of nature and natural resources 1968. Convention at Algiers, 15 September 1968, ratified by Nigeria on 16 June 1969.

1.8.4.7 Convention concerning the Protect of workers against occupational Hazard in the working environment due to air pollution, noise and vibration, Geneva 1997

1.8.4.8 Convention concerning Occupation Safety and Health and the working environment, Geneva 1987

1.8.4.9 International Union for Conservation of Nature and Natural Resources (IUCN) Guidelines (1996)

The World Conservation Union – IUCN Red List of Threatened Animals provides taxonomic, conservation status and distribution information on species that have been evaluated using the IUCN Red List categories. This system is designed to determine relative risk of extinction and the main purpose of the red list is to catalogue the species that are regarded as threatened at the global level i.e. at risk of overall extinction. The 1996 red list also included information on species that are categorized as extinct; on species that cannot be assessed because of insufficient data; and on certain species in the lower risk category. Nigeria, as a member of this body, categorizes species using the red list.

1.8.4.10 Gulf of Guinea Large Marine Ecosystem Project (GOG-LME) 1999

1.8.4.11 Convention on Fisheries Cooperation among African States Bordering the Atlantic Ocean 1991

1.8.4.12 Montreal Protocol on Substance that Deplete the Ozone Layer 1987

1.8.4.13 Vienna Convention on the Ozone Layer 1985

1.8.4.14 United Nation Convention on the Law of the Sea 1982

1.8.4.15 Convention on Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Regions (Abidjan Convention) 1981

1.8.4.16 Protocol Concerning Cooperation in Combating Pollution in Cases of Emergency in the West and Central African Region 1981

1.8.4.17 International Convention on Standards of training Certification and Watch-Keeping for Seafarer 1978

1.8.4.18 International Convention for the Safety of Life at Sea 1974

1.8.4.19 Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES) 1973

1.8.4.20 International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) (this supersedes OILPOL, 1954) 1973

1.8.4.21 Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (the convention was amended in 1992) 1972

1.8.4.22 Convention on the International Regulations for Preventing Collisions at Sea 1972

1.8.4.23 Convention on the Territorial Sea and Contiguous Zone 1958

1.8.4.24 Convention on the Continental Shelf 1958

1.8.4.25 Convention on the High Seas, Geneva 1958

1.8.4.26 The IFC Environmental, Health, and Safety (EHS) Guidelines (2007)

The EHS guidelines (1991 and updated in 2007) are a set of technical reference materials that provide pollution related to limited and standards that are acceptable to the IFC. In general, the guidelines seek to avoid, minimize, and control environmental, health, and safety (EHS) impacts during the construction, operation, and decommissioning phase of a project or facility.

1.8.4.27 IFC Environmental, Health, and Safety Guidelines for Port, Terminal, and Harbour. (2007)

In addition to the General Health and Safety Guidelines, the IFC presents guidelines for 'Port and Harbour Facilities'. The latter is applicable for the design, construction, and use of ports, harbours, and associated facilities. The requirements of these guidelines include:

• Project siting procedures should be conducted in a manner that takes into consideration environmental factors and minimizes impacts, considers the application of the World Bank resettlement policy, indirect environmental and socio-cultural impacts, consultation with governmental agencies, affected communities, and NGOs, and considers the alternative sites;

• Dredging should take into consideration minimizing impacts on environmental resources:

• The dredging program should be designed to minimize impacts;

• Field investigations and physical and chemical analyses of sediments should be conducted prior to dredging activities, and a plan should be developed to minimize sediment re-suspension in environmentally sensitive areas;

• Evaluation of disposal options;
• Minimising and monitoring turbidity at the dredged site; and,
• Minimising the impacts associated with land disposal of dredged material.

1.8.5 General Environmental Impact Assessment requirements

The requirements include:

• Assessment of the potential impacts on shoreline vegetation, coral reefs, fisheries, birdlife, other sensitive aquatic, and near-shore habitat, etc. A plan should be developed to mitigate these impacts;
• Locations of stationary installations (e.g. wastewater outfalls, underwater cables, pipelines) should be identified and incorporated in the dredging plan;
• Avoiding project designs that would increase saltwater intrusion to groundwater or surface waters;
• Mitigation of impacts on air quality during construction;
• Minimising the impacts on ambient noise levels;
• Emergency plans to prevent spills and fires during construction and operation;
• Minimising onsite storage of hazardous materials and wastes which should be disposed of in accordance with local requirements. International conventions (e.g. the London Convention 1972, the Basel Convention, other regional waste management agreements) should be taken into consideration as a minimum requirement. "In no case should waste be indiscriminately dumped onto land or into the surface, coastal or marine waters"; and,
• Assessment of pollution control options, according to the requirements of the International Convention for the prevention and Management of Pollution from Ships (1973), as modified by the Protocol of 1978 relating thereto (MARPOL 73/78).

Port and Harbour Safety:

• Coordination is required with government agencies, including port and harbour safety and emergency response plans;
• Coordination of harbour traffic with other marine activities;
• General harbour safety operational measures including signals and wind directional instruments, and emergency procedures;
• Ensuring that only authorized personnel are allowed to enter hazardous or restricted areas;
• Establishing procedures for handling, storage, and transportation of hazardous materials; and
• Implementation of operations and public emergency response programs for spills, fires, and major accidents.

Hazards Protection

• Design criteria, as well as the location of the facilities, should be chosen as to ensure the minimization of potential risks from earthquakes, tides, floods, and fires, taking into consideration

the local seismic risk, wind and snow loading or any other dynamically imposed loads associated with climatic or geological factors. Structural engineers or architects must provide a certification of the design criteria.

Training

• Training is required for personnel involved in the construction and operation of the facility, in accordance with the General Health and Safety Guidelines and the General Environmental Guidelines;

• Training of an on-site team for emergency response plans, and for handling oil and chemical spills and firefighting equipment; and,

• Training is required for the monitoring and mitigation of the environmental and socio-cultural impacts of the project.

Record keeping and reporting:

• Significant environmental matters must be recorded, including monitoring data, spills, occupational accidents and illnesses, fires, as well as any other emergencies;

• A record of public complaints and accidents must be kept; and,

• A review and evaluation of the above information must be conducted in order to improve the effectiveness of the environmental, health, and safety program.

1.8.6 Bestaf Marine Policies

BMSL policies and commitments take into consideration relevant Nigerian regulations, international laws, guidelines, conventions and treaties. BMSL shall in the course of executing this proposed project ensure that all relevant standards and conditions are complied with and where double standards exist BMSL would as much as possible comply with the more stringent one. The project shall be managed in accordance with all relevant sections of BMSL's Health, Safety and Environment (HSE) Governing Policy. The BMSL's HSE policy at work imposes responsibilities on all levels of management, supervision and all employees, for which they will be held accountable.

1.9 Structure of the Report

The report shall conform to International standard and Federal Ministry of Environment reporting format which is summarized as follows:

- Title Page
- Table of Contents
- List of Tables
- List of Figures

- List of Maps
- List of Plates
- List of Acronyms and Abbreviations
- List of Preparers
- Acknowledgement
- Executive Summary
- Chapter One – Introduction; - Background information, Administrative and Legal framework, Terms of reference, Declaration

- Chapter Two – Project Justification; - Project background, project objectives, need for the project, value of the project, envisaged sustainability, alternatives considered (including no project alternative), development options considered, site selection.

- Chapter Three - Project Description, - Type of project, scope, location, material input/output and by-products, waste generation, technical layout and process, operation and maintenance, schedule.

- Chapter Four – Description of the biophysical, socio-economic and health environment, - Study approach, literature review, baseline data acquisition method and QA/QC, geographical location, field data, climatic conditions, air quality, noise level, vegetation cover characteristics, land use and landscape pattern, ecologically sensitive areas, terrestrial fauna and wildlife, soil studies, aquatic studies including hydrobiology and fisheries, ground water resources, social, economic and health studies, prediction of changes in the baseline condition without the development in place. Consultation, - Identification of stakeholders, consultation with regulators, consultation with communities, community concerns and observations, and Participatory Rural Appraisal (PRA).

- Chapter Five, - Associated and Potential Environmental Impacts, - Scoping, impact prediction methodology, impacts of project activities (site clearing, dredging, construction, transportation, excavation, sand filling, etc), impacts on resource utilization, process impacts (operation), short term/long term impacts, reversible/irreversible impacts, cumulative impacts, direct/indirect impacts, adverse/beneficial impacts, risk assessment (HAZOP, HAZID, QRA), social impacts, health impacts, etc.

- Chapter Six, - Mitigation Measures and Alternatives, - Control technology, compensation, alternative site, alternative route or location, compliance with health and safety hazards requirements.

- Chapter Seven, - Environmental Management and Community Development Plans, - Guidelines for specific project activities, emergency response procedures, mitigation plan, costing of alternatives and budget requirements, monitoring programme (scope, parameters, frequency, location, methodology), auditing and inspection procedures, waste handling procedures, training program, roles and responsibilities.

- Chapter Eight, - Conclusions and Recommendations

- References
- Appendices

1.10 Declaration

Bestaf Marine Services Limited (BMSL) hereby declares her intention to abide by the existing international and national laws and regulations regarding environmental protection during the construction of the proposed port facility. BMSL management is committed to the implementation of the Environmental Management Plan (EMP) proposed in the EIA report. BMSL hereby declares that it has prepared this EIA report using the best available expertise in personnel, equipment, and internationally acceptable methods.

CHAPTER TWO
PROJECT JUSTIFICATION

2.1 Need for the Project

Ports within Nigeria are currently used to undertake a variety of cargo handling activities (containers, dry and liquid bulks, RoRo ferries and general cargoes). The Lagos Ports are presently the most functional and busiest Ports in Nigeria. BMSL proposes to develop a port facility at the Kirikiri for a custom bonded free trade zone as well as containerized import and export activities. The proposed port facility is situated at the west ward of Tincan and Apapa ports within where there is the availability of water front and water draft of approximately 10 metres and capacity to accommodate ship sizes of 35,000 DWT. The project proponent has acquired a 49,900.758 square meters (4.99 hectares) site in order to serve as a custom bonded free trade zone as well as an import and export of containerized cargo. The proposed port facility development is therefore set to reduce the burden of activities in the existing jetties, promote economic business activities, accelerate export and import, boost manufacturing, agricultural production, food security in Nigeria and offer job opportunities in various categories to a number of Nigerian professionals' skilled and semi-skilled craftsmen.

2.2 Project Justification

Transport of freight in containers is developing spectacularly in developing countries like Nigeria. Increasing container transport volumes also put higher demands on the performance of container Ports and Terminals. Many seaports have started or launched ambitious port terminal expansion plans to handle larger volumes of containers. Increasing container throughput in Ports however also raised the issue of capacity and quality of the hinterland transport. Shippers and carriers value the attractiveness of a container port not only on its performance in the seaside operations, but also on its ability to offer a wide range of high quality services to the hinterland. Scale economies in the sea transport sector have shifted the attention of shippers and carriers to the inland sector of the chain as a way to control costs, for instance in many cases hinterland services have the largest share in the total transport bill. As a result, hinterland accessibility has become increasingly important for the competitiveness of a seaport. In view of the current situation of the road traffic congestion in Lagos State and the deplorable condition of the road network in Nigeria diversifying and improving the hinterland accessibility through inland waterways has become a strategic issue for BMSL proposed port facility. BMSL proposed system of barge transport clearly demonstrated its attractiveness as an alternative hinterland transport mode. The ability to offer cheap and reliable services has attracted the interest of shippers and carriers in barge transport and this explains the significant growth of container barge transport with the dredging of the Niger River by the Federal Government of Nigeria, creation of inland water ports in Onitsha, Anambra State and in Lokoja, Kogi State,

favourable natural circumstances, such as the presence of extensive national and international waterway network with good navigable conditions, have also stimulated the strong development of hinterland transport by barge. These strong assets of barge transport quality of services and infrastructural capacity suggest that a more prominent role of barge transport would be desirable to keep the port decongested and operational. This modal shift is not a matter of course, but requires a permanent high performance of container barge services to the hinterland.

The port facility is to serve as a customs approved bonded terminal for the temporary storage of imported goods until the customs duties have been paid or the goods have been released, where Bonds are required to be posted by the terminal operator in order to indemnify the government if the goods are released improperly. The creation of bonded port facility was necessitated to decongest the other already congested Ports of Apapa and Tincan island where grossly inadequate precipitating excessive delay in clearing at the port.

2.3 Value of the Project

The value of the proposed port facility project consisting of land acquisition, construction, personnel, equipment, approvals, corporate social operation is put at approximately Ten Billion Naira (N10,000,000,000). A higher percentage of the project amount would be injected into the Nigerian economy through contracts, subcontracts and purchase of construction materials and labour. Consequently, the cost of the port facility with its attended custom bonded activities, free trade zone and container transit will boost industrialization.

2.4 Envisaged Sustainability

2.4.1 Economic sustainability

The port facility project will reduce down time of delivery of containers from overseas vessel in the waters of Nigeria to customers especially those located upland. It shall create a boost in import and export of goods. Thus, the project will be sustainable as funds will be available to operate and maintain the project. Activities at the port will promote business opportunities and enhance the nation's economic development. The exportation of products from the port facility will increase the country's foreign reserves and her GDP. The utilization of the port facility for loading and offloading of other vessels and delivery of containers upland through inland waterways will improve vessel turn-around time, reduce demurrage, reduce Apapa, Tincan port congestion and contribute significantly to the growth of the maritime business in Lagos State and other parts of Nigeria.

2.4.2 Technical sustainability

The Bestaf Marine Services Limited port facility is technically sustainable because of the immense expertise in marine and logistic technology with strict adherence to internationally and nationally

acceptable engineering design and construction standards. Innovative technologies such as port digitalization, internet-of-things, augmented reality, use of smarter and fast cranes, application of drones in monitoring the port activities/security that are economically viable and having minimal environmental, social and health impacts shall be utilised in the execution of the proposed facility. The technical sustainability of the proposed project stems from the application of the best available technology (BAT). Also, strict adherence to international and national port facility engineering design, construction standards and codes of practices that shall be adopted at all stages of the proposed project development shall ensure the technical viability of the project.

2.4.3 Environmental Sustainability

The project's activities are guided by national and international environmental regulatory and guidelines and standards. The incorporation of the findings and recommendations of this EIA at various stages of the project shall be strictly ensured so as to guarantee that the project is environmentally sustainable. BMSL shall also ensure strict adherence to the Environmental Management Plan (EMP) of this EIA in order to help safeguard the environment at the various phases of the project's activities. Design for the proposed Bestaf Marine Services Limited port facility will incorporate features that will preserve its integrity so that the impact on the environment is minimal. This will be achieved through construction techniques suited to specific ecological requirements and guided by regulatory and engineering design standards. The facility is designed and will be constructed to be eco-friendly based on the concept of building with nature (BWN). The design incorporates nature in infrastructural design, resulting in flexibility, adaptability and extra functionalities. This proactive utilization and/or provision of ecosystem service as part of the engineering solution is a key characteristic of the building with nature (BWN) in comparison to other design.

2.4.4 Social Sustainability

The BMSL proposed port facility project is to be executed in a Nigerian Ports Authority designated Industrial layout area and water channel which implies a negligible infringement on the social rights of the host communities. The management of the port facility project has elaborate Social Action Plan and continues consultation with relevant stakeholders throughout the life cycle of the project shall be ensured.

2.5 Project Options and Alternatives

In accordance with the requirements of EIA procedural guideline a number of alternatives have been considered during the conceptualization of the proposed Project design. This section describes the various project concepts that were considered and the rationale for the selected alternatives. This section also discusses the alternatives with respect to location, technical and environmental

considerations. The consideration of the main alternatives in respect of the proposed project was undertaken jointly by the respective stakeholders input and has occurred throughout an extensive and coordinated decision-making process, over a considerable period of time. Project alternatives analysis in environmental assessment is designed to bring environmental and social considerations into project selection at the early stages of project planning, and the later stages of site selection, design and implementation. The project options took cognizance of environmental, safety and operational considerations. These include the no-project option, delayed project, modified project option, and/ or the planned option.

2.5.1 Do nothing Option

The option will reduce and stunt effective economy and infrastructural development of the nation. This option was rejected because it under-exploits a proven strategy to empower the people and the nation. The project will have many social, economic and environmental benefits such as jobs creation, revenue generation, infrastructural advancement, social development, reduction in crime, fast delivery of containers upland etc. The Do Nothing 'scenario would also fail to offset the likely environmental impact of any alternative options to secure the future reinforcement of the port facility infrastructure in Kirikiri Lighter Terminal. Thus, the "zero action" alternative by not implementing the project will not contribute to the social economic benefits envisaged in the plan.

2.5.2 The 'Delayed' Option

This option implies that the planned project will be delayed until a much later date. Such option is usually taken when conditions are unfavourable to project implementation such as in war situation, or where the host community is deeply resentful of the project. Also, if the prevailing economic climate is not quite favourable to the project, then delayed project option may be feasible. None of these conditions is applicable. Indeed, the social, economic and the political environment are most favourably disposed towards the project. Therefore, the implication of delayed project option will mean that all the preliminary work and associated efforts/ costs incurred would have come to nothing. Also, because of inflationary trends, such a delay may result in unanticipated increase in project costs, which may affect the final profit from the project. The consequence of these is that it would be a discouragement for private/local investors. In consideration of the above concerns and assessment of the current proposed site the Delayed option of the project is not viable option. These, and other related problems make impracticable to adopt the delayed option. It is therefore unattractive to adopt the "Delayed Project" option.

2.5.3 Modified Project Option

A Port facility with a Free Trade Zone will be one of the most modern ports in Lagos, offering enormous support to the burgeoning commercial operation across Nigeria and the entire West

African region. The proposed modification and expansion will provide ships with a greater mooring room, shortens waiting times, and provides jetty operators with more workroom. Developing a port by expanding an existing port ('brownfield') or constructing a new one ('greenfield') represents one of a range of potential solutions to a perceived transport capacity problem. The option of project development is thus the best of all the possible options considered economically, technologically, logistically and environmentally. During the proposed project design development, alternatives were considered in compliance with the requirements of Nigeria's EIA procedures together with international best practices. These options are highlighted below.

2.5.3.1 Location Alternative

Appropriate site selection is a crucial step in minimizing the associated ecosystem impacts and exploring restoration opportunities of degraded ecosystems as port site selection aim to preserve the natural ecosystem functioning as much as possible, considering requirements such as habitat connectivity, endogeneity, trophic web integrity, physical-chemical water quality, and system resilience. This implies working or building with nature rather than counteracting it. If possible, extension or requalifying an established ('brownfield') port infrastructure at an existing site is usually preferable to developing a new site from an ecosystem point of view because the marine and terrestrial infrastructures of existing ports are already in place and the additional impacts of further port development are anticipated to be less severe than for new port developments in pristine or limitedly impacted marine environments. The location of the site along the Badagry creek helps to focus on building or working with nature rather than counteracting it. The site possesses a naturally favourable conditions for port functioning (e.g., depth, maneuvering space, mild hydrodynamic conditions). The port development becomes inevitable and an appropriate site selected considering nearness to international waters and closeness to other existing port facilities. Ideally, the natural conditions at the selected site support port functioning, meaning that little to no human interference is necessary. The important factors that influence the site selection for the port facility include;

- land availability,
- availability of water with adequate draught
- availability of skilled manpower; and
- availability of infrastructure and utilities;

The Badagry creek has a considerably adequate and available waterfront and water draft to accommodate the size of the ship of 35,000DWT and above. With the comparative advantages of the site it is assumed that carrying out the project as proposed in this site is most suitable as against other alternatives. This alternative is therefore upheld.

2.5.3.2 Technology Alternative

The alternative technologies adopted in the port concepts are considered. This alternative implies the application of different technologies that are considered to have better advantages and yet produce similar effects. The present option of developing the project will involve immediate development of the proposed port in the designated area using the available existing technology. Port facilities are important transport hubs within a coastal system. These strategic assets are located in complex environments characterized by interactions between physical networks (e.g., infrastructure, transport networks), socio-economic influences (e.g., employment opportunities) Sustainability and ecological system processes (e.g., sediment transport, fish migration, coastal habitat dynamics) therefore the best technology for efficient performance and environmental preservation is needed.

CHAPTER THREE
PROJECT DESCRIPTION

3.1 Introduction

The proposed BMSL port facility shall consist of port structures such as a wharf, berth, quay, pier and an existing 206 meters Jetty with intention to construction an additional 125 meters is to be used as a container terminal, custom bonded facility, and a Free trade zone. The proposed Project site of approximately 49,900.758 square metres (4.99 hectares) is located at G-Cappa yard, off Cardoso Street, kirikiri lighter terminal port, Amuwo-Odofin Local Government Area in Lagos State. It is situated south west of Tin Can Island Port (TCIP) in Apapa region which lies near the mouth of Lagos Lagoon and is seven (7) kilometers due west of the center of Lagos across Lagos Harbour. The project Site is shown by site Layout plans presented as Figures 3.1 and 3.2. The site lies on the bank of the Badagry Creek also known locally as Imore creek and it is accessible by land through the Apapa to Mile 12 road and also by water through the Tincan island waterway.

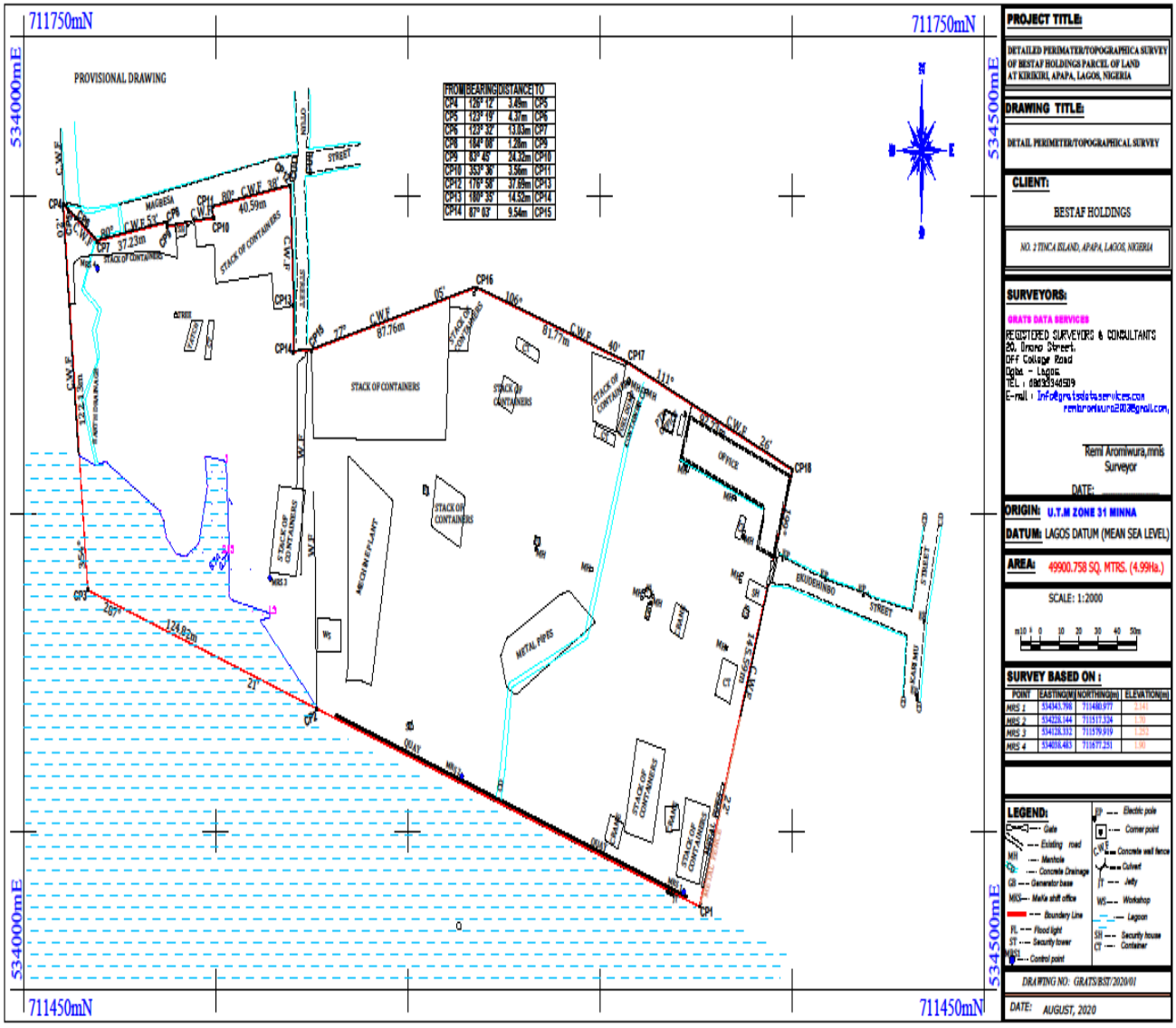


Figure 3.1: Project site layout

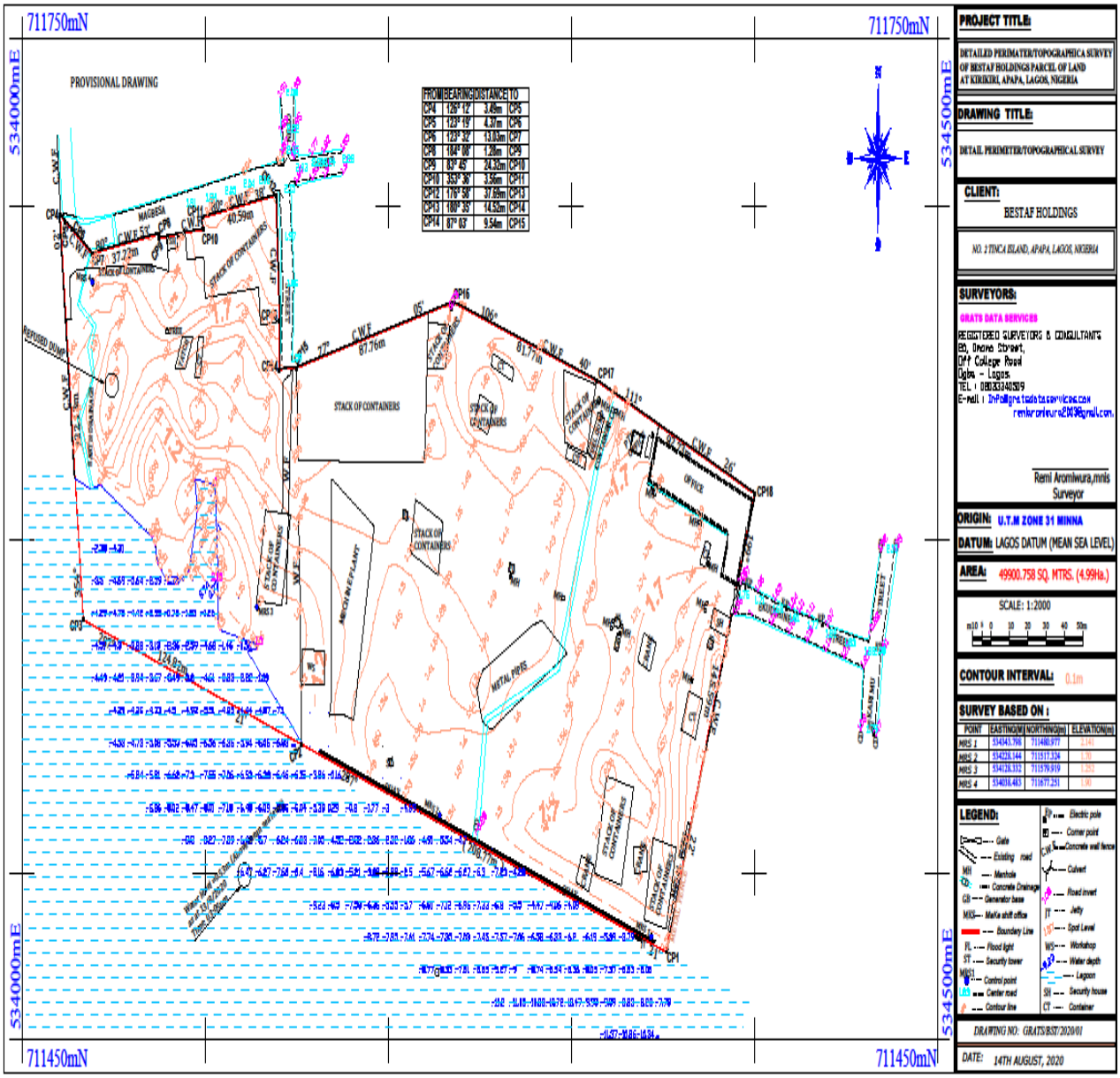


Figure 3.2: Project site contour map

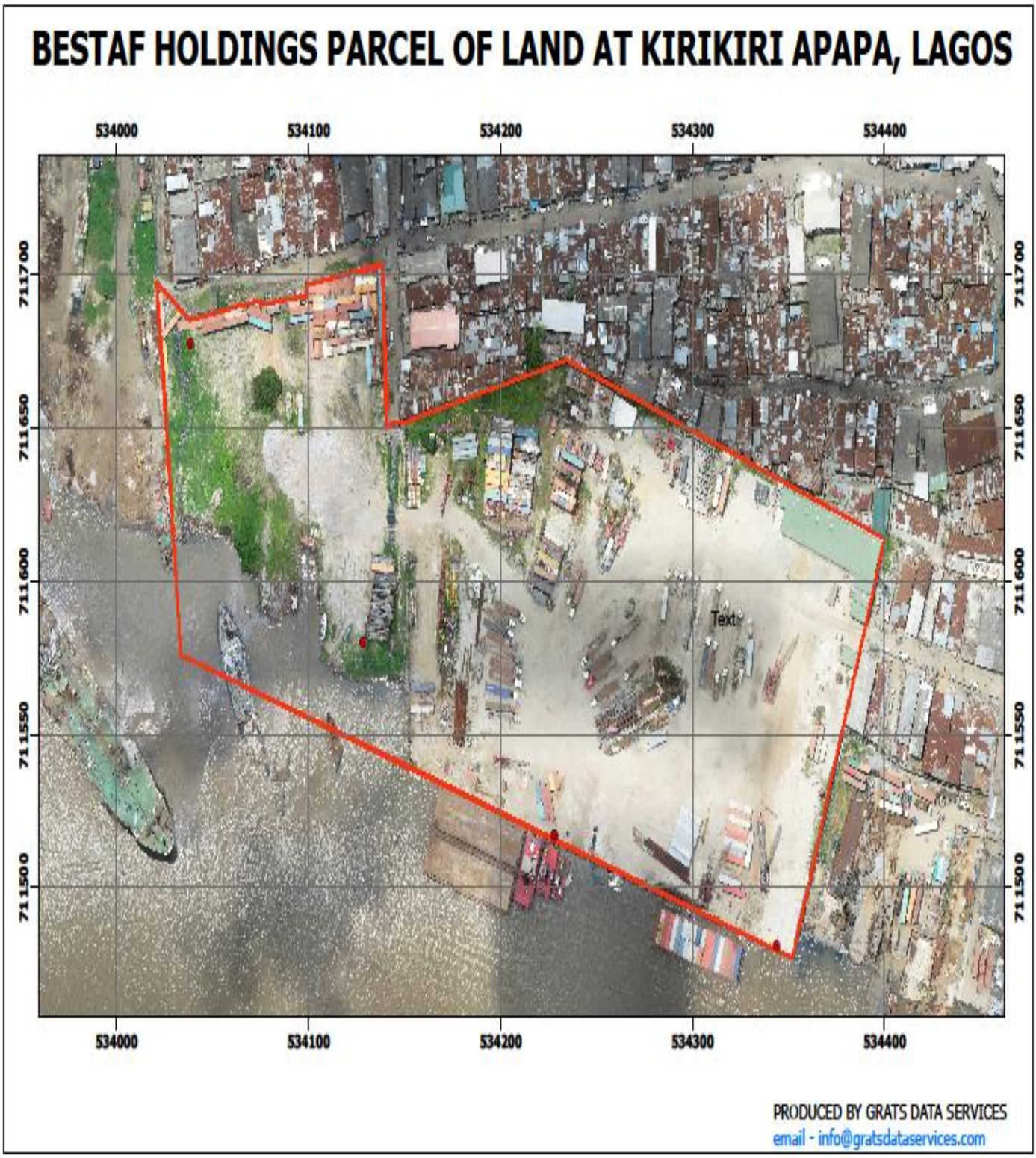


Figure 3.3: Project site satellite imagery

3.2 Project Components

The Port facility shall comprise of port structures such as a wharf, berth, quay, pier and other infrastructure. The project will have the following facilities and components:

- Concrete quay (340 meters)
- Foundation (Precast driven or bored cast – in-situ concrete piles)
- Construction of open piled quay deck size – 7680m^2
- Truck unloading area
- Container and break bulk storage yard
- Material handling system e.g Cranes (1 unit each of 240 tons, 220 tons, 200 tons and 180 tons) forklift (2 units each of rotary and fixed head), gantry type ship loader etc
- Workshop
- Machine Plant
- Fuel dump (33,000 litres diesel capacity)
- Administrative (8 offices) and Accommodation (10 living quarters) building
- Utilities (e.g. Power generation (1 Megawatt 2 units, 500 Megawatts 4 unit, 250 Megawatts 1 unit and 100 Megawatts 1 unit), Borehole (220 metres depth), Water Treatment Plant, lighting, Storm Water drainage system)

3.3 Design standards

The design of the berth and associated structures will be carried out in accordance with International Standards, Codes and specifications and regulations. Table 3.1 below includes the proposed list of International Standards codes and specifications. This list may not be considered as complete.

Table 3.1 International standards, codes, specification and regulation

Reference Standards	Description standards
BS 6349	Part 1 General criteria Part 2 Design of quay, jetties and dolphins Part 4 Code of practice for design of fencing and mooring systems
BS 8004	Code of practice for foundations
BS 8110	Structural use of concrete Part 1 code of practice for design and

	construction. Part 2 Code of practice for special circumstances
BS 5400	Steel Concrete and composite bridges Part 2 Specification of Loads Part 4 code of practice for design of concrete bridges
EAU 2004	General Maritime structure-Recommendations of the committee for water front structures, harbour and waterways
PIANC	Guidelines for design of fender systems 2002 (WG33) Seismic design guideline for port structures 2000 (WG34) Criteria for moored ships in harbours Guidelines for design of armour slopes under open piled quay walls (WG22)
OCIIMF	Mooring equipment guidelines

3.4 Project Scope

The following is an overview of the project operations and it can be summarised as follows:

- Vessel movement (inbound and outbound);
- Tugging
- Mooring
- Berthing
- Loading and unloading containers
- Wharf-side services;
- Maintenance Jetty sweeping exercise/dredging; and
- Custom bonded free trade zone activities

3.4.1 Jetty Floor Sweeping Exercise

Thus the sweeping exercise to be handled for the berthing pocket is estimated approximately 780 m^3. Hydraulic dredging will be used for suction to remove the sediment which will be transported through a pipe and deposited at the south west end of the site as a backfill. A certain amount of skill and experience are required to achieve the optimal suction setting for different bodies of water and types of sediment. The Intended floor

sweeping area is the site jetty walls. The channel on which the proposed project will be built has a draughts of 10 meters at the middle and between 7 – 8 at the sides due to sedimentation and waste deposition. A draught of 10 meters is needed along the edges of the creek which will accommodate the berth. Location can play an important role since hydraulic dredging is a good solution for areas where environmental concerns are important. A Geo-Form Dino 6 type hydraulic dredge with increased mobility and precision compared to larger hydraulic dredges will be used for the floor sweeping. Hydraulic dredging equipment is best suited for removing fine silt, sand and dirt. Hydraulic dredger in contrast to mechanical dredger uses a cutter head shroud to contain the suspended material so it can be pumped away because during the floor sweeping exercise certain amounts of dredge material which can include contaminants will be stirred up and suspended in the water. The hydraulic dredge equipment benefits include the lower costs of purchasing, operating and maintaining the equipment, a low percentage of suspended sediment and the ability to remove fine materials such as silt and sand

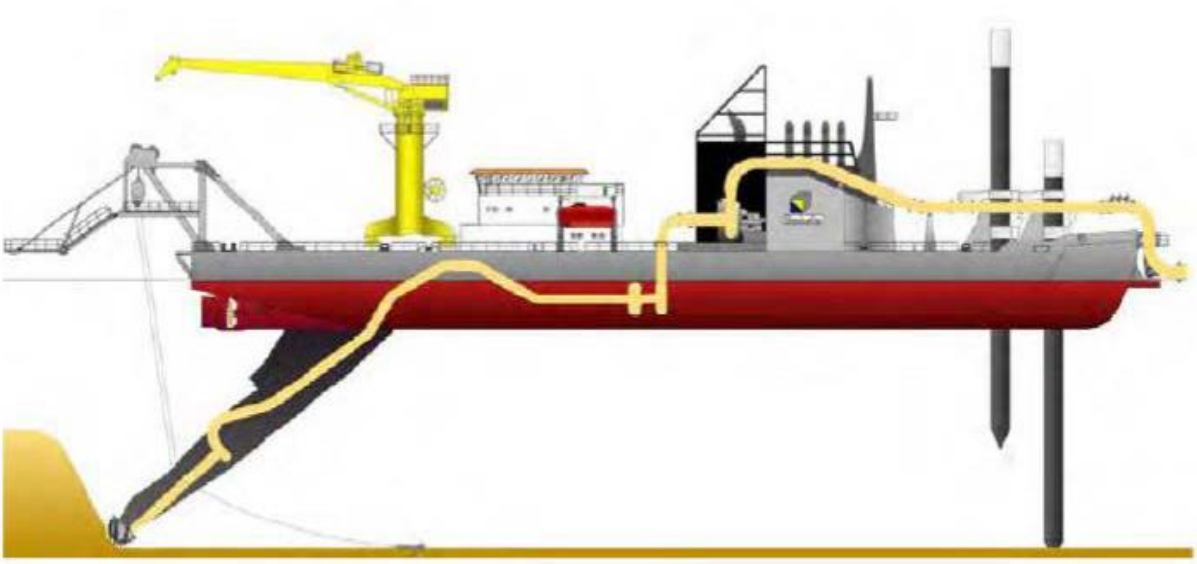


Figure 3.4: Cutter Suction Dredger (CSD)

3.4.2 Containers

The standard 20-foot and 40-foot container or "dry van" are the most commonly-used containers for the shipment of goods in ocean freight. The most common twenty-foot container occupies a space 20 feet (6.1 m) long, 8 feet (2.44 m) wide and 8 feet 6 inches (2.59 m) high, with an allowance externally for the corner castings with the internal volume at 1,172 cubic feet (33.2 m^3) and usable capacity of 32.6m^3. The dimensions of a 40-foot

container are Exterior Dimensions (in feet): 40 feet (12.19 m) long, 8 feet (2.44 m) wide and 8 feet 6 inches (2.59m) high with an allowance externally for the corner castings with the internal volume at 2,344 cubic feet (66.4m3) and usable Capacity 67.7m^3**.** The port facility is to be built to handle and estimate of 500 to 1000 containers per day.

3.4.3 Handling Equipment

Main equipment for container handling are "Quayside Container Cranes (QCC) and Rubber Tyerd Gantry Cranes (RTGC)". The required quantities of both are estimated taking into account of the demand forecast of containers including the productivity and service level of the port facility. For handling cargo especially Container type ULCS, Quayside Container Gantry Cranes are to be installed. For handling system container inter-field, System Transfer Crane (RTG) is suggested will be used considering size of container volume that will be handled. BMSL plans estimates at total 4 cranes of 240, 220, 200 and 180 tons. Design and number of quayside container cranes are decided based on container volume estimation as much as 1.25 million TEUs.

Table 3.2: Design and Number of Quayside Container Crane

Item	Symbol	Unit	*Quay* No. 2
Berth Length	Bw	m	340
Number of QC	Q	Unit	2
Yearly work time	H	Hour	8760
Handling Capacity (per hour)	P	Q'ty/hr	30
QC operational availability	Sf	%	90
Berth operational availability	Sw	%	50
Conversion rate from TEU to actual quantity	TF		1.5

Notes: QC means "Quayside Container Crane".

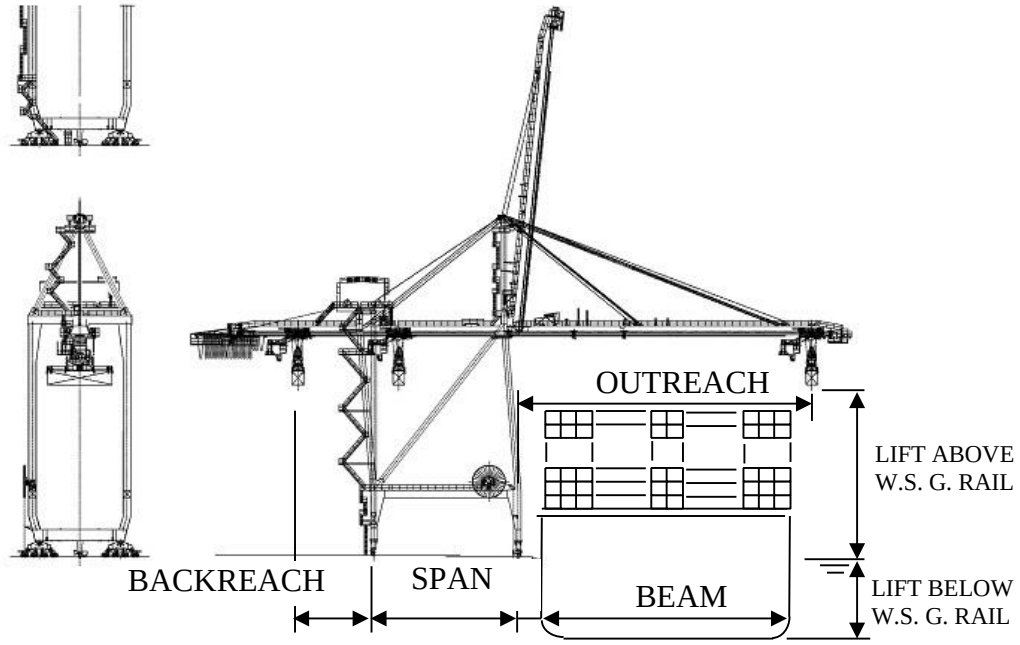


Figure 3.5: Quayside Container Crane

Handling Container Capacity of 1,730 TEUs/m is adopted for balancing length. It is because Conversion from planned multi-purposed terminal, especially for handling container to mobile terminal in seaport master plan study. Total length of Berth for container handling is planned to be 340 m length. Maximum Unit capacity per year is estimated to be about 2,000 TEUs/m with reference to leading Seaport literatures in the world. Consequently, the adoption of 1,730 TEUs/m as the planned capacity for container handling is considered fair and will be fulfilled with reference to the number of required container handling machines including container gantry cranes dan RTG.

Table 3.3: Required Container Handling Equipment

Handling Equipment	**Numbers**
Quayside Container Crane	2
RTG	2
Yard Tractor	12
Yard Chassis	6
Top Lifter	6
Reach Stacker	4
Forklifts	4

3.4.4 Plan ship size

Main vehicle on the port is ships. Ships which are predicted will enter and lean on BMSL port facility are Cargo Ships, Container Ships and Bulk Cargo Ships.

Table 3.4: Plan Ship

No	Type of Container Ships						
	Name	DWT (Ton)	TEU	LOA (m)	B (m)	D (m)	Photo
1	Maersk Tåsinge Class	29,700	1,597	191	28	10.6	
2	Maersk Alabama Class	17,525	1,068	155	25	9.5	

Source : http://www.maersk.com/en/hardware/fleet/maersk-line

3.4.5 Inland waterways transport

BMSL plans to move containers upland through the inland waterways rather than road therefore barge shall serve as a form of intermodal freight transport where containers are stacked on a barge and towed to a destination such as Onitsha, Anambra State and Lokoja, Kogi State on inland waterways. ISO containers which come in 5 standard sizes 20s, 40s, 45s, 48s, and 53 footers shall be stacked on one another because all the connections and load bearing is at the 40 foot coupling except for the 20s. In container barge transport the different types of motor vessel/push-barge combinations and push-boat/push-barge formations shall be used. The container loading capacity of these vessel types vary significantly from about 32 TEU for the smallest motor vessel to 200 TEU in the range of domestic trade size of vessels. In addition to transport demand, the size of the vessels is strongly determined by the waterway characteristics mainly draught and size of locks, but also the height of bridges restrains economies of scale. Three of the barge types used for container transport with their main dimensions are presented in Figure 3.

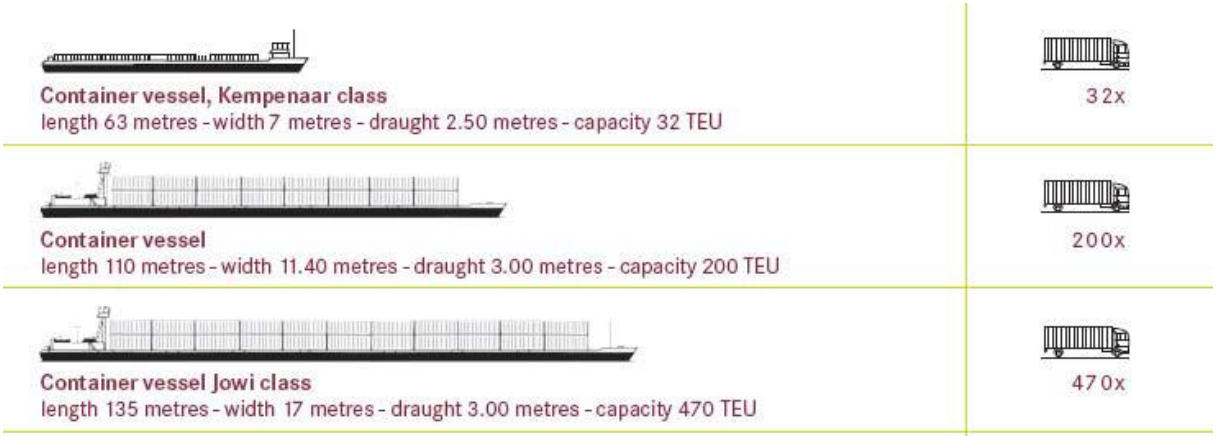


Figure 3.6: Dimension of barge types
(Source BVB –www.inlandshipping.com)

3.4.6 Ancillary facilities

3.4.6.1 Firefighting

The firefighting system designed for this project will include fixed fire fighting for the container yard, workshop and building exteriors. Firefighting inside building will not be beyond the supply of connection points to the building. Firefighting will be by fixed hydrants supplied by fresh water. No foam system will be present. Portable and mobile firefighting equipment will be present to supplement the fixed installation. Hydrant locations will have multiple hydrant heads and be equipped with hose reels. Where possible hydrant locations will be combined with illumination posts to increase their visibility. All Hydrant locations must be protected against impact from moving vehicles and their cargo. Where ever possible hydrants will be of the aboveground pillar type. Should fire hydrants be inaccessible due to fences or similar obstructions then an additional hydrant location will be placed on the other side of the obstruction connected to the same water main. Hydrants placed in the container yard shall be placed in clear corridor through the container stacks such that they are accessible from either side of the container stack. Branches to the fire main shall be equipped with block valves to permit proper operation of all remaining systems in the event of a critical failure or leakage of one section. Block valves are to be of the below ground type but must be easily accessed and operated by an above ground operator. The Fire-fighting features are combined minimum flow of two neighbouring hydrants is 250 m^3/h, minimal pressure at hydraulic furthest hydrant nozzle is 5 bars, estimated pump pressure of 8 bars, estimated pump power is 100 Kw, Minimum fire water tank capacity is 500 m^3 and the minimum action range of hydrants is 50m. fire extinguishers shall be placed at designated points of the Administrative/accommodation and security buildings.

3.4.6.2 Power Generation

Electricity will be provided for the project complex by installing a number of technological advanced Diesel Generators (DG) of 1 megawatt (2 nos), 500 megawatts (4 nos), 250 megawatts (1 nos) and 100 megawatts (1 no) with modification for conversion to natural gas a fuel in the near future. One will be in running mode, while the other will be standby. The output voltage of the DG set will be connected to a 440V, 50Hz, 3 phases, 4 wire panels for distribution of power to all electric equipment for material handling and lighting purposes. Lighting system with high mast lighting tower will be installed around the port for illumination at night for 24 hours' activities and for security purposes.

3.4.6.3 Water Treatment

An industrial borehole of 220 metres deep is planned for the facility. Complete new borehole pumps, filter water package will be installed for the port project. During normal operation the total requirement of water will be approximately 25 m^3 / day. The raw water de-carbonator package, pressure sand filter package will be used for pre-treatment of bore hole water which is then used for the fire water distribution plus potable water after further filtration & suitable treatment. The raw water de-carbonator package aerates the borehole water to remove excess carbon dioxide, oxidize soluble ferrous including magnesium salts to insoluble ferric and magnesium oxides with hydroxides. The insoluble compounds may then be removed in the downstream sand filters. The addition of chlorine in the form of calcium hypochlorite also assists the oxidation of soluble salts. The de-carbonated water flows through sand filters to remove any suspended matter & finally stored in filter water tank. The treated water will be piped to the community (Kirikiri town) were potable water shall be supplied as form of corporate social responsibility of Bestaf Marine Services Limited. The above water treatment process will guarantee that water supplied in this project site meets the specification as presented in Table 3.6 below.

Table 3.5: Drinking Water standards

Parameters	FMEnv Limit	WHO Limit
pH	6.5-8.5	6.5 – 9.2
Fluoride (mg/l)	1.5	0.2
Nitrate (mg/l)	50	-
Nitrite (mg/l)	2	-
Chloride as Cl^- (mg/l)	600	600
Chlorine (mg/l)	5	Free
Copper as Cu^{++} (mg/l)	1.5	1.5
Iron as Fe^{++} (mg/l)	1.0	1.0
Zinc as Zn^{++} (mg/l)	15	15
Sulphate as SO_4 (mg/l)	400	400
Total Hardness (CaCO3) (mg/l)	500	-
Calcium as Ca^{++} (mg/l)	200	200
Magnesium as mg^{++} (mg/l)	150	150
Colour	5 unit	
Odour	Unobjectionable	Unobjectionable
Taste	Unobjectionable	Unobjectionable
Turbidity (NTU)	-	25

Source: FMEnv guidelines 1999 and WHO guideline 2018

3.4.6.4 Sewerage system

Wastewater containing mainly household sewage plus industrial wastewater shall be managed via the use of a system of surface and sub-surface septic tank to process and remove contaminants through Physical, chemical, and biological processes to produce treated wastewater that is safe enough for release into the environment.

3.4.6.5 Fuel Dump

A large storage of diesel is not anticipated. Diesel will be received in trucks and stored in 500 or 1,000 litres above ground and double-wall storage tank. The storage tank area will be surrounded by a concrete bund wall equivalent to the volume of the above ground double-wall storage tank.

3.4.7 Concrete Buildings

The administrative building which shall serve also as an accommodation is structured in an L shape, occupies an area of approximately 860 m^2. The ground floor shall be used as accommodation for security agencies, essential staff for 24 hours' service, customs officers and other regulatory agencies while the top floor shall accommodate the offices. The security house /gate house at 9.66 m x 5.53 m occupies 53.42 m^2 land take.

3.4.8 Waste Management

The port facility construction and operation will produce wastes that must be disposed of in accordance with regulations. Effort shall be intensified to minimize or reduce waste that will normally be produced in the jetty. Operational staff will be given training on waste handling and management, which will improve the overall performance of their operations in the Jetty. Wastes generated within the jetty will be discarded in a manner that will not pose any threat to the environment. Efforts will also be made toward minimization of dust emission. The generated wastes are classified according to the work phase into construction and operational wastes.

3.4.8.1 Construction waste

Solid waste

This will include initial dredged spoils, concrete debris, steel cutting and shaping generated wastes such as scrap metals from steel plate cutting and shaping, as well as spent abrasive from the removal of oxidation and unwanted coating. Welding work will produce used welding rods. Scrap metal and welding rods poses no inherent environmental hazards and can be recycled. However, spent abrasive and paints may be toxic depending on the characteristics of the unwanted coating. Maintenance wastes (oil & fuel/diesel filters, wires etc) generated shall be collected in designated bins and transported to recycling plants. Jetty floor sweeping spoils are unwanted sediments and materials removed from marine, tidal or brackish water substrata as a result of dredging activity. Spoil disposal involves the disposal and management of dredged material in areas where impacts of turbidity and siltation will be minimal (Hopkins and White, 1998). Types or range of material disposal usually consist of fine grained sediments and such areas often contain high concentration of organic materials while dredged materials tend to be mostly of fine to coarse grained sand which usually contain large amount of organic matter. Dredged materials are usually considered potentially hazardous as they are well known· to be sinks for many contaminating chemical compounds as a result of several physical and chemical processes, for instances:

- Many contaminants, eg polychloro-biphenyl (PCB), pesticides, poly aromatic hydrocarbon (PAH) have a low solubility in water and therefore primarily associated with the bottom sediments;
- Heavy metals are deposited from water onto bottom sediments when their solubility decreases during interaction with seas water; and

- Contaminants associated with suspended solids are precipitated onto sediments when extraneous materials mix with seawater and flocculation of the suspended solids occurs.

Therefore, due to worldwide concern, many governments have special limitation on the disposal of dredged materials. Such constraints are designed to limit adverse effects on either the marine environment ecology and on fisheries resources or to limit bio-accumulation of various contaminants in fauna or food resources. The floor sweeping exercise dredging to be carried out in this channel will have minimal impact on aquatic life because the area to be swept is small and volume of material will be contained on land. The site falls with the Badagry Creek area under NPA jurisdiction giving it only the exclusive right to carry out maintenance dredging of the channel. The potential wastes likely to be generated during the dredging operation are solid wastes (dredged spoils), liquid wastes, domestic waste and atmospheric emissions

Liquid Waste

Bentonite shall be used as drilling fluid for piling works. The bentonite fluid shall not be let off into the sea and shall be collected in tanks and sun dried. The solids shall be used in filling works. During the jetty floor sweeping & reclamation of plots the excess water shall be made to flow in water boxes so that the solid particles shall be contained and only water let off to the creek. It is ensured that water let off is not turbid.

Atmospheric Emissions

Gaseous Emissions in the Jetty will primarily result from the combustion of the dock engine as well as vessels, boats and generators. Emissions form compressors and trucks exhaust will also increase atmospheric emission in the jetty. The suspended particles in the air could be reduced by filtering emissions being discharged by covering the exhaust pipes with metallic gauze.

3.4.8.2 Operational Waste

Solid waste

The various forms of solid waste that will be generated from the Port facility include metal scraps, wood; packaging materials, paper, glass etc. due to the need for proper management of solid waste in the port facility, all generated waste shall be segregated at source for

effective handling and management. Colour coded waste bins with list of waste to be collect attached on them will be provided at strategic positions. The waste bins will be marked as general, food and chemical wastes, this will enhance proper segregation of waste at source of collection. The disposal of general and food waste will be done in government approved dumps by government approved contractors, while chemical waste disposal will be handled by engaging the services of waste management professionals. Waste in transit will be accompanied and traced by consignment note. Instructions on material safety handling sheet shall be strictly adhered to and shall form the basis for disposal of waste relating to such products.

Liquid Waste

Ships berthing in the jetty for delivery or shipment of containers are usually required to unload wastes that were generated during the ship's cruise. Bilge wastewater must be treated to remove oil contamination. NPA has existing waste management contract with MARPOL for disposal of hazardous waste includes Bilge wastewater.

Runoff and storm water

Drainage is to be provided to drain all surfaces and storm water from the community, site and jetty as appropriate. The drain structures which will be constructed with reinforced concrete will be finished to a gentle gradient. Operational area storm water such as workshop and trucking areas will be collected into a coalescence pit, where the contaminated storm water will be treated before discharge into creek. Wastes management plan for handling of these wastes is presented in Table 3.7

Table 3.6: Waste generation and disposal

Waste	Est. Vol/wt	Disposal methods
Solid		
Jetty sweeping exercise mud (sludge and sand)	740m^3	Direct disposal into the designated disposal site stipulated by NPA
Bentonite used for bored cast-in place Concrete piles for quay	2 Tons	Overflowing Bentonite will be collected/ contained in tanks. It will be sundried and disposed as filling material at NPA approved site
Empty oil/chemical	500kg/month –	Containers shall be properly washed,

containers	Construction period 100kg/month – Operation period	detoxified and cleaned of residues before being re-used. It may also be crushed and recycled after washing
Maintenance wastes (oil and fuel/diesel filter, wires etc)	100kg/month – construction period 100kg/month – construction period	Collect in designated bins and transport to recycling unit/facilities
Food wastes	25kg/day – Operations	Segregate and disposed in government approved dump sites
Metal scraps, broken tools, rag, old parts, etc	1,500kg/Month – Operations	Stored in skips, segregated and recycled for future use
Plastic bins and containers	20kg/Month – Operations	Segregated, washed and re-used, or may be sold.
Liquid		
Sewage/waste water	10kl/day design	Waste water treatment plant will be installed within the Jetty for sewage and waste water treatment before disposal.
Ballast water	Cannot estimate at this time	Treated appropriately before disposal through MARPOL contractor
Used lube/engine oils	<1,000l/day	Stored in carboys and sent to recycling units
Sanitary waste	10kl/day design	Sewage will be treated in site package Treatment Plant to chlorine levels of 0.8 – 2.0mg/l, BOD of <30mg/l before disposal
Storm water	20cm/day (dry season 450cm/day (wet Season)	Storm water from areas prone to urea spillage will be collected in pit and shall be disposed after checking for quality.
Lube oil, seal and hydraulic oil spills and residuals, and diesel fuel residuals from Dredger	1,040l/week	Suitable equipment will be provided on the dredger to deal with minor spillages
Chemicals such as corrosion inhibitors,	<100l/week	Chemicals wastes will be segregated at sources before disposal . The chemical waste materials

unit cleaning/ regeneration chemicals etc		will be temporarily stored in special containers before transporting them to special high temperature incinerator that will be identified at the commencement of the project.

3.4.9 Man power Prerequisite

The establishment, construction and development of the project would require at least one prime contractor and multiple subcontractors. The project contractor will work closely with the host communities to identify and maximize sourcing of skilled, semi-skilled and unskilled workers from the communities. Approximately 50 workers would be employed during the peak of the construction period which is expected to last about 6 months. The impact avoidance objective on rural setting for line construction will be short term and is not expected to have a significant impact. The contractor would provide and maintain a detailed schedule throughout the construction period with construction of the project progressing either in an orderly fashion from one end of the project to the other, with each activity taking place sequentially or more likely it would progress in a rather random pattern around numerous obstacles. Some of the factors that would determine the flow of work include weather, permit approvals, seasonal environmental restrictions, avoidance of sensitive resources and the contractors' available resources. The total number of personnel all-inclusive is around 100 personnel during the day and night shift.

3.5 Project Phase

The port facility project activities are discussed below with reference to the following activity phases:

1. Pre-Construction/Mobilisation phase;
2. Construction phase;
3. Operation phase; and
4. Decommission phase

3.5.1 Pre-Construction / Mobilization Phase

The pre-construction phase is the initial phase of project implementation (Design or planning phase). In general, this phase involves conducting the Environmental and Social Impact Assessment, geotechnical investigation works and obtaining of permits, survey, demarcated of site. During mobilization (pre-construction), the Project Contractor will recruit necessary administrative and engineering staff for the project and procure and

transport construction equipment to the site. The project design and engineering, procurement and construction contractor will determine and confirm the basis of design, layout and marine engineering design study, design input conditions for quay wall design, fast-time simulations and wave penetration study.

3.5.2 Construction Phase

The construction phase includes Jetty sweeping exercise, clearing, jetty construction, site concreting as well as securing the site. Both machines and manual labour will be involved during construction phase. The construction phase will take about 6 months to construct the port facility. The Project Proponent and Contractor will to the extent practical, recruit construction workers from the local community of Kirikiri. General masonry and related activities to be undertaken will include concrete mixing, construction of foundations, erection of steel tower and curing of fresh concrete surfaces. These activities shall utilize labour from the neighbourhood to supplement some machinery works such as that by the concrete mixers there creating employment for the local population. Once the construction and commissioning of the port facility is complete the project contractor will organize for demobilization of the project areas. Activities to be conducted are demolition of temporary structures installed to support the construction phase removal of installations and equipment from the site. On completion of the above, the project contractor will conduct a rehabilitation and restoration of the environment disturbed to as near as possible to its original state prior to any construction activities.

3.5.3 Operation Phase

The port facility shall be operated by the Bestaf Marine Services Limited. The port facility shall be designed to facilitate maintenance and when the port facility is to be maintained, the downtime will be minimal, and failed or faulty components shall be replaced as needed and expeditiously. All components shall be safe, of good quality, of required design capacity and readily available. The operability philosophy is to ensure the safety requirements and avoid incidents by proper design. Best practices are to be considered in evaluating access to and viewing of operating data, manipulation of controls, removal and replacement of equipment and components of the port facility.

3.5.4 Decommissioning Phase

The expected life span of the port facility is estimated to be at least 50 years. Decommissioning of such an infrastructure is not very likely, but rather a long ranging

repair or exchange of line components. Decommissioning of the port facility will be effected when the active life of the port facility has expired. The aim is to return the disturbed site to equivalent land capability following the port facility decommissioning.

Project Schedule

The port facility which is proposed to commence operation in June 2021 with construction phase expected to last six (6) months (November 2020 to April 2021) provided no hi-coughs are experienced along the way. The project schedule is attached as Table 3.7.

Table 3.7: Project Implementation Schedule

Sr No	Commencement Date: November 2020	TIME (MONTHS)					
		1	2	3	4	5	6
A	**Preliminary Works**						
	Mobilization						
	Site clearing & temporary site set up						
B	**Land Civil Works**						
	Ground Improvements						
	Buildings, Storages, Workshop etc						
	Storm drainages etc						
	Utilities (Water supply, Power supply, Sewage, Lighting)						
C	**Marine Civil Works**						
	Jetty floor area sweeping						
	Reclamation of 0.5 hectares plot by landfill						
	Installation of piles for quay						
	Concrete deck installation						
	Deck fittings						
D	**Mechanical, Electrical & Instrumentation Works**						
	Installation of handling & lifting system						
	Installation of cranes						
	Electrical works						
	Instrumentation Works						
	Pre-commissioning						
	Commissioning						
E	**Ancillary Works**						
	Landscaping						
	Demobilization						

CHAPTER FOUR
DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Study Approach

The purpose of the baseline data acquisition was to establish, the status of the various environmental components in the proposed project area. In order to achieve this, environmental parameters were determined from literature survey, fieldwork, laboratory and data analyses. The components of the environment evaluated covered biophysical, social and health. The EIA study of the project incorporated data from already approved Environmental and Social Impact Assessment reports as secondary data amongst others. The approach adopted was to obtain ecological baseline data from desktop, field and laboratory studies, interviews and consultations with individuals/representatives of the communities of the project area. This approach would provide adequate information for establishing the baseline status of the environment of the study area. The scope of the study covered meteorology, air quality/noise, soil, land use/cover, vegetation, wildlife, geology, hydrogeology, surface water, sediment, hydrobiology, public & occupational Health and socio-economics. Literature review is conducted prior to field data gathering campaign in order to obtain relevant background information on the soil, water, and air of the study area. Further research was also conducted at the end of the field data gathering exercise in order to compare literature information with generated field data and for additional information on the study area. Generally, literature research involved consulting relevant textbooks, journals and publications, researches as well as technical presentations.

The baseline was produced based on a one-season (wet season) field exercise carried out between 26thand 28th August, 2020 (Data gathering Attendance Sheet in Appendix 4.1) as approved by the Federal Ministry of Environment. The samples were analysed at Akwa Ibom State Ministry of Science and Technology Research and Development Laboratory Uyo, a FMEnv accredited laboratory. (Laboratory witnessing Attendance sheet in Appendix 4.2). The past approved FMEnv Environmental Impact Assessment within the project area served as second season (Dry Season) for biophysical parameters. Specific examples of previous studies consulted in generating comparative based data for describing the existing environment of the project area for dry season include but not limited to the following:

- Environmental Impact Assessment (EIA) for Dangote Industries Limited (DIL) Cement Clinker Export and Gypsum Import Facility Apapa Wharf Complex Lagos. November 2018

- Various MRS Holding Limited and Bestaf Marine Services in-house scoping reports, maps/charts on the area (remote sensing, satellite imagery and land use)

4.2 Spatial Boundary

The map showing the study area inclusive of sampling stations is presented in Figure 4.1 and Appendix 4.3. The Sampling points were geo-referenced by means of Global Positioning System (GPS) on the field. Judgmental sampling was applied in the selection of study stations, taking into account ecological features, geographical location of communities and control points in apparently undisturbed areas. The overriding considerations in the selection of sampling points included:

- Ecological features at 0.5km (were sensitivity of physical and biological receptors (e.g. location of water body, flora and fauna, settlements, existing facilities)

- The environmental, natural and man-made features within 2 km radius of the site was surveyed and mapped for biophysical components.

- The buffer distance 2 km for health and socio economics components used here, was chosen at the time as it is considered likely to be the distance beyond which the Project and related activities are unlikely to exert an influence.

- Accessibility;

- geographical dynamics of the study area such as wind direction, upstream/ downstream system and topography of the area

- Areas of interest from satellite imageries; and

- Situating control points in undisturbed areas outside the project area but within the same ecological zone. (2.5km)

- 0.5km radius for biophysical sampling (Table 4.1)

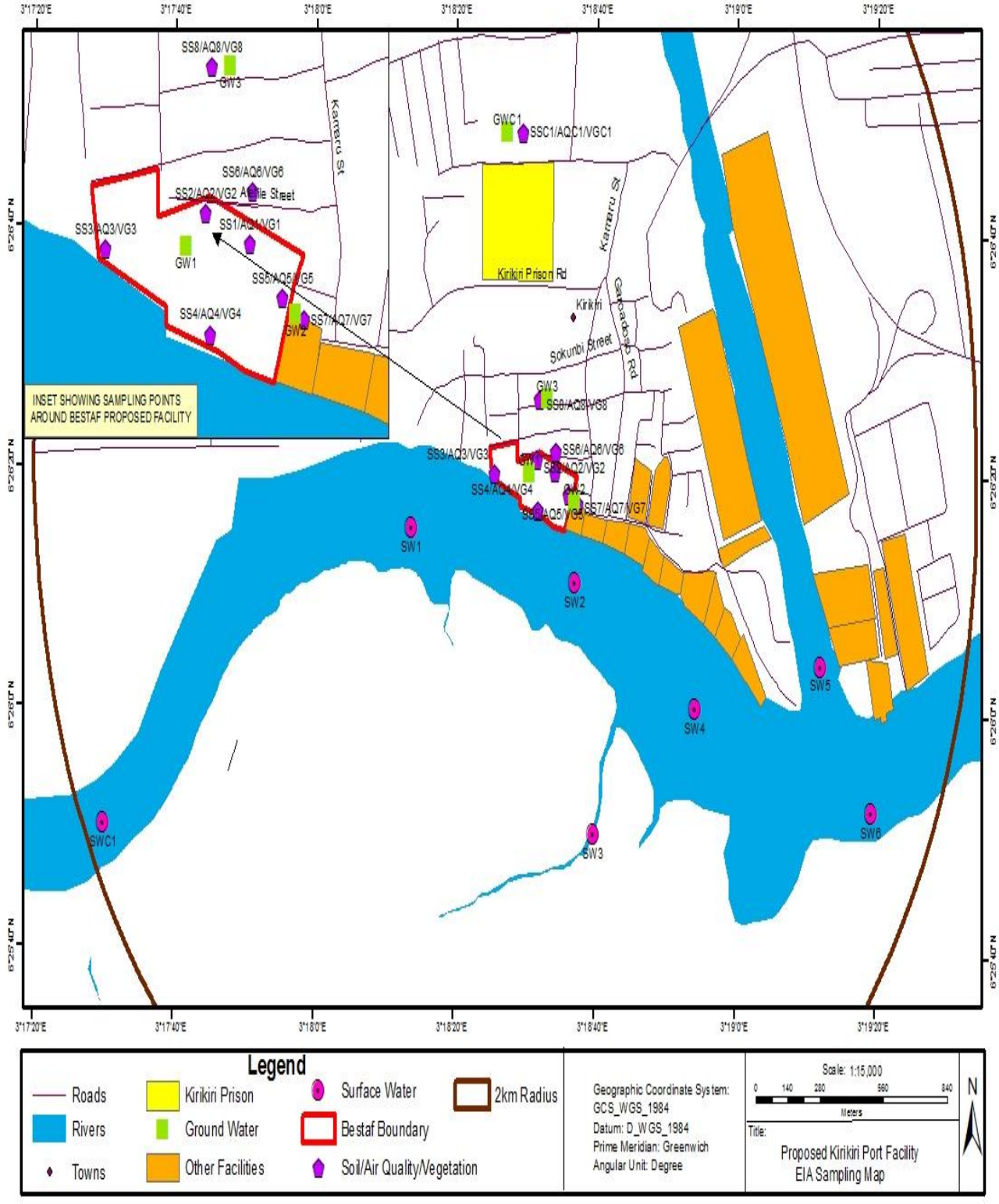


Figure 4.1: Sampling Map

A systematic sampling design according to the Terms of Reference(TOR)/Scope of work(SOW) approved by FMEnv was adopted to cover the entire area both surface water and soil, air quality and meteorological with emphasis on the Port facility project and its immediate environs.

Table 4.1: Sampling Protocol

S /N	Environmental Components	Description of Sample Stations
1.	Surface Water	6 stations + 1 Control
2.	Fisheries	Within the surface water bodies
3.	Ground Water	3 Stations + 1 Control
4.	Sediment	6 stations + 1 Control
5.	Vegetation	3 stations
6.	Wildlife	Study area
7.	Soil	7 stations + 1 Control
8.	Air Quality	7 stations + 1 Control
9.	Climate/Meteorology	7 stations + 1 Control

Table 4.2: Sampling Coordinates

Sampling Station	Easting	Northing
SS1/AQ1	3°18'28.81"E	6°26'18.49"N
SS2/AQ2	3°18'25.64"E	6°26'19.94"N
SS3/AQ3	3°18'25.74"E	6°26'21.94"N
SS4/AQ4	3°18'28.62"E	6°26'22.26"N
SS5/AQ5	3°18'23.28"E	6°26'21.32"N
SS6/AQ6	3°18'29.84"E	6°26'21.11"N
SS7/AQ7	3°18'25.80"E	6°26'24.61"N
SS8/AQC	3°18'21.87"E	6°26'40.44"N
GW1	3°18'25.15"E	6°26'21.70"N
GW2	3°18'30.51"E	6°26'19.22"N
GW3	3°18'28.38"E	6°26'24.54"N
GWC	3°18'20.16"E	6°26'40.70"N
SW1	3°17'48.88"E	6°26'10.15"N
SW2	3°18'13.43"E	6°26'15.67"N
SW3	3°18'37.07"E	6°26'11.50"N
SW4	3°18'54.32"E	6°26'0.54"N
SW5	3°19'10.10"E	6°25'55.73"N
SW6	3°18'40.17"E	6°25'50.52"N
SWC	3°17'23.54"E	6°25'49.01"N

Source: Fieldwork 2020 SS= Soil, AQ= Air Quality, GW= Ground Water, SW= Surface Water

Field sampling and observations was conducted for biophysical components through in-situ measurements with appropriate equipment of certified calibration and ex-situ laboratory analysis of samples using standard methods. A detailed sampling methodology of all components is attached in Appendix 4.4

4.3 Sampling Methodology

The field procedures employed in samples/data collections are summarized in Table 4.3 and details presented in Appendix

Table 4.3 Environmental components and associated methodologies

Environmental Components	Methods
Meteorology	Literature survey, field studies with rain gauge, Thermograph, Wind Vane
Air Quality Noise	Electronic air quality monitor, High volume sampler Noise meter
Vegetation	Transects, Quadrats, key informant interviews, FGD, Questionnaires and Direct observations
Land use/cover	Observations, interviews and sample collections. Environmental baseline survey (EBS) by remote sensing (satellite imagery interpretation), Direct physical observations
Fauna (Wildlife) Terrestrial invertebrates, Amphibians, Reptiles, Birds, Mammals	Direct observations, key informant interviews, Focus group discussions (FGD)
Hydrogeology and Geotechnics	Boreholes and Geophysical Measurements, Vertical electrical sounding (VES)
Surface water/ Hydrodynamics	Observations, water sampler, current meter, pH meter, DO meter, sediment grab, TDS meter, Turbidimeter and conductivity meter
Soil Quality	Soil samples with an auger, and description of each sample with Munsell colour chart
Microbiology	Collection of water samples with Hydrobios water sampler into sterile McCartney bottles; Soil samples with soil auger into aluminium foil Sediments samples with van Veen grab sampler into aluminium foil.
Aquatic biology Sediment	Collection with van Veen grab Collection with plankton net

Phytoplankton Zooplankton Fish species and Fisheries	Collection with plankton net Observation, collection, interviews and laboratory analyses
Social Environment	Key informant interviews, Focus Group Discussion (FGD), direct observation, Administration of structured questionnaires and Collection of secondary data.
Health Studies	Key informant interviews, FGD, Administration of structured questionnaire and interviews, Physical examination of volunteers, Walk-through survey and Collection of secondary data.
Waste Management Waste Management	Physical examination, inventorisation and walk-through survey

***See Appendix 4.4 for details of methodologies**

In situ field measurements recommended by FEPA (1991) and DPR (2018) in situ measurements were carried out on some parameters like Meteorology (temperature- minimum and maximum, relative humidity (RH), wind speed and direction), Air quality/Noise (suspended particulate matter (SPM), COx, SOx, NOx, NH3, H2S, HC and noise), Vegetation lifeform, species frequency and floristic composition, Soil quality – colour, pH, electrical conductivity) and Water quality (pH, temperature, dissolved oxygen concentration, total dissolved solids conductivity, turbidity and salinity)

4.4 Quality Assurance / Quality Control

The overall focus was the application of international standards to Quality & Environmental aspects of the study thereby improving the client Project execution performance. The study was managed and administered according to strict Quality Assurance procedures under the control of specific procedures, which ensures that Client needs and requirements are met for all aspects of the assessment. The QA/QC programme covered all aspects of the study including sample collection, handling, laboratory analyses, data evaluation, data storage and report writing. The procedures all conformed to International Standard of Quality Management System (ISO 9001: 2015) & Environmental Management System (ISO 14001:2015). The quality assurance programme used in the fieldwork and laboratory analyses is in accordance with international and National regulatory recommendations such as:

- Ensuring that only experienced and qualified personnel were engaged in the study

- Carrying out field calibrations of equipment and running distilled water blanks to reduce errors that could arise from field measurements.
- Ensuring that replicate samples were collected and used as checks of instrument performance.
- Carrying out field analytical operations in a defined sequence to avoid cross contamination of instruments.
- Conducting in-situ Parameters such as temperature, pH, turbidity, electrical conductivity and dissolved oxygen because of their rapid change on storage as samples could be subject to microbial degradation and transformation. They were therefore analysed at minimum time after collection.

4.5 Description of the Baseline Environment

4.5.1 Climate / Meteorology

The meteorological and air quality analysis for the study area tends to underscore the state of atmospheric variables on the environment. Meteorological variables such as wind speeds and direction, relative humidity, temperature are crucial in the evaluation of pollutant dispersions and effluents from both anthropogenic and natural induced activities that take place in any environment. The atmosphere serves as sink or a medium of transfer through meteorological activities for these impacts. Rainfall is the key climatic variable and there is marked alternation of wet and dry seasons in most areas. Two air masses controls rainfall – moist northward moving maritime air coming from the Atlantic Ocean and the dry continental air coming from the African Landmass. The climate of the area is affected by ocean and atmospheric interactions both within and outside its environment, in which the Inter-Tropical Convergence Zone (ITCZ) plays a controlling factor. The movement of the ITCZ is associated with the warm humid maritime Tropical air mass with its south-western winds and the hot and dry continental air mass with its dry north-easterly winds.

4.5.1.1 Local Climate

The climate of project study environment falls under the humid tropical rainy climates classified by Koppen and Geiger 1954 as *Aw*. The extent of rainfall periods ranges from 119 – 220 days, with the highest number recorded between the months of July and September, while the lowest is recorded during December and January. A brief dry spell is recorded between the months of August (August

break), however, this not usual as August within the last few years yields high amount of rainfall in the area when compared to peak rainfall periods. The mean annual rainfall for Lagos is above 1,600mm with dominant wind direction being south-westerly during the wet season and north-westerly during the main dry season. The mean daily minimum temperature is about 23°C and a mean daily maximum temperature of about 31°C. The mean monthly relative humidity of the area varies from 70 - 89 %.

Microclimatic data were acquired from the study area for a period of 24 hours and thirty (30) years (1989-2019) long term data (macroclimatic data) retrieved from the Nigerian Meteorological Agency, Lagos and literature sources. During field work survey, a weather station was set up in an open ground representative of the entire site, N 06° 26^{I} 18.2^{II}; E 003° 18^{I} 32.36^{II} and allowed to run for a period of 24 hours in order to establish a baseline for the project environment. All precautions taken when setting up a weather station and during measurements were observed for the onsite measurements as specified by 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. Other air quality parameters monitored include:

a) Nitrogen Oxides
b) Sulphur Oxides
c) Hydrocarbon
d) Suspended particulate matters (PM2.5 and PM10)
e) Hydrogen sulphide
f) Carbon monoxide

The weather parameters were measured with a digital sky-master meter with various sensors for the meteorological components and a digital compass for the wind direction. Criteria air pollutants such as NOx, SOx, CO etc. were measured with a Bosean gas analyzer and suspended particulate matters were measured with a multi-gas analyzer. The air quality measuring equipment as well as the noise meter were allowed to run for 1 hour so as to have accuracy in measurement.

Table 4.4: 24-hour weather pattern recorded within study area.

Hours(GMT) August 27, 2020	Air Temp. (°C)	R/Humidity (%)	Wind		Pressure (mbar)	Cloud Cover (Oktas)	Weather
			Speed (m/sec)	Direction			
11:00	29	80	3.2	SW	1010	6	Partly Cloudy
12:00	30.2	70	3.4	SW	1010	6	Cloudy
13:00	30.5	70	3.2	W	1010	6	Partly Cloudy
14:00	31.0	68	3.4	W	1010	6	Partly Cloudy
15:00	31.2	66	3.8	SW	1010	6	Partly Cloudy
16:00	30.3	70	3.9	SW	1010	6	Partly clougy
17:00	29.5	79	4.0	SW	1010	6	Partly clougy
18:00	29.3	80	3.4	W	1011	6	Cloudy
19:00	29.0	80	3.0	W	1012	Night Time	
20:00	28.2	86	2.5	SW	1011	Night Time	
21:00	28.0	86	2.4	W	1012	Night Time	
22:00	27.7	89	2.0	SW	1012	Night Time	
23:00	27.2	89	1.9	SW	1012	Night Time	
00:00	26.3	92	0.7	SW	1012	Night Time	
01:00	26.1	92	0	Calm	1012	Night Time	
02:00	26.0	92	1.0	W	1012	Night Time	
03:00	25.5	94	1.2	W	1012	Night Time	
04:00	25.0	94	1.0	S	1012	Night Time	
05:00	24.7	94	1.1	W	1012	Night Time	
06:00	24.7	94	1.2	W	1012	6	Cloudy
07:00	25.5	91	1.8	SW	1012	6	Cloudy
08:00	26.8	89	1.9	SW	1013	6	Cloudy
09:00	27.6	85	2.2	SW	1012	6	Cloudy
10:00	29.1	80	2.5	W	1012	6	Cloudy
Mean	**28.0**	**84**	**2.3**	**SW**	**1011**	**6**	

GPS Coordinates: Latitude N06° 26^{I} 18.2^{II} Longitude E003° 18^{I} 32.36^{II}

4.5.1.2 Rainfall Pattern

There was no rainfall amount measured during the period of fieldwork. The study area is situated within the coastal climatic belt. In this belt, rainfall variation is the most important variable for the determination of season. The annual distribution begins with the early rains in March, which ceases in November. In general, there should be only two seasons, but in climatology four seasons are actually discernible for the area. These seasons too are differentiated by rainfall and they are the early rainy season (March-July), little dry season (also called August break), late rainy season

(September-November) and dry season (December-February). The most important role of rainfall to air pollution studies is that it acts as a scavenger by washing pollutants off the atmosphere. The amount and distribution of rainfall in the study area is such that it plays an important role in moving pollutants from the atmosphere to other spheres of the environment. The mean annual rainfall for the study area is above 1600mm and mean monthly rainfall distribution for a synoptic station to survey area as retrieved from existing 30 years (1989-2019) data are shown in Table 4.5. Highest rainfall value was obtained in June (374 mm) while the lowest rainfall value was obtained in January (19 mm) within the period under review. It should be noted that rainfall is very important in environmental projects because of its power to cause erosion and erode soil particles from ground level surfaces.

4.5.1.3 Air Temperature

Maximum and minimum onsite temperature was 31.2 ºC measured at 15:00 GMT and the minimum recorded was 24.7 ºC between 05:00 – 06:00 GMT (Table 1). Analysis from the macro data shows that the months of July-September recorded lower temperatures (27ºC) due to rainy periods while the months December to March recorded higher temperatures (29-30 ºC) due to intense solar radiation prevalent in the dry season (Table 2). The degree of air temperature is dependent on the amount of solar radiation received and this impact on the stability pattern of the atmosphere in the area. Lagos exhibit a stable stability condition at nights that inhibits emission dispersion and slightly unstable/moderate stability classes during the day periods that enhances emission dispersions.

4.5.1.4 Relative Humidity

The maximum relative humidity observed during fieldwork was 94%, recorded at 03:00 - 06:00 GMT. The minimum recorded was 66% at 15:00 GMT. Relative humidity which measures water vapour in the atmosphere is noted to be low during dry season and high during the peak of rainy season due to the influence of moisture laden south-westerly's as seen from the macro average monthly results (Table 4.5). Also relative humidity was minimum during the afternoons and maximum at nights as indicated from the field data (Table 4.4). Figure 4.2 shows relative humidity and temperature values moving in opposite directions. As ambient temperature increases percentage humidity decreases and vise-versa.

Table 4.5: Average Weather Trend for Lagos (1989-2019).

S/N0	Month	Average Temp (°C)	Rainfall (mm)	Cloud Cover (Oktas)	Pressure (mbar)	R/H (%)	Wind Speed (m/s)	Wind Dir.
1	January	29.5	19	5	1009	77	2.9	NE
2	February	30.1	49	6	1008	81	3.4	SW
3	March	30.1	85	6	1008	84	3.8	SW
4	April	29.6	137	6	1008	85	3.8	SW
5	May	29.3	245	6	1009	85	3.6	SW
6	June	28.2	374	7	1011	87	4.2	SW
7	July	27.3	237	7	1012	87	4.8	SW
8	August	27.7	98	7	1012	88	4.8	SW
9	September	27.2	188	7	1011	89	4.3	SW
10	October	28.5	165	6	1010	87	3.5	SW
11	November	29.5	64	6	1009	83	2.8	SW
12	December	29.6	21	5	1009	78	2.5	NE

Source: NIMET, Lagos.

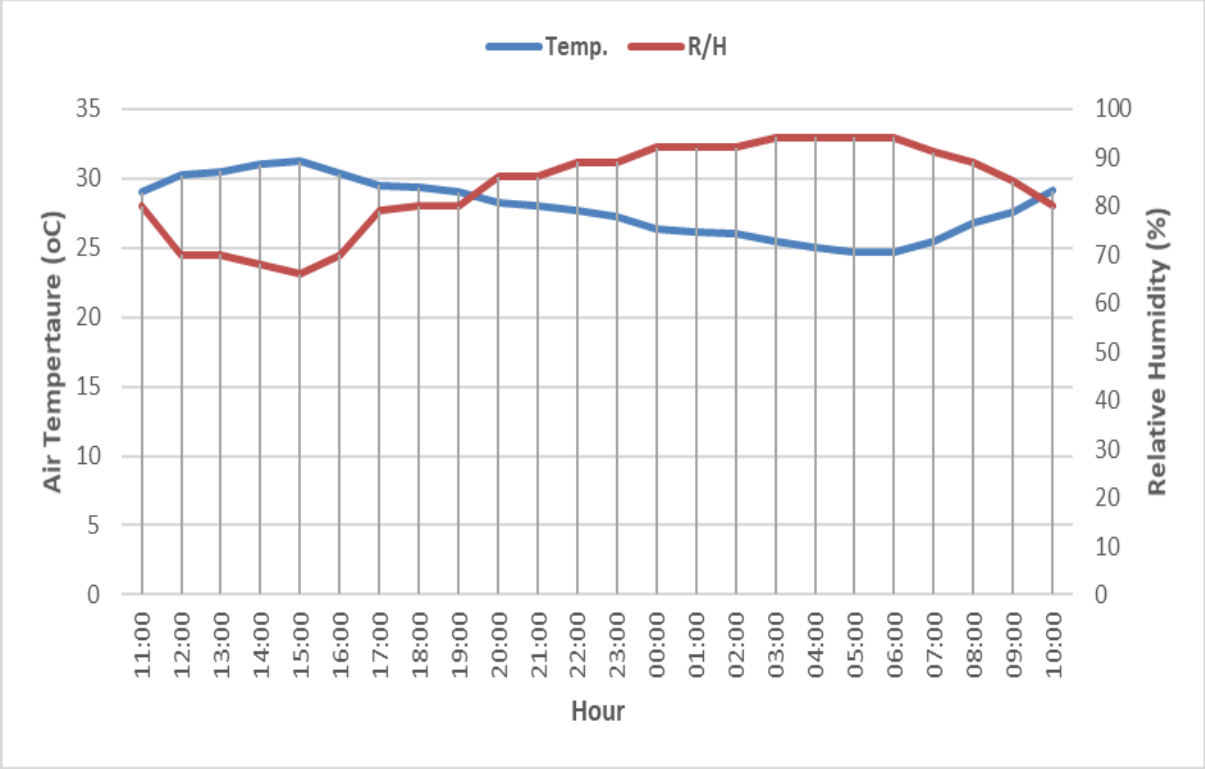


Figure 4.2: Diurnal temperature and relative humidity variations during fieldwork

4.5.1.5 Wind Speed/Direction

Mean wind speed measurement for the study was 2.3 m/sec. Generally, wind speeds were maximum during the day and minimum at dawn. It was calm at the hour 01:00GMT of dawn. Average annual wind speed pattern indicates that rainy periods (March-September) maintains higher trend than the dry season (Table 4.6). The prevailing wind direction during field survey was the south-westerly winds as presented in the wind rose below (Figure 4.3). This trend is also the same for the macroclimatic data retrieved from the Nigerian Meteorological Agency. This implies that emissions will be transferred towards the north-east and eastern direction of the study environment. Wind speed classification from the area shows that range 0.5 -2.1m/s constituted 48.5% while the ranges 2.1 – 3.6 m/s and 3.6 - 5.7 m/s constituted 25 % each (Figure 3). It is however the period of calm that is of importance in evaluating emissions (4.17%). In pollution meteorology calms are associated with inversions (temperature increasing with height). Inversion may result in fumigation; meaning that emissions are trapped at ground level close to their source as against other situations where it is dispersed and diluted much more easily. Inversion is widely known to be frequent during the early hours in the seasons' transition periods.

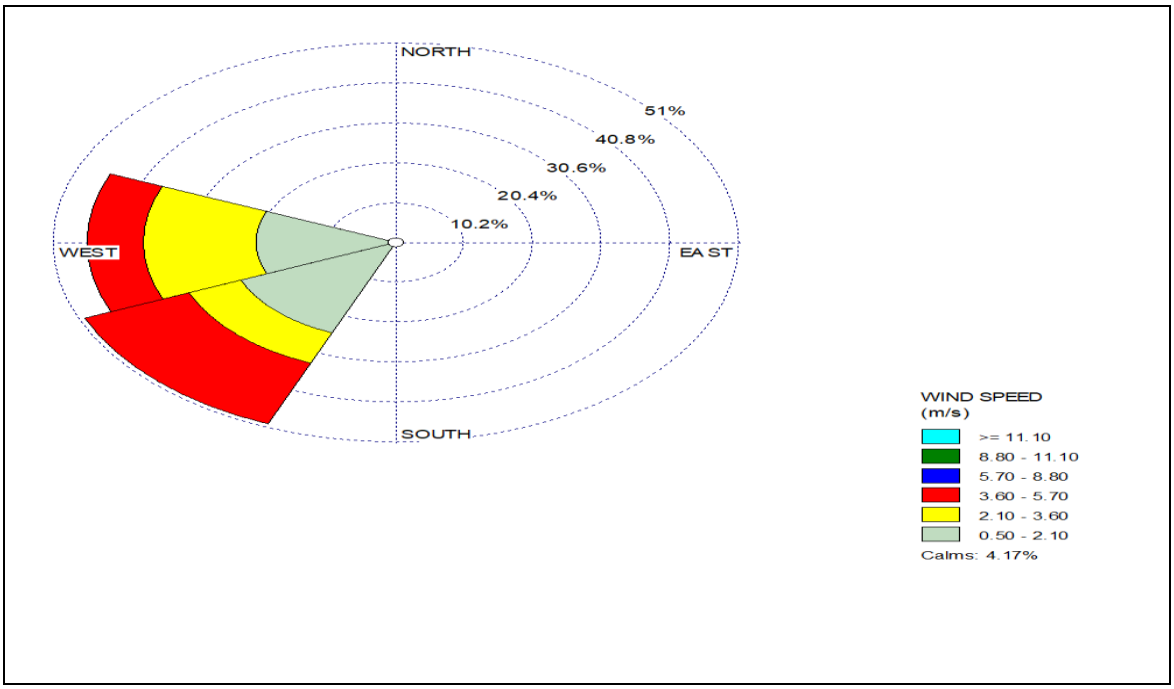


Figure 4.3: **Diurnal wind rose pattern of project area during fieldwork**.

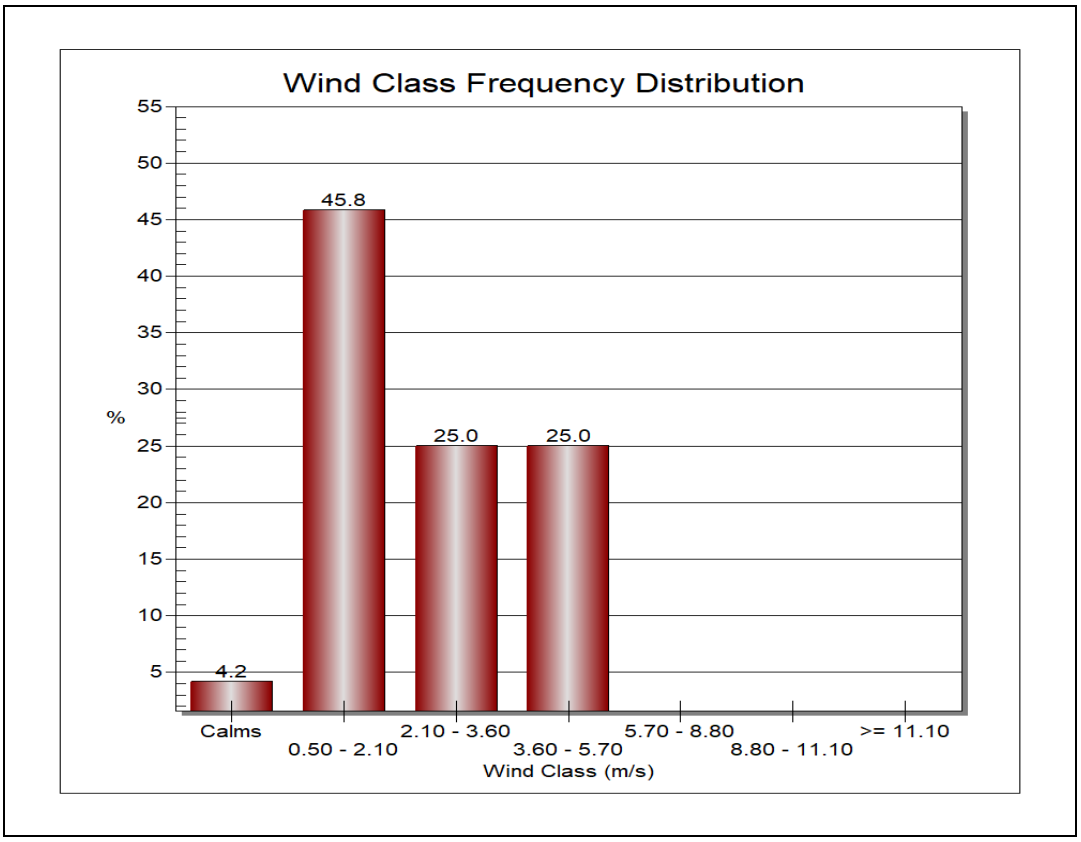


Figure 4.4: Diurnal wind speed record for project area during fieldwork.

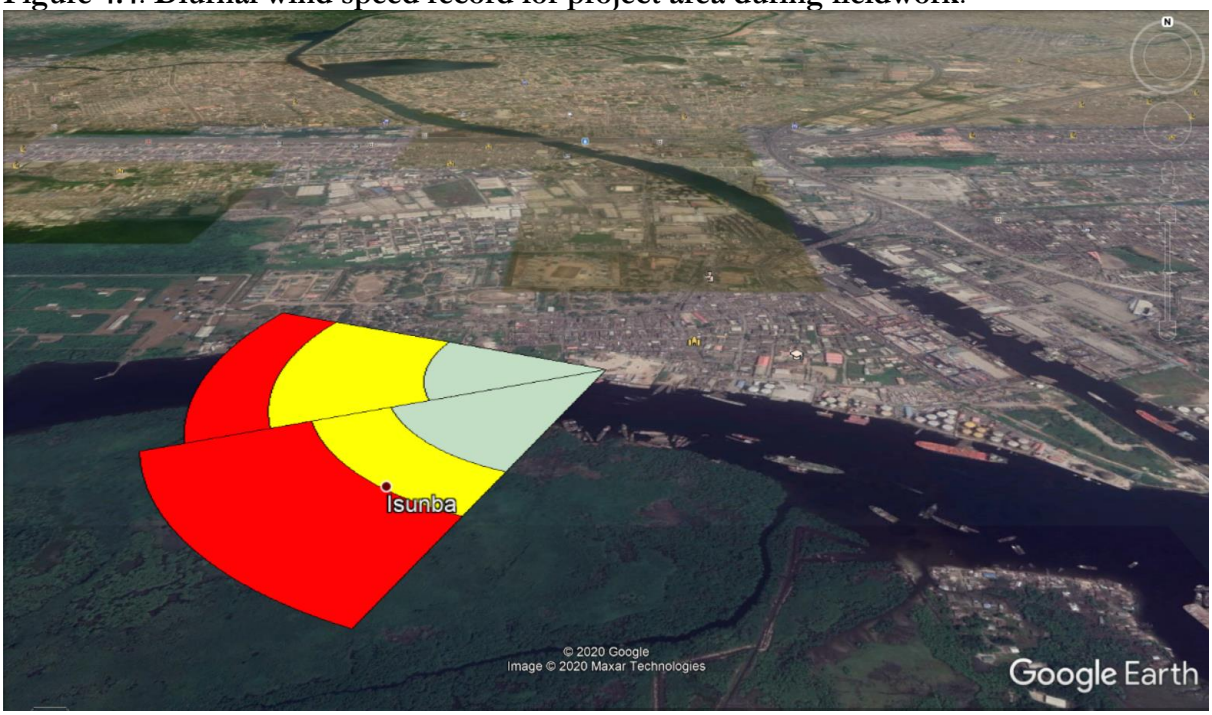


Figure 4.5: Wind Pattern for Study Environment.

4.5.1.6 Cloud Cover

Generally, the weather condition during the period of field observation was cloudy and the average cloud cover was 6 oktas. High amounts of cloud inhibit instability that enhances the dispersion of plumes and lower amounts promote atmospheric dispersion of plumes. Cloud cover is prominent during rainy periods and minimal during dry seasons which either allow or hinder the penetration of solar energy which increases/decreases heat during these periods.

4.5.1.7 Atmospheric Pressure

Atmospheric pressure at sea level measured during the period of field work was between 1010-1013mbar. An important characteristic of the atmosphere is its pressure as it often determines wind and weather pattern across an area. The normal range of the earth's air pressure is from 970mbar to 1050mbar. These differences are the results of low and high air pressure systems which are caused by unequal heating across surfaces. Low pressure areas are usually associated with high winds, warm air and atmospheric lifting. Because of this, lows normally produces clouds, precipitation and other bad weather such as tropical storms and cyclones. Unlike areas of low pressure, the absence of clouds means that areas prone to high pressure experience extremes in diurnal and seasonal temperatures since there are no clouds to block incoming solar radiation or trap outgoing long wave radiation.

Fieldwork study have revealed that the average weather parameters monitored for the study environment showed that ambient temperature, relative humidity, wind speed/direction, atmospheric pressure and cloud cover were 28 ^{o}C, 84 %, 2.3 m/s, SW, 1011 mbar and 6 oktas respectively. The study area features a humid tropical wet climate that is typical of the coastal areas in Nigeria. There are two rainy seasons, with the heaviest rains falling from June to July and a weaker rainy season in September and October. There is a brief relatively dry spell in August and a dry spell from December to February. Average annual rainfall is greater than 1,600 mm and ambient temperature in the range 23^{o}C to 31^{o}C. Relative humidity is always high during rainy months due to the presence cloud cover and slightly lower during the dry season. One of the important weather parameters (wind speed/direction) analyzed shows that the dominant wind direction is WSW, meaning that air emissions will be dispersed at the north-east and eastern directions of the study environment. During field sampling wind speed was generally low at night and moderate during the

day meaning that emissions would disperse faster during the day than at night. Ambient air quality measured for observed pollutants indicated a very low concentrations and far below set limits. Noise levels monitored were moderate and within ambient standards, except for periods of increased human activities which increases the noise levels.

4.5.2 Air Quality & Noise

4.5.2.1 Criteria Pollutants

Air Quality is the measurement of deviation of the ambient air from its natural state due to air pollution (the presence of undesirable material in air, in quantities large enough to produce harmful effects. The undesirable materials may damage human health, vegetation, human property, or the global environment as well as create aesthetic insults in the form of brown or hazy air or unpleasant smells. The assessment of the air quality of the study area was necessary in order to determine the air quality status of the area and investigated the possible contribution of the study environment activities to ambient air quality. The air quality parameters determined were mainly those of public and health concern. Table 4.6 shows the values of air pollutants monitored across the various survey areas.

Table 4.6: Air quality samples recorded during field survey

Parameter	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQC
SOx (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NOx (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CO (ppm)	3	2	2	3	1	2	3	3	1
H2S (ppm)	<0.01	<0.01	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CxHy ($\mu g/m^3$)	1	1	1	1	<1.0	<1.0	<1.0	<1.0	<1.0
NH_3 ($\mu g/m^3$)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PM2.5 ($\mu g/m^3$)	23	16	13	12	10	25	30	25	14
PM10 ($\mu g/m^3$)	26	17	15	13	16	28	32	27	16
Noise [dB(A)]	61.4	68.1	52.7	69.3	66.5	54.3	48.2	42.1	40.5

The concentrations of pollutants measured in the study environment were generally minimal and were almost similar in all the stations. In particular, the concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ammonia (NH_3) and hydrogen sulphide (H_2S) were <0.01 and below significant detection limits. However, there were indication of some level of concentrations for SPM i.e. PM2.5 and PM10 of range (10-23 $\mu g/m^3$) and (13-32 $\mu g/m^3$) across the stations respectively (Table 4.7). This could be attributed to the various activities going on in the study environment as well as close sites that contributes to particulates in the boundary layer atmosphere. Carbon monoxide (CO) for the area was within range 1 – 3 ppm and within the average daily acceptable

range. The level of hydrocarbon in the atmosphere was insignificant across the surveyed stations as it ranged from <1 to 1 μg/m^3. All criteria pollutants measured during fieldwork were below the ambient air quality acceptable limits (Table 4.7).

Table 4.7: Nigerian Ambient Air Quality Standard

Pollutants	Time of Average	DPR Limit	FMEnv Limit
Particulates	Daily average of daily	60-90	250 μg/m3
	values 1 hour	150-230	600 μg/m3
Sulphur Oxides (SOx)	Daily average of hourly values 1 hour	100-150 350	0.01ppm(26μg/m3) 0.1ppm (260μg/m3)
Non Methane Hydrocarbon	Daily average of hourly values 3 hour	-	160 μg/m3
Carbon monoxide	Daily average of hourly values 8 hourly average 1-hour mean	10 30	10ppm (11.4 μg/m3) 20ppm (22.8 μg/m3)
Nitrogen Oxides	Daily average of hourly values (range)	150 400	0.04ppm-0.06 ppm (75.0 μg/m3 -112 μg/m3)
Photochemical Oxidant	Hourly values		0.06 ppm

Source: FEPA, 1991.

Air borne Metals

Air-born metals that are typically linked with chronic health effects (WHO, 1999). Air borne metals when deposited in the lungs have the potential to cause serious irritations leading to bronchitis and exacerbation of existing lung conditions such as asthma. Lung cancers have also been reported following long term exposure to metals in the air. The concentrations of heavy metals in the air environment of the project area were generally low (<0.01ppm) for Rainy season. The air-borne metals concentrations therefore represent background values and indicate that the project area is free from man-made and vehicular contributions (Ajayi and Kamson, 1983).

Table 4.8: Air borne Metals

Stations	Fe (ppm)	Cu (ppm)	Zn (ppm)	Mn (ppm)	Cr (ppm)	Cd (ppm)	Ni (ppm)	Pb (ppm)
AQ1	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ3	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQ8	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AQC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Source: Field work 2020

4.5.2.2 Noise Levels

Noise levels were observed to be low and within acceptable limits during low and peak anthropogenic activities at the stage of fieldwork except at cases were power generation sets as well as both smaller and bigger vehicular movements' transverses the close by road thereby increasing ambient noise levels. Noise level ranged between 40 dB (A) to 69 dB (A) with periods of low activity ranging between 40dB (A) to 55dB (A) and periods of more activities ranging between 60 dB(A) to 69 d(BA). Details of the noise level measurements captured during fieldwork are provided in the Table 4.8. All values recorded were below the Noise Exposure Limits set within the various durations (Table 4.9 and 4.10).

Table 4.9: Noise Exposure Limits for Nigeria.

Duration per Day, Hour	Permissible Exposure Limit dB (A)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Source: FEPA, 1991.

Table 4.10: Maximum Allowable Log Equivalent (Hourly Measurement) in dB (A)

Receptor	Day-time (7:00 – 22:00)	Night-time (22:00 – 7:00)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: World Bank, 1998.

4.5.3 Vegetation

The information presented is based on existing data sources (*e.g.* previous EIAs or published scientific studies and the field survey work completed for the project in August 2020. The proposed project area is a brownfield that fall in the mangrove swamp forest vegetation belt along the Lagos coastline that stretches from Lekki-Epe down to Badagry. Plants were identified by both floristic and structural attributes along with root formation in the mangrove forest vegetation, while visual observation was used to estimate vegetation cover. The survey was delineated into three distinct vegetation stations taking into account ecological features, geomorphological characteristics, geographical location of communities and control points in apparently less disturbed areas. Vegetation zone one (VG1) is across the river by Imore kingdom, vegetation zone two (VG2) is around the facility site at G-kappa street, while vegetation zone three (VG3) is in kirikiri town along dillion street within 2km radius from the project location.

Zone 1 (Badagry creek area)

This area is about 1km radius away from the project site. It is a mangrove swamp vegetation belt characterized by ecological stressors such as fluctuating salinity, periodic inundation, muddy soil etc with minimal anthropogenic disturbance. Typical of the vegetation is the dominant *Avicennia germinans* (Black mangrove) that has developed a very specialized root system with the pneumatophore for life in this tough ecosystem making over 85% of the total plant cover. (See plate 4.1 and 4.2). Cohabiting with the black mangrove are few communities of *Laguncularia racemosa* (white mangrove) and the fern *Acrosticum aureum*). Along the edges of the mangrove by the seaboard are *Hibiscus tiliaceus, Ipomoea aquatica, andropogon sp., Phaseolus lunatus, Pistia stratiotes, R corymbosa*

Plate 4.1: Mangrove vegetation across the river

Plate 4.2: Aquatic sampling showing cross section of mangrove vegetation

Zone 2 Project Site Vegetation

This zone is a brownfield undergoing continuous development and almost devoid of vegetation except for scanty grass community at the fringes and two stand-alone economic trees with insignificant ecosystem services. (see plate 4.3 and 4.4). this area is originally characterized by the riparian vegetation, however developmental activities going on has obliterated major signs of the original vegetation except for a few herbs and grass community along the fence area and just around the drainage. *Terminalia Catappa* (Tropical almond) of the Combretaceae family with a height of about 36m (Plate 4.4) and *Mangifera indica* (Mango tree) of Anacardiaceae family with a height 29m were the only standing tree species present. Among the herbaceous plants were; *Luffa cylindrica*, *Mimosa invisa*, *chromolaena odorata*, *Sida acuta* Grasses/Sedges were *Paspalum vaginatum*, *Typha australis*, *Paspalum. scrobiculatum*, *Andropogon sp.*, *Panicum. Subaldidum*, *Scleria depressa, Typha australis*, *Kyllinga erecta*, *Cyperus esculentus*, *Vossia cuspidata.*

Plate 4.3: Scanty vegetation by the fringes of the project site.

Plate 4.4: Stand-Alone *Terminalia catappa* (Almond tree) at project site.

Zone 3 Kirikiri Town Vegetation

This zone falls under the tropical rainforest vegetation belt but has been stressed by anthropogenic disturbance such as deforestation, urbanization and changes in land-use pattern. The only significant Vegetation cover is at the Prison Barrack which is over 1km away from the project site and will not be impacted by project activities since the barrack infrastructure is not accessible for business use. The vegetation here is abandoned and fallowing farmlands, grass/herb community and a few community of economic trees (see plate 4.5). *Mangifera indica* (Mango), *Terminalia Catappa* (Tropical almond) *Cocos nucifera* (Coconut) and *Musa paradisiaca* (Plantain), *Musa acuminata* (Banana) *Azadirachta indica* (neem),*Psidium guajava* (Guava), *Carica papaya* (pawpaw) were common. *Mitracarpus scaber* and *Melantera scandens* were the dominant herbaceous plants. Others were *Asystasia gangetica*, *Hyptis suaveolens*, *Stachytarpheta indica*, *Sida acuta* and *ageratum conyzoides*. Among the grasses were *Paspalum vaginatum*, *Paspalum scrobiculatum*, *Andropogon sp*., *Panicum. Subaldidum*, *Scleria depressa*, *Typha australis*, *Kyllinga erecta*, *Cyperus esculentus*, *Vossia cuspidata* (see plate 4.5).

Plate 4.5: Grasses colonizing abandoned structure and some economic trees in kirikiri prison barracks.

Plate 4.6: Community of Mango tree in kirikiri prisons barrack

Table. 4.11: Vegetation Composition and Conservation Status

	Species	Common Name	Family	Occurrence	IUCN Status	Plant Type
1	*Avicennia germinans*	Black mangrove	acanthaceae	A	LC	Tree/shrub
2	*Laguncularia racemosa*	White mangrove	combretaceae	O	LC	Tree/shrub
3	*Acrosticum aureum*	Golden leather fern	pteridaceae	C	LC	Herb
4	*Hibiscus tiliaceus*	Cottonwood	Malvaceae	O	LC	Tree
5	*Ipomoea aquatic*	Water spinach	Convolvulaceae	C	LC	Herb
6	*Mangifera indica*	Mango	Anacardeceae	C	DD	Tree
7	*Terminalia catappa*	Almond	Combretacea	C	LC	Tree
8	*Musa paradisiaca*	Cooking plantain	Musaceae	C	LC	Tree
9	*Azadirachta indica*	Neem	Meliaceae	O	LC	Tree
10	*Psidium guajava*	Common guava	Myrtaceae	O	LC	Tree
11	*Musa acuminate*	Banana	Musaceae	C	LC	Tree
12	*Carica papaya*	Pawpaw	Caricaceae	C	LC	Tree
13	*Melanthera scandens*	Black anther	Asteraceae	C	DD	Herb
14	*Mitracarpus scaber*	girdlepod	rubiaceae	A	LC	Herb
15	*Asystasia gangetica*	foxglove	acanthaceae	A	LC	Herb
16	*Hyptis suaveolens*	pignut	lamiaceae	A	LC	Herb
17	*Stachytarpheta indica*		verbenaceae	C	LC	Herb
18	*Aspilia Africana*	Sunflower	Asteraceae	C	LC	Herb
19	*Ageratum conyzoide*	Goatweed	Asteraceae	C	LC	Herb
20	*Philoxerus vermicularis*	saltweed	Amaranthaceae	C	LC	Herb
21	*Luffa cylindrica*	Sponge gourd	Cucurbitaceae	A	LC	Herb
22	*Sida acuta*	wireweed	malvaceae	A	DD	Herb
23	*Mimosa invisa*	Sensitive plant	fabaceae	O	LC	Tree/Shrub
24	*Chromolaena odorata*	Christmas bush	asteraceae	A	LC	Tree/Shrub
25	*Paspalum vaginatum*	Biscuit grass	Poaceae	C	LC	Grass/sedge
26	*Typha australis*	Bulrush	typhaceae	O	LC	Herb
27	*Kyllinga erecta*	Spike sedge	Cyperaceae	A	LC	Grass/sedge
28	*Cyperus esculentus*	Tigernut	Cyperaceae	R	LC	Grass/sedge
29	*Vossia cuspidata*	Hippo grass	poaceae	O	LC	Grass/sedge
30	*Cocos nucifera*	Coconut tree	Arecaceae	C	LC	Tree
31	*Paspalum scrobitulatum*	Kodo millet	Poaceae	A	LC	Grass/sedge
32	*Andropogon sp.*	Beard grass	Poaceae	A	LC	Grass/sedge
33	*Scleria depressa*		Cyperaceae	C	LC	Grass/sedge

Source: Field work 2020 NOTE: **A**-Abundant **C**-Common **O**-Occasional **R-**Rare. **LC**-Least concern **DD**-Data Deficient

There are a total of 33 species, comprising 13 tree/Shrub species most of which are economic trees, 13 herbaceous plants, and 7 grass/sedge species all belonging to a total of 20 families with Asteraceae and Poaceae having 4species each as the dominant families from the result summarized in Table 4.12. The conservation status clearly shows that all surveyed species were either of least

concern to conservation threats or they are Data deficient (DD). It is therefore inferred that they have a healthy population in the wild and need no special conservation attention with respect to this proposed project.

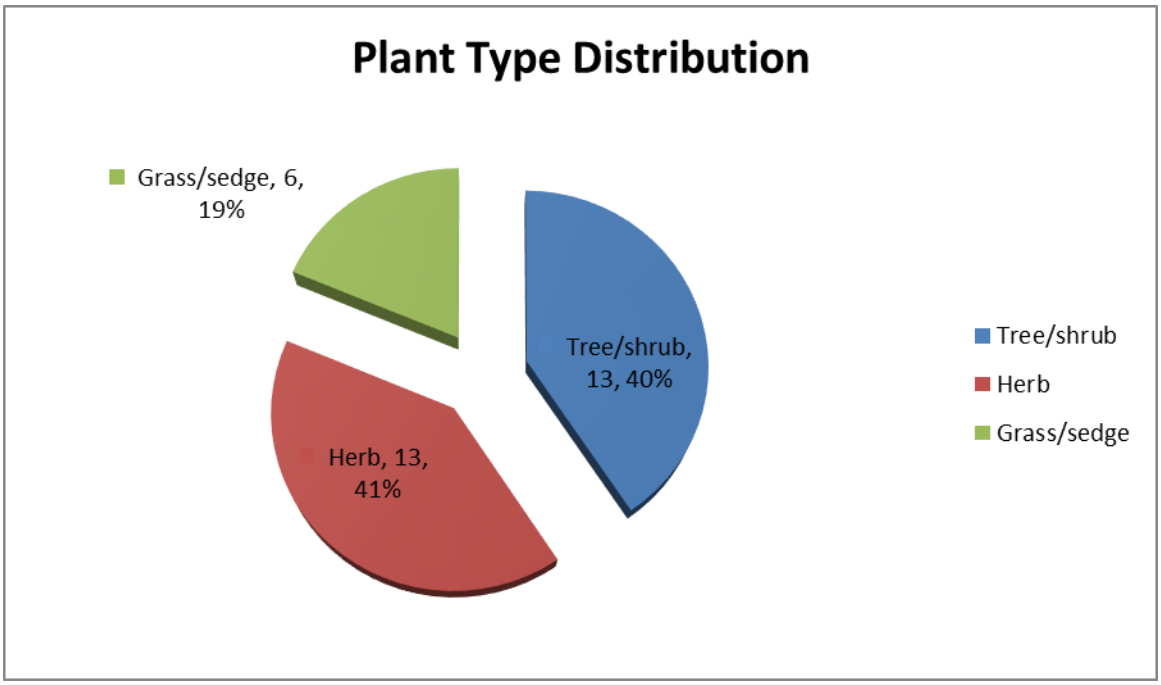


Figure 4.6: Flora Percentage Composition

4.5.4 Wildlife

4.5.4.1 Fauna Composition of study area

The fauna in the study area have largely been hunted, displaced and persecuted by human activities. Direct evidence, which included discussion with the people, as well as, observations revealed that the larger mammals and reptiles have either migrated from the area because of habitat fragmentation or have had their population decimated by over hunting. Despite this scenario, the people interviewed confirmed that there remained a critical mass of small to medium sized mammals in the area. Table 4.12 below shows the total animals surveyed from the entire study area.

Table 4.12 Fauna Resources of the Study Area

S/N	Wild Life Species Scientific Name	Common Name	Class	Occurrence	IUCN Status
1	*Xerus erthropus*	Stripped ground squirrel	Mammalia	O	LC
2	*Epixerus Wilsoin*	Biafran bight palm squirrel	Mammalia	O	LC
3	*Rattus norwegicus*	Africana giant rat	Mammalia	A	LC
4	*Rattus fuscipes*	Bush rat	Mammalia	A	LC
5	*Cercopithecus mona*	Mona monkey	Mammalia	R	NT
6	*Rattus rattus*	House rat	Mammalia	A	LC
7	*Thryonomys swinderianus*	Grass cutters	Mammalia	O	LC
8	*Mastomys natalensis*	Giant rat	Mammalia	A	LC
9	*Agama agama*	West African rainbow	Retilia	A	LC
10	*Lacerta vivipara*	Viviparous Lizard	Reptilia	R	LC
11	*Python sebae*	African rock python	Reptilian	O	LC
12	*Eutropis indeprensa*	Brown skink	Reptilian	C	LC
13	*Naja siamensis*	Spitting cobra	Reptilia	O	V
14	*Crocodiles niloticus*	Nile Crocodile	Reptilia	O	LC
15	*Amblyrhynchus cristatus*	Marine Iguana	Reptilia	R	V
16	*Grayia Smythii*	Smith's water snake	Reptilia	C	LC
17	*Nectarinia cuprea*	Copper sun bird	Avian	C	LC
18	*S. Senegalensis*	Laughing dove	Avian	C	LC
19	*Petronia dentate*	Bush sparrow	Avian	A	LC
20	*Bubulcus ibis*	Cattle egret	Avian	A	LC
21	*Boissonneaua flavescens*	Buff-tailed coronet	Avian	C	LC
22	*Columba iriditorques*	Western bronze-naped pigeon	Avian	C	LC
23	*Ardea alba*	Great white egret	Avian	C	LC
24	*Caprimulgus natalensis*	Swamp nightjar	Avian	C	LC
25	*Cuculus clamosus*	Black cuckoo	Avian	C	LC
26	*Mycteria ibis*	Yellow-billed stork	Avian	O	LC
27	*Ciconia episcopus*	Woolly-necked stork	Avian	C	LC
28	*Glareola cinerea*	Grey pratingcole	Avian	C	LC
29	*Aviceda cuculoides*	African cuckoo hawk	Avian	C	LC
30	*Ispidina picta*	African pygmy kingfisher	Avian	C	LC
31	*Amnirana galamensis*	True frog	Amphibian	C	LC
32	*Bufo regularis*	West African toad	Amphibian	A	LC
33	*Hylarana albolabris*	White-lipped frog	Amphibian	A	LC
34	*Amietophrymus maculatus*	Flat-backed toad	Amphibian	R	LC
35	*hyperolius fusciventris burtoni*	Lime reed frog	Amphibian	C	LC
36	*Haplobatrechus occipitalis*	crowned bullfrog	Amphibian	O	LC

Source: Field work 2020 NOTE: **A**-Abundant **C**-Common **O**-Occasional **R-**Rare. **LC**-Least concern **DD**-Data Deficient

Table 4.13 Diversity indices for the study area

Wildlife	Richness(n)	Relative abundance(n/N)
Mammalian	8	0.22
Reptilian	8	0.22
Bird	14	0.39
amphibian	6	0.17

4.5.4.2 Species Diversity Indices

Shannon weiner, Simpson and equitability indices were used to evaluate species diversity in the study. These indices are used in accessing the degree of richness of any habitat. The diversity indices for the entire study area was conducted across all faunal groups. The avi-fauna group was the richest, recorded a total of 14 species, followed by the mammalian and reptilian group with 8 species each. The amphibians however recorded the least of 6 species from the habitat mix. Simpson index (D) was 3.65, Shannon index (H) was 2.67, while Equitability was 0.91 which indicates that the few species inventoried were well represented.

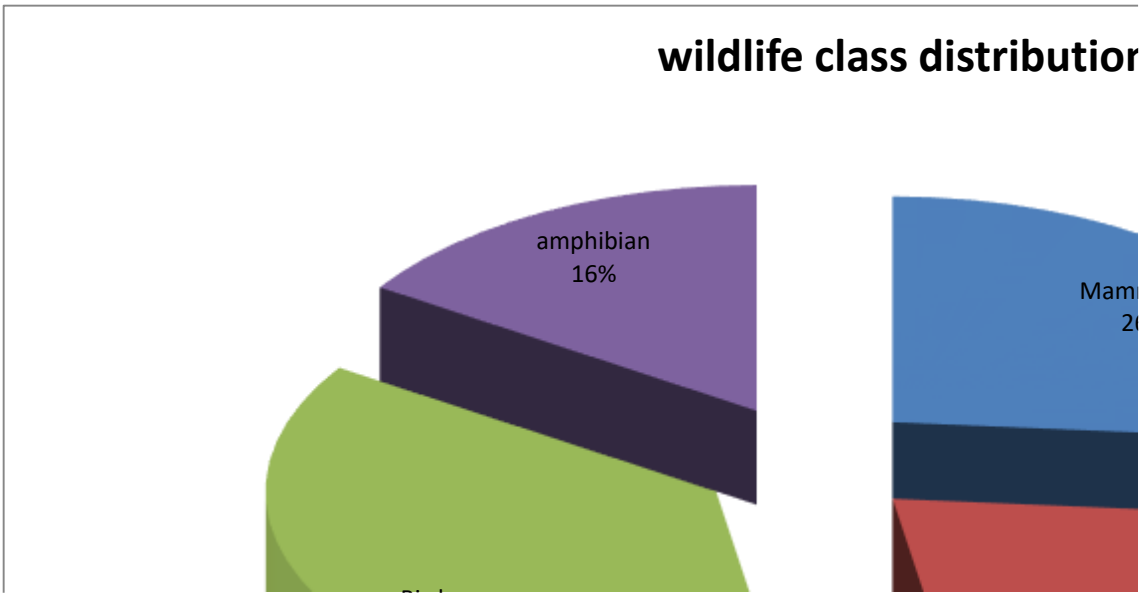


Figure 4.7: Wildlife percentage abundance

4.5.4.3 Avian migration

Some avian species are known to migrate. Avian migration is either a regular or irregular (nomadism, irruption, or invasions) seasonal movement between north and south. In some species, the movement is one directional. Whatever the movement is, avian migration is usually driven by food, habitat and changes in weather conditions. These movements are usually between breeding and

wintering grounds (Veen *et al.,* 2014). In Nigeria as in other countries in the Northern hemisphere, migratory birds commence this movement between February, March and April to warmer areas and return between August, September and October to winter grounds. Migratory movement often results in high mortality and predation. In this study, a total of 4 migratory birds were inventoried.

Table 4.14 Migratory birds censored in the project area

Species	IUCN status	Habitat	Nesting ground	Breeding Season	Major threats	Conservation actions
Ardea alba	LC	Terrestrial and freshwater	Reed beds, bamboo, bushes.	April to July	Wetland degradation and loss	Colony protection, control of vegetation management
Ardea cinerea	LC	freshwater	Low trees and bushes	February to june	Renewed hunting and timber harvesting	
Egretta garzetta	LC	Mangrove	On grounds of protected sites and mangroves	March to july	Wetland degradation and los through drainage for agriculture	Nesting sites should be protected
Milvus migrans	LC	Terrestrial and freshwater	Branches of trees	July to October	Poisoning shooting and pollution of water	Establish non-intrusion zone around colonies.

Fauna population within the project site is sparse and of low diversity and only few species were inventoried. Apart from the abundance of avian species due mainly to the coastal nature of the project area, human activity has significantly reduced the presence of wildlife to only a few mammalian and reptilian species with rodents dominating the other, therefore its ecological significance is minimal. No known threatened or endangered species reside on the proposed site neither is there any known protected area within 5km radius.

4.5.5 Soil

Physico-Chemical characteristics

The nature and quality of soil could also be determined from information on the status of the physico-chemical properties. Such information is also vital in determining the parameters that would also be responsible for specific changes and effects in the study area environment. The results of physio-chemistry, anions and nutrients analysis of soil of the area are presented in Table 4.15 compared with the control station and dry season results of DIL EIA 2018.

Table 4.15: Topsoil (0 – 15 cm) physico-chemical characteristics

Parameter	Wet Season Range	Mean	SD	Wet season Control	EIA 2018 Dry Season	EIA Mean
pH	5.86 – 8.06	7.3	0.9	6.23	4.34 –5.24	4.79
NO_3^-(mg/kg)	0.59 – 2.44	1.4	0.6	1.22	0.36 –0.65	0.51
PO_4^{3-} (mg/kg)	1.21- 1.83	1.4	0.2	1.34	1.36 –1.67	1.56
SO_4^{2-}(mg/kg)	1.43 – 1.68	1.5	0.1	1.53	3.45 –4.68	4.23
Na (mg/kg)	6.2 – 18.3	10.8	4.2	11.50	1.68 –2.08	1.93
K (mg/kg)	7.5 – 13.6	10.6	2.2	7.50	1.15 –1.65	1.37
Ca (mg/kg)	20 – 40	30.3	6.4	20.00	12.55-18.33	15.37
Mg (mg/kg)	2.8 – 8.3	5.2	2.4	6.80	8.88 – 12.68	10.19
CEC (mg/kg)	1.06 – 2.12	1.6	0.4	1.56	9.45 – 12.14	11.07
THC (mg/kg)	0.33 – 1.46	0.8	0.4	1.22	0.03 – 0.36	0.22
Fe (mg/kg)	9.52 – 18.72	14.3	3.3	10.32	247.19-313.64	294.31
Cr (mg/kg)	0.01 – 0.02	0.0	0.0	0.03	0.37 – 0.66	0.50
Cd (mg/kg)	0.36 – 0.51	0.4	0.1	0.35	0.18 – 0.27	0.24
Ni (mg/kg)	1.12 – 1.46	1.3	0.1	1.25	0.13 – 0.47	0.23
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001-0.035	0.04
Pb (mg/kg)	<0.01- 0.01	<0.01	<0.01	0.01	0.09 – 0.26	0.19
Zn (mg/kg)	0.43 – 3.82	1.6	1.3	0.74	93.58 – 109.3	102.41
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	NA	NA
HUB (cfu/100g) x 10^3	2.5 – 3.6	3.0	0.4	2.5	NA	NA
HUF(cfu/100g) x 10^3	1.8 – 3.2	2.6	0.5	1.8	NA	NA

Parameter	Wet Season Range	Mean	SD	Wet season Control	EIA 2018 Dry Season	EIA Mean
THB (cfu/100g)	1.3 x10^3 – 2.2 x10^3	1.7 x10^3	0.4	2.0 x10^3	1.14 – 1.82x10^6	1.56 x10^6
THF (cfu/100g) x 10^3	1.2 – 2.2	1.8	0.4	1.0	2.08-6.24	4.23

Source: Field work 2020, DIL EIA 2018

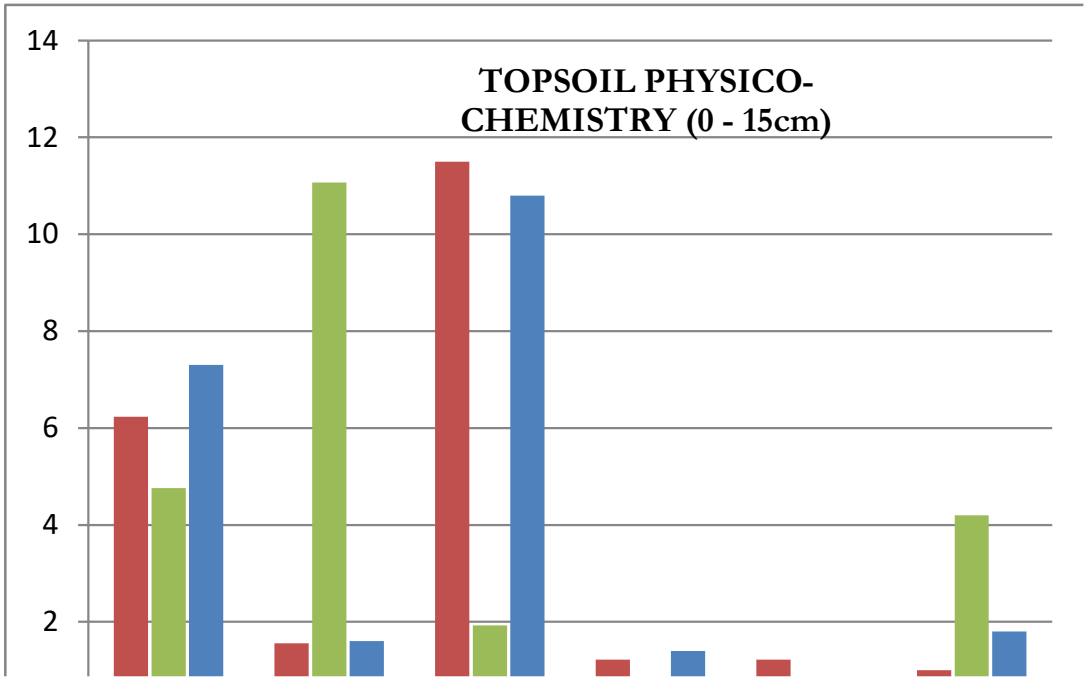


Figure 4.8: Topsoil comparative analysis for rainy and dry season of topsoil

Table 4.16: Subsoil (15-30 cm) physico-chemical characteristics

Impact Parameters	Wet Season Range	Mean	SD	Wet Season Control	EIA 2018 Dry Season	EIA Mean
pH,	7.14 - 8.93	8.1	0.6	8.22	4.28 – 5.16	4.67
NO_3^-(mg/kg)	1.3 - 2.06	1.5	0.3	1.46	0.31 – 0.67	0.48
PO_4^{3-} (mg/kg)	1.15 - 1.83	1.4	0.3	0.82	1.25 – 2.13	1.71
SO_4^{2-}(mg/kg)	1.38 - 1.94	1.7	0.2	1.24	3.14 – 4.68	4.04
Na (mg/kg)	6.2 - 16.2	10.4	3.6	10.30	1.33 – 2.56	1.83
K (mg/kg)	5.31 - 14.6	9.3	3.0	8.30	1.15 – 2.98	2.36
Ca (mg/kg)	15 - 44	30.8	10.9	25.00	10.28 – 15.25	12.20
Mg (mg/kg)	4.2 - 6.4	5.0	1.1	4.70	8.75 – 10.26	9.55
CEC (mg/kg)	1.12 - 2.2	1.7	0.4	2.19	10.56 – 15.36	11.84
THC (mg/kg)	1.22-1.77	1.4	0.2	0.83	0.11 – 0.18	0.16
Fe (mg/kg)	8.46 - 21.11	13.3	4.2	9.78	238.17 – 264.36	255.50
Cr (mg/kg)	0.01 - 0.09	0.03	<0.01	0.02	0.18 – 0.47	0.38
Cd (mg/kg)	0.44 - 0.53	0.5	<0.01	0.41	0.19 – 0.43	0.34
Ni (mg/kg)	0.84 - 1.43	1.2	0.2	1.16	0.22 – 0.31	0.26
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001 – 0.021	0.02
Pb (mg/kg)	<0.001 - 0.01	<0.001	<0.001	0.01	0.03 – 0.36	0.22
Zn (mg/kg)	0.6 - 2.47	1.4	0.7	1.35	84.23 – 104.24	94.17
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	NA	NA
HUB (cfu/100g) x 10^3	1.8 - 4.4	2.9	0.9	3.1	NA	NA
HUF(cfu/100g x10^3)	2 - 3.6	2.9	0.6	2.2	NA	NA
THB (cfu/100g)	1.2 x10^3 - 2.2 x10^3	1.7 x10^3	0.4	1.5 x10^3	1.32 – 2.15 x10^6	2.02 x10^6
THF (cfu/100g) x10^3	1.2 - 2.4	1.9	0.5	1.3	3.44 – 7.36	5.73

Source: Field work 2020

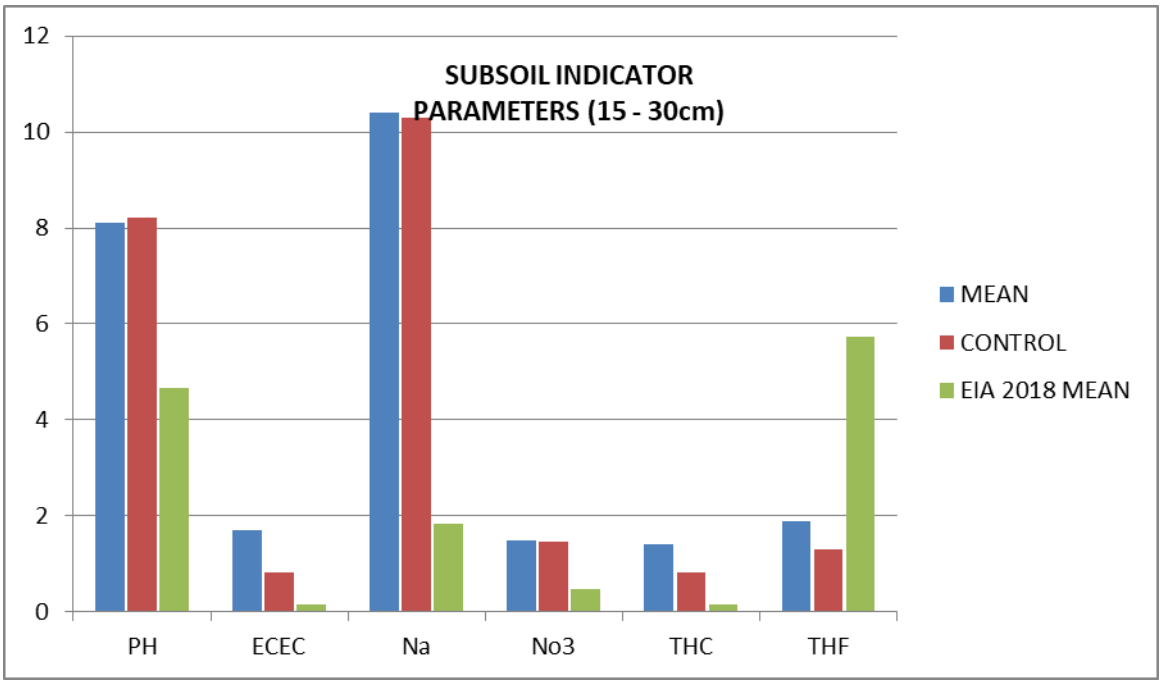


Figure 4.9: comparative analysis of sub soil physico-chemical

4.5.5.1 Soil pH

The pH of the moist soils ranged from 5.86 to 8.06 for top-soils with mean of 7.3 and control at 6.23 in wet season compared to the DIL EIA 2018 dry season result range from 4.34 – 5.24 and mean of 4.79. The subsurface soils with means of 8.1 ranged from 7.14 – 8.93 and control station at 8.22 in wet season compared to DIL EIA 2018 dry season mean of 4.67 with range at 4.28 -5.16 respectively (Table 4.15 and 4.16) in the project environment. Soil pH is fundamental to the understanding of soil systems, because it is an indicator of many reactions in the soils (Moore and Loeppert, 1987; SSSA, 2001). Soil pH controls plant nutrient availability and microbial reactions in soils.

4.5.5.2 Heavy Metals

Heavy metals exist in variable oxidation states, particularly those that belong to the d-group of the periodic table, each with different reactive, toxicological, physiological and bio-concentration potential. Albeit, many heavy metals, namely Cadium (Cd), Lead (Pb) and Zinc (Zn) are toxic in their cationic form, while others require biochemical transformation to organic metallic compounds Donahue, 1990. The soils of the study area show considerable low concentration of iron, lead, zinc, nickel as follows. The observed level of Fe in the wet season was considerably lower than in the dry season both for top and sub soil and study is consistent with most studies carried out on Nigerian

soils in which low concentrations of Fe have been reported during wet season probably due to dilution. The observed Fe concentrations in soils of the project area fall between low and medium soil macro nutrient rating (Table 4.15 and Table 4.16). All metals gave varying concentrations with the exception of arsenic (As), mercury (Hg) and vanadium (V) that showed concentration below the instrument detection limit. Spatial variation across the sampling stations and for both soil depths was very low. The control soil samples recorded values within the ranges observed for the project area for only iron (Fe) and copper (Cu), while it consistently showed higher concentrations for other heavy metals monitored in this study. As observed in iron, the subsoil consistently showed higher concentrations of the metals than topsoil, except Cd and Cr with the same mean concentrations in both soil depths.

The mean metal values were moderately higher in the topsoil compared to the subsoil, during the rainy season. In the dry season, mean concentration of soils declined significantly at 55% level of probability. The mean available nutrient levels for both topsoil and subsoil in both the rainy and dry seasons, fell within the range of values reported for similar ecosystems in the Niger Delta (Ekundayo et al 1997). The mangrove ecosystem area is known to contain high amounts of organic materials mainly because of the high rate of turnover of detritus in the form of decaying mangrove tissues.

4.5.5.3 Oil and Grease

The mean concentrations of oil and grease for topsoil 0.4 mg/kg for subsoils, 1.4 mg/kg and 1.22 and 0.83 mg/kg for the control soils in the rainy season. The values obtained in the DIL EIA 2018 dry season were 0.22 and 0.16 mg/kg soil in the top and sub soil horizons respectively) were lower. The slightly high oil and grease levels obtained in the rainy season for soils from study area indicated that some degree of hydrocarbon contamination of the soils had taken place.

4.5.5.4 Soil Microbiology

Soil represents a very favourable habitat for microorganisms and is inhabited by a wide range of microorganisms, including bacteria, fungi, algae, viruses and protozoa. Microorganisms are found in large numbers in the soil (usually between one and ten million microorganisms are present per gram of soil) with bacteria and fungi being the most prevalent. However, the availability of nutrients is often limiting for microbial growth in soil and may increase soil fertility and plant growth. The analysis reveals low count of hydrocarbon utilizing bacteria and fungi, which is indicative of no

hydrocarbon spillage within the study area. This is further justified by low concentration of THC result recorded in the study area as presented in Table 4.15 and 4.16.

4.5.5.5 Soil Fauna

The soil macro-fauna identified through visual observation in the study area include various arthropods (*Myricaridstriata*, *Dorylusfimbriatus, Glomensmarginata*), Annelids (Earthworms) and Nematodes (*Acanthamoebapolyphaga, Acrobeloidessp, Porcelliascraber*). These organisms are primary consumers; decomposers, mixers and utilizers of energy stored in plants and plant residues, and contribute to the recycling of nutrients. They also help in soil particle aggregation to encourage soil stability. Others are secondary consumers such as centipedes and spiders. These animals consume smaller sized animals and they, also may serve as food for organisms occupying higher levels of the food chain. Soil fauna are notable and are critical in the biological turnover and nutrients release of plant residues by fragmenting the plant residues, resulting in enhanced microorganism activities and grazing of micro flora by fauna. Anderson and Fletcher (1988) noted a symbiotic interaction between earthworm and microorganism in the breakdown and fragmentation of organic matter.

4.5.5.6 Land Use and Cover

Typical of an urban beach area the majority of the coastal land cover in the study area comprises commercial and residential buildings and piles of scrap and waste materials. The facility is situated in the well built up Kirikiri lighter Terminal zone in Amuwo-Odofin LGA of Lagos State. There are no sites of historical or cultural importance within the facility area and therefore its operations shall have no impact on any archaeological or cultural heritage. The land within the facility and its surrounding is used solely for commercial and residential purposes. The information obtained from the land cover/land use satellite imagery of the project area of the port facility project showed that the area (spatial boundary of 2 km) measured about 12.6 km^2. The primary forests (mangrove) occupied approximately 40%, secondary forest 0%, Sparse vegetation and bare soil constituted 0% built up area (urban/industrial) 55%, water constituted about 5% of the land area as meandering Badagry creek channel.

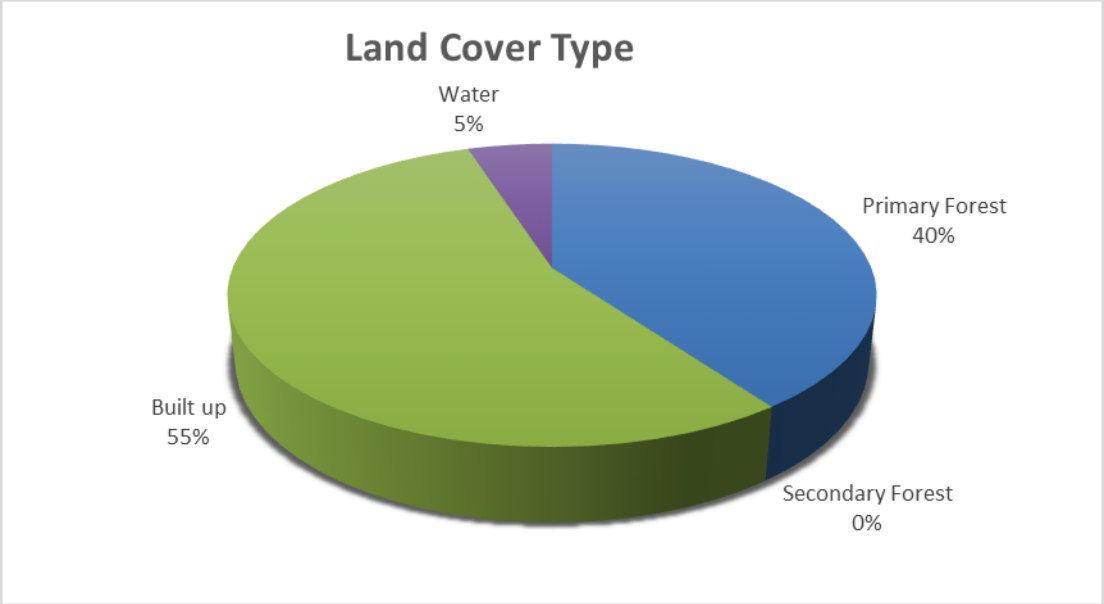


Figure 4.10: Land cover type within 2km radius of study area

4.5.6 Geology / Hydrology

4.5.6.1 Geomorphology

The study area lies in the creek zone of tropical Southwestern Nigeria situated within the lagoon-beach belt in which five physiographic units have been recognized (Adegoke et al., 1980). The first is the Abandoned Beach Ridge complex which comprises coast parallel savannah-grassed sand ridge. This is dissected by creeks and alternating muddy depressions, which support Raphia palm growth. The second is the Coastal Creeks and Lagoons which occur as a belt of nearly 1000 km between Abidjan and the western flank of the Niger Delta. The third is the Swamp Flats which commonly border the lagoon, and are often densely forested with Alchornea cordifolia, a fresh water mangrove. The fourth is the Forested River Flood Plains which constitute a geomorphic form, and dissected the Benin Formation. It is characterized by gallery forests growing on the levees flanking the rivers. The fifth is the Active Barrier Beach complex consisting of a continuous line of wave-washed white to brownish sand with abundant mollusc shells. Low-angle cross stratification is common with exposed clean, fine to coarse sand layers. According to Nwajide (2013) two main vegetation types are identifiable in the area are swamp forest in the coastal belt and dry lowland rain forest in the vegetated area. The swamp forests in the state are a combination of mangrove forest and coastal

vegetation developed under the brackish conditions of the coastal areas and the swamp of the freshwater lagoons and estuaries.

4.5.6.2 Geology

4.5.6.2.1 Physical description

The Kirikiri zone in Lagos State falls within the extensive Dahomey Basin in Southwestern Nigeria. It is underlain by sand, sandy clay and lignite, with vegetated freshwater deposits of mainly Recent-Quaternary alluvium above the Ilaro Formation (Malomo and Oloruniwo, 1983; Onwuka, 1990). The dominant properties of the soils are thick layer of poorly consolidated organic soil that shows no evidence of soil structure and coarse soil particles. High composition of shells and holes and biotic activities of marine and mangrove organisms on to top 15cm of the soil greying. Dark greyish brown colour of the sub-surface (>60cm) soil which is a reflection of the permanent water regime of the deeper layers due to the dominance of anaerobic conditions. In the area a consistent geological sequence was established to depth of 30 metres through manual excavation of trial pits, while groundwater was encountered near the surface to a depth of 1.0 metre The typical trial pit logs show loose organic fine- to medium grained silty sands from the existing ground level to a depth of 0.5 m. The color varies from brown to grey with different plants roots. This can be assumed to be the top soil. The layer 0.5 - 1.5 m is mostly dominated by white colored, fine to medium-grained sands. There exist also few plants and tree roots at this depth. Borehole also confirmed a narrow discontinuous band of organic hydromorphic soils occurs to a depth of 2.0 m. This is underlain by dominantly red ferrallitic soils on loose sandy sediments, which are medium grained sand, sand, clayey sand and coarse sand beyond 12.0 m, as confirmed by Oyedele et al. (2009).

4.5.6.2.2 Penetrometer Test

Borehole BH1 & Cone Penetrometer Test P1 from the ground surface to the depths between -9m in the borehole BH1 and -10m in the penetrometer test P1, the first stratum of sands was encountered. The subsoil observed in the course of the investigation was *in situ* occurring soil type pattern, being in their place of primary origin. The end resistance, q_c *values* between 26kgf/cm^2 and 104kgf/cm^2 and skin resistance q_c *values* between 6kgf/cm^2 and 44kgf/cm^2 were recorded in the penetrometer test, and standard penetration test *N-values* between 7 and 13 were recorded in the borehole test. The sands stratum is considered very loose to loose becoming medium dense in relative density and is considered suitable as a foundation medium for safely supporting structures

on convectional shallow foundations to safely bear moderate to high bearing pressure. Underlying the first sands stratum to the depth of -15m in the borehole BH1 and cone penetration test P1, the first layer of clays and silts was encountered. The clays and silts layer is considered soft becoming firm/stiff in consistency with depth, judging from cone resistance, q_c *values* between 28kgf/cm^2 and 65kgf/cm^2 and skin resistance q_c *values* between 6kgf/cm^2 and 34kgf/cm^2 as recorded in the penetrometer tests. The q_c *values* indicate material with very low to moderate shear strength and high to moderate compressibility potential, suitable for safely supporting very low to moderate loads using any appropriate form of foundations. Beyond the first layer of clays and silts, the second sands stratum was encountered to the depth of -21m. The point resistance, q_c *values* between 76kgf/cm^2 and 140kgf/cm^2 and skin resistance q_c *values* between 16kgf/cm^2 and 48kgf/cm^2 were recorded in the penetrometer test, and standard penetration test *N-values* between 16 and 18 were recorded in the borehole test. The sands stratum is considered medium dense becoming dense in relative density and the density values shows high shear strength and low compressibility potential and the capacity to sustain appreciable superstructures loads via the use of deep foundations in the form of piles. Under the second sands stratum, the second layer of clays and silts were encountered to the depth of -25.5m. The material engineering properties is shown by SPT *N-values* between 7 at the upper reaches and 6 at the lower reaches as recorded within the testing borehole indicating a firm consistency and is considered suitable for safely supporting low to moderate loads using any appropriate form of foundation. Directly under the second layer of clays and silts, the third sands stratum was encountered to the end of the borehole at the depth of -30m. The sands stratum is adjudged medium dense in state of relative density as indicated by SPT *N-values* figure of 22 as recorded in the testing borehole. It possesses moderate to high shear strength and a moderate to low propensity for volume compressibility and deemed good as a foundation medium for safely supporting moderate to high working loads via the use of deep foundations in the form of piles.

Plate 4.7: Penetrometer Test PI in operation

Plate 4.8: Borehole drilling

Borehole BH2 & Cone Penetrometer Test P2 from the ground surface to the depth of -9m in the borehole BH2 and in the penetrometer test P2, the first stratum of sands was encountered. The subsoil observed in the course of the investigation was *in situ* occurring soil type pattern, being in their place of primary origin. The end resistance, q_c *values* between 8kgf/cm^2 and 106kgf/cm^2 and skin resistance q_c *values* between 6kgf/cm^2 and 34kgf/cm^2 were recorded in the penetrometer test, and standard penetration test *N-values* between 5 and 10 were recorded in the borehole test. The sands stratum is considered very loose to loose becoming medium dense in relative density and is considered suitable as a foundation medium for safely supporting structures on convectional shallow foundations to safely bear moderate to high bearing pressure. Underlying the first sands stratum to the depth of -13.5m in the borehole BH2 and cone penetration test P2, the first layer of clays and silts was encountered. The clays and silts layer is considered very soft to soft becoming firm/stiff in consistency with depth, judging from cone resistance, q_c *values* between 6kgf/cm^2 and 70kgf/cm^2 and skin resistance q_c *values* between 4kgf/cm^2 and 32kgf/cm^2 as recorded in the penetrometer tests. The q_c *values* indicate material with very low to moderate shear strength and high to moderate compressibility potential, suitable for safely supporting very low to moderate loads using any appropriate form of foundations. Beyond the first layer of clays and silts, the second sands stratum was encountered to the depth of -23.25m with a band of clays and silts between -16.5m and -18m. Standard penetration test *N-values* between 12 and 16 were recorded in the borehole test, the sands stratum is considered medium dense in relative density. The density values show moderate to high shear strength and moderate to low compressibility potential and the capacity to sustain superstructures loads via the use of deep foundations in the form of piles. Under the second sands

stratum, the third layer of clays and silts and the last subsoil zone was encountered to the end of the drilling at the depth of -30m. The clays and silts layer proved here possesses average engineering properties judging from SPT *N-values* between 6 at the upper reaches and 8 at the lower reaches. The clays and silts layer is considered firm in consistency exhibiting low to moderate shear strength properties with a low to moderate capacity to support superstructure loads using deep foundations in the form of piles.

Borehole Log

Site : Former G. Cappa Yard, End of Ikudehinbo Street, Kirikiri, Lagos State.		Client : MESSRS. BESTAF MARINE SERVICES LIMITED.
Type of Boring	Shell	Job No. : 1009/20
Dia of Hole (mm):	152.00	Bore Hole No.: BH1
Depth (M):	0.00-30.00	Co-ordinates : X = 3.3091926. Y = 6.4386645
Commenced on : 28 July 2020	Completed on : 30 July 2020	Ground Bed RL:
Water Struc : 1.00m	Ground Water : 0.50m	Location of Bore Hole :

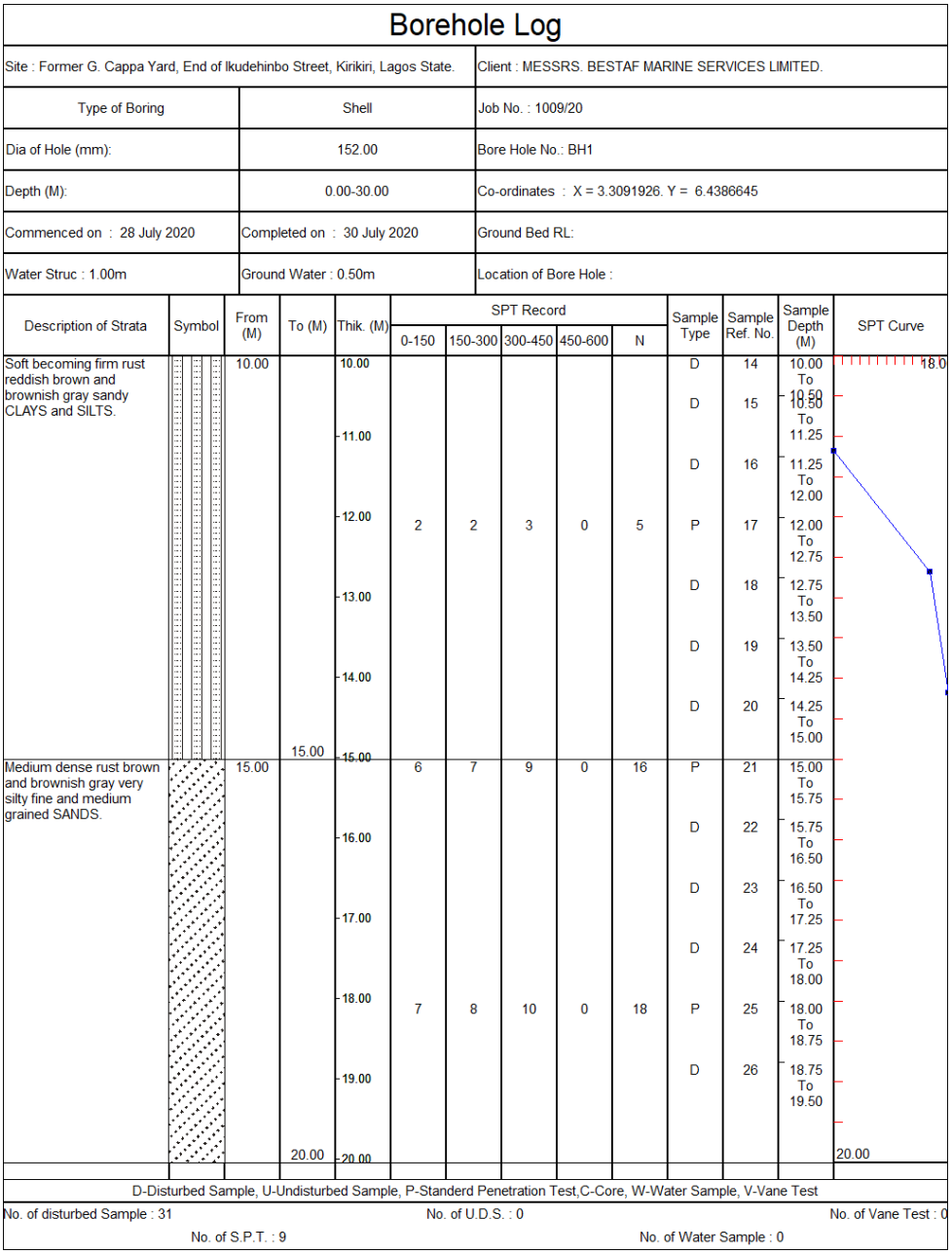
Description of Strata	Symbol	From (M)	To (M)	Thik. (M)	SPT Record 0-150	150-300	300-450	450-600	N	Sample Type	Sample Ref. No.	Sample Depth (M)	SPT Curve
Loose becoming medium dense grayish brown and light brown very silty to silty fine and medium grained SANDS with some coarse grain.		0.00	9.00	0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00	2	3	4	0	7	D D D D P D D D P D D	1 2 3 4 5 6 7 8 9 10 11 12	0.00 To 0.75 0.75 To 1.50 1.50 To 2.25 2.25 To 3.00 3.00 To 3.75 3.75 To 4.50 4.50 To 5.25 5.25 To 6.00 6.00 To 6.75 6.75 To 7.50 7.50 To 8.25 8.25 To 9.00	13.0
Soft becoming firm rust reddish brown and brownish gray sandy CLAYS and SILTS.		9.00	10.00	9.00 10.00	2	3	3	0	6	P	13	9.00 To 9.75	10.00

D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test

No. of disturbed Sample : 31 No. of U.D.S. : 0 No. of Vane Test : 0

No. of S.P.T. : 9 No. of Water Sample : 0

Figure 4.11: Geotechnics Borehole Log 1



Borehole Log

Site : Former G. Cappa Yard, End of Ikudehinbo Street, Kirikiri, Lagos State.		Client : MESSRS. BESTAF MARINE SERVICES LIMITED.
Type of Boring	Shell	Job No. : 1009/20
Dia of Hole (mm):	152.00	Bore Hole No.: BH1
Depth (M):	0.00-30.00	Co-ordinates : X = 3.3091926. Y = 6.4386645
Commenced on : 28 July 2020	Completed on : 30 July 2020	Ground Bed RL:
Water Struc : 1.00m	Ground Water : 0.50m	Location of Bore Hole :

Description of Strata	Symbol	From (M)	To (M)	Thik. (M)	SPT Record 0-150	150-300	300-450	450-600	N	Sample Type	Sample Ref. No.	Sample Depth (M)	SPT Curve
Soft becoming firm rust reddish brown and brownish gray sandy CLAYS and SILTS.		10.00	15.00	10.00 11.00 12.00 13.00 14.00 15.00	2	2	3	0	5	D D D P D D D	14 15 16 17 18 19 20	10.00 To 10.50 10.50 To 11.25 11.25 To 12.00 12.00 To 12.75 12.75 To 13.50 13.50 To 14.25 14.25 To 15.00	18.0
Medium dense rust brown and brownish gray very silty fine and medium grained SANDS.		15.00	20.00	15.00 16.00 17.00 18.00 19.00 20.00	6 7	7 8	9 10	0 0	16 18	P D D D P D	21 22 23 24 25 26	15.00 To 15.75 15.75 To 16.50 16.50 To 17.25 17.25 To 18.00 18.00 To 18.75 18.75 To 19.50	20.00

D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test

No. of disturbed Sample : 31 No. of U.D.S. : 0 No. of Vane Test : 0

No. of S.P.T. : 9 No. of Water Sample : 0

Figure 4.12: Geotechnics Borehole Log 2

Borehole Log

Site : Former G. Cappa Yard, End of Ikudehinbo Street, Kirikiri, Lagos State.		Client : MESSRS. BESTAF MARINE SERVICES LIMITED.
Type of Boring	Shell	Job No. : 1009/20
Dia of Hole (mm):	152.00	Bore Hole No.: BH1
Depth (M):	0.00-30.00	Co-ordinates : X = 3.3091926. Y = 6.4386645
Commenced on : 28 July 2020	Completed on : 30 July 2020	Ground Bed RL:
Water Struc : 1.00m	Ground Water : 0.50m	Location of Bore Hole :

Description of Strata	Symbol	From (M)	To (M)	Thik. (M)	SPT Record 0-150	150-300	300-450	450-600	N	Sample Type	Sample Ref. No.	Sample Depth (M)	SPT Curve
		20.00	21.00	20.00 - 21.00						D	27	20.00 To 20.25	22.0
Soft becoming firm rust yellowish brown and brownish gray CLAYS and SILTS.		21.00	25.50	21.00 - 22.00	2	3	4	0	7	P	29	21.00 To 21.75	
										D	30	21.75 To 22.50	
				22.00 - 23.00						D	31	22.50 To 23.25	
										D	32	23.25 To 24.00	
				23.00 - 24.00	2	2	4	0	6	P	33	24.00 To 24.75	
				24.00 - 25.00						D	34	24.75 To 25.50	
Medium dense brownish gray silty fine medium and coarse grained SANDS.		25.50	30.00	25.00 - 26.00						D	35	25.50 To 26.25	
										D	36	26.25 To 27.00	
				26.00 - 27.00	5	10	12	0	22	P	37	27.00 To 27.75	
										D	38	27.75 To 28.50	
				27.00 - 28.00						D	39	28.50 To 29.25	
										D	40	29.25 To 30.00	30.00
				28.00 - 29.00									
				29.00 - 30.00									

Bore Hole Terminated at : 30.00

D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test

No. of disturbed Sample : 31 | No. of U.D.S. : 0 | No. of Vane Test : 0

No. of S.P.T. : 9 | No. of Water Sample : 0

Figure 4.13: Geotechnics Borehole Log 3

Borehole Log

Site : Former G. Cappa Yard, End of Ikudehinbo Street, Kirikiri, Lagos State.		Client : MESSRS. BESTAF MARINE SERVICES LIMITED.
Type of Boring	Shell	Job No. : 1009/20
Dia of Hole (mm):	152.00	Bore Hole No.: BH2
Depth (M):	0.00-30.00	Co-ordinates : X = 3.3076361. Y = 6.4392471
Commenced on : 30 July 2020	Completed on : 01 August 2020	Ground Bed RL:
Water Struc : 0.80m	Ground Water : 0.20m	Location of Bore Hole :

Description of Strata	Symbol	From (M)	To (M)	Thik. (M)	SPT Record 0-150	150-300	300-450	450-600	N	Sample Type	Sample Ref. No.	Sample Depth (M)	SPT Curve
Very loose becoming loose/medium dense grayish brown and light brown slightly silty to silty fine medium and coarse grained SANDS.		0.00	9.00	0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00	1	2	3	0	5	D D D D P D D D P D D D	1 2 3 4 5 6 7 8 9 10 11 12	0.00 To 0.75 0.75 To 1.50 1.50 To 2.25 2.25 To 3.00 3.00 To 3.75 3.75 To 4.50 4.50 To 5.25 5.25 To 6.00 6.00 To 6.75 6.75 To 7.50 7.50 To 8.25 8.25 To 9.00	10.0
Soft becoming firm brownish gray and light gray sandy CLAYS and SILTS.		9.00	10.00	10.00	2	3	5	0	8	P	13	9.00 To 9.75	10.00

D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test

No. of disturbed Sample : 31 No. of U.D.S. : 0 No. of Vane Test : 0

No. of S.P.T. : 9 No. of Water Sample : 0

Figure 4.14: Geotechnics Borehole Log 4

Borehole Log

Site : Former G. Cappa Yard, End of Ikudehinbo Street, Kirikiri, Lagos State.		Client : MESSRS. BESTAF MARINE SERVICES LIMITED.
Type of Boring	Shell	Job No. : 1009/20
Dia of Hole (mm):	152.00	Bore Hole No.: BH2
Depth (M):	0.00-30.00	Co-ordinates : X = 3.3076361. Y = 6.4392471
Commenced on : 30 July 2020	Completed on : 01 August 2020	Ground Bed RL:
Water Struc : 0.80m	Ground Water : 0.20m	Location of Bore Hole :

Description of Strata	Symbol	From (M)	To (M)	Thik. (M)	SPT Record 0-150	150-300	300-450	450-600	N	Sample Type	Sample Ref. No.	Sample Depth (M)	SPT Curve
Soft becoming firm brownish gray and light gray sandy CLAYS and SILTS.		10.00	13.50	10.00 11.00 12.00 13.00	3	3	4	0	7	D D D P D	14 15 16 17 18	10.00 To 10.50 10.50 To 11.25 11.25 To 12.00 12.00 To 12.75 12.75 To 13.50	15.0
Medium dense rust brown and light gray clayey very silty fine and medium grained SANDS with some coarse grain.		13.50	16.50	14.00 15.00 16.00	6	7	8	0	15	D D P D	19 20 21 22	13.50 To 14.25 14.25 To 15.00 15.00 To 15.75 15.75 To 16.50	
Soft becoming firm light gray sandy CLAYS and SILTS.		16.50	18.00	17.00 18.00						D D	23 24	16.50 To 17.25 17.25 To 18.00	
Medium dense whittish gray, rust yellowish brown and whittish gray clayey very silty predominantly fine grained SANDS.		18.00	20.00	19.00 20.00	4	5	7	0	12	P D	25 26	18.00 To 18.75 18.75 To 19.50	20.00

D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test

No. of disturbed Sample : 31 No. of U.D.S. : 0 No. of Vane Test : 0

No. of S.P.T. : 9 No. of Water Sample : 0

Figure 4.15: Geotechnics Borehole Log 5

Borehole Log

Site : Former G. Cappa Yard, End of Ikudehinbo Street, Kirikiri, Lagos State.		Client : MESSRS. BESTAF MARINE SERVICES LIMITED.
Type of Boring	Shell	Job No. : 1009/20
Dia of Hole (mm):	152.00	Bore Hole No.: BH2
Depth (M):	0.00-30.00	Co-ordinates : X = 3.3076361. Y = 6.4392471
Commenced on : 30 July 2020	Completed on : 01 August 2020	Ground Bed RL:
Water Struc : 0.80m	Ground Water : 0.20m	Location of Bore Hole :

Description of Strata	Symbol	From (M)	To (M)	Thik. (M)	SPT Record 0-150	150-300	300-450	450-600	N	Sample Type	Sample Ref. No.	Sample Depth (M)	SPT Curve
		20.00	23.25	20.00 21.00 22.00 23.00	5	7	9	0	16	D D P D D	27 28 29 30 31	20.00 To 20.25 20.25 To 21.00 21.00 To 21.75 21.75 To 22.50 22.50 To 23.25	16.0
Soft becoming firm rust yellowish reddish pinkish brown and whittish gray sandy CLAYS and SILTS.		23.25	30.00	24.00 25.00 26.00 27.00 28.00 29.00 30.00	2	2	4	0	6	D P D D D P D D D	32 33 34 35 36 37 38 39 40	23.25 To 24.00 24.00 To 24.75 24.75 To 25.50 25.50 To 26.25 26.25 To 27.00 27.00 To 27.75 27.75 To 28.50 28.50 To 29.25 29.25 To 30.00	30.00
				Bore Hole Terminated at : 30.00									

D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test

No. of disturbed Sample : 31 No. of U.D.S. : 0 No. of Vane Test : 0

No. of S.P.T. : 9 No. of Water Sample : 0

Figure 4.16: Geotechnics Borehole Log 6

4.5.6.2.3 Particle Size Analysis

The result of the particle size analysis of soil samples are presented in the geotechnical report conducted by International Geotechnical Services presented in Appendix 4.5. Evaluation of the field and laboratory analytical results of the soils shows that the texture of soils in the field was mainly sandy loamy with sand particles dominating the aggregates. The percent sand ranged from 55.5% to 75.1% averaging about 65.5% and the top samples (0-15cm depths) have more sand particles than the bottom or lower (15-30cm depths). Clay particle had the least composition of between 2.5% to 10.5%. It had a mean percent composition of 5.5% which increased down the profile.

4.5.6.2.4 Porosity

In general, the porosity of the soils in the area was moderately high with a range of 45 -75% for the o-15cm depth and 40-60% for the 15-30cm depths. The porosity is higher on the surface. There was no area in the field where the total porosity was within 9-10% that would have resulted in adequate supply of oxygen for good root development at field capacity

Plate 4.9: SPT BH 3 on site

Plate 4.10: Penetrometer Test P2

4.5.6.2.5 Bearing Pressure

Zone 1 within the project site as observed in the analysis of the site geology, the subsoil encountered from the ground surface to depths between -9m in the borehole BH1 and -10m in the penetrometer test P1 is considered very loose to loose becoming medium dense in relative density and capable of safely supporting moderate to high bearing pressures load. The important factor is to ensure that the total settlement of pavement under the loads is not excessive. Using q_c *value* of

38kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 124kN/m^2 is calculated for the ground surface with a factor of safety of 3 and to limit expected maximum settlement to 25mm. If the allowable bearing pressures values given above with factor of safety of 3 are considered inadequate, low factor of safety of 2.5 may be adopted. Using q_c *value* of 38kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 141kN/m^2 is calculated for the ground surface with a factor of safety of 2.5 and to limit expected maximum settlement to 40mm. If the allowable bearing pressures values given above with factor of safety of 2.5 are considered inadequate, low factor of safety of 2 may be adopted. Using q_c *value* of 38kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 176kN/m^2 is calculated for the ground surface with a factor of safety of 2 and to limit expected maximum settlement to 65mm.

Zone 2 Aas observed in the analysis of the site geology, the subsoil encountered from the ground surface to depth of -9m in the borehole BH2 and in the penetrometer test P2 is considered very loose to loose becoming medium dense in relative density and capable of safely supporting moderate to high bearing pressures load. The important factor is to ensure that the total settlement of pavement under the loads is not excessive. Using q_c *value* of 11kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 36kN/m^2 is calculated for the ground surface with a factor of safety of 3 and to limit expected maximum settlement to 25mm. If the allowable bearing pressures values given above with factor of safety of 3 are considered inadequate, low factor of safety of 2.5 may be adopted. Using q_c *value* of 11kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 44kN/m^2 is calculated for the ground surface with a factor of safety of 2.5 and to limit expected maximum settlement to 40mm. If the allowable bearing pressures values given above with factor of safety of 2.5 are considered inadequate, low factor of safety of 2 may be adopted. Using q_c *value* of 11kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 51kN/m^2 is calculated for the ground surface with a factor of safety of 2 and to limit expected maximum settlement to 65mm. If the allowable bearing pressures values given above with factor of safety of 2 are considered

inadequate, low factor of safety of 1.5 may be adopted since we are dealing with pavement/traffic loads and not columns axial loads. Using q_c *value* of 11kgf/cm^2 with consideration for the expected settlement within the very loose to loose becoming medium dense sands stratum, an allowable bearing pressure value of 68kN/m^2 is calculated for the ground surface with a factor of safety of 1.5 and to limit expected maximum settlement to 100mm. Some form of ground improvement or reinforced concrete pavement may be considered necessary before higher value of allowable bearing pressure may be adopted for safely supporting loads on this second site.

4.5.6.3 Hydrology

The hydrogeology of the project area is a reflection of the interplay between surface waters, geomorphic structures and regional deep groundwater flow (Abam 1999). The groundwater in the project area can be regarded as shallow groundwater contained within the topmost 1 -3 m from the ground level based on the hydrogeological characteristics as presented in Table 4.17.

Table 4.17: Groundwater depth

Tests	Groundwater Level
BH1	0.50m
BH2	0.20m
P1	0.25m
P2	0.20m

The level indicated in the boreholes shall be subject to seasonal variation accordingly as rainfall and the nearby body of water influences the groundwater regime. The test may be considered to have being carried out during the height of the raining season and the groundwater level is not expected to rise. The water quality represented by the physico-chemical properties of the shallow groundwater within the project area is presented in Table 4.19. The groundwater quality is naturally dependent on the morphology of the surface water system, interactions between surface water and groundwater along the creek channels, frequency and quantity of rainfall, tidal movement, brackish discharges and the density of the distributaries in the area. The creek is in hydraulic and hydrodynamic connection with the shallow aquifer. Both the groundwater levels and quality are therefore affected by the tidal movements and salinity.

Table 4.18: Physicochemical parameters of ground water of the study area

S/N	Impact Parameters	GW1	GW2	GW3	GWC
1	pH	6.50	6.50	6.90	6.90
2	Temperature (°C)	29.2	29.4	30.1	27.9
3	Elec. Conductivity (µs/cm)	1061	1131	412	462
4	TDS (mg/l)	607	642	227	310
5	DO (mg/l)	3.90	4.10	2.90	2.30
6	Turbidity (NTU)	4.20	4.00	2.70	1.70
7	Alkalinity (mg/l)	50.00	80.00	60.00	50.00
8	TSS (mg/l)	15.0	9.0	0.60	0.50
9	THC (mg/l)	<0.1	<0.1	<0.1	<0.1
10	BOD (mg/l)	2.25	1.75	1.70	0.60
11	COD (mg/j)	4.50	3.50	3.40	1.20
12	Oil Grease (mg/l)	<0.1	<0.1	<0.1	<0.1
13	NO_3^- (mg/l)	1.20	0.16	0.51	0.01
14	PO_4^{3-} (mg/l)	0.13	1.30	0.52	0.22
15	SO_4^{2-} (mg/l)	2.05	2.11	0.93	1.00
16	Na (mg/kg)	3.00	2.40	3.80	2.60
17	K (mg/kg)	3.20	2.80	3.10	1.60
18	Ca (mg/kg)	10.00	8.00	8.00	6.00
19	Mn (mg/kg)	0.75	0.77	0.78	0.36
20	Mg (mg/kg)	6.00	4.80	6.00	3.60
21	Fe (mg/l)	1.02	0.98	1.11	0.82
22	Cd (mg/l)	<0.001	<0.001	<0.001	<0.001
23	Cr (mg/l)	<0.001	<0.001	<0.001	<0.001
24	Ni (mg/l)	0.62	0.58	0.61	0.99
25	V (mg/kg)	<0.001	<0.001	<0.001	<0.001
26	Pb (mg/l)	<0.001	<0.001	0.002	<0.001
27	Zn (mg/l)	0.43	0.49	0.62	0.39
28	Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001

Source: Fieldwork 2020

Groundwater chemistry is controlled by the chemistry of the infiltrating water, the chemistry of the porous media including the interstitial cement or matrix of the aquifer, the rate of groundwater flow and the permeability of the aquifer (Offodile, 2002). More than 85% of public water for consumption is sourced from groundwater (Ufoegbune et al, 2009), and this is used for domestic, industrial and agricultural purposes. Groundwater pollution is one of the environmental problems facing many coastal regions as a result of high population, urbanization and industrialization. The quality of groundwater in the study area was investigated in this study using multivariate geostatistical techniques. The groundwater in the project area was conducted

based on collection of groundwater from hand dug wells and geotechnical survey drilled boreholes.

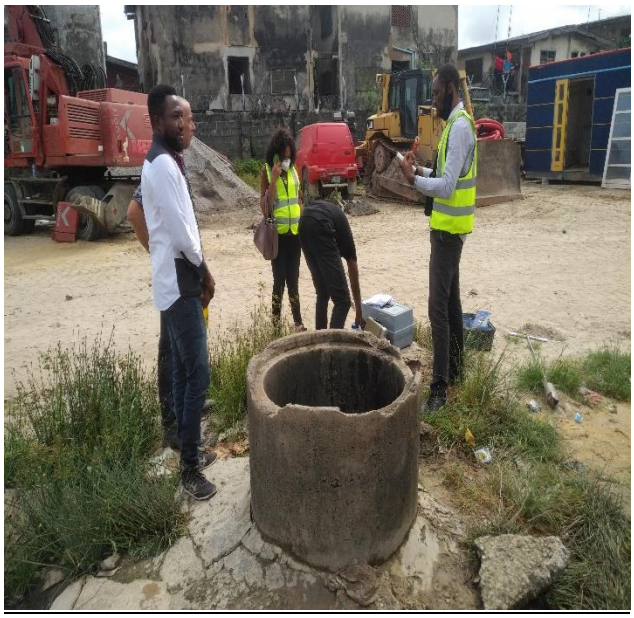


Plate 4.11: Groundwater sampling from open hand dug well

Plate 4.12: Groundwater sampling within the community

Table 4.19: Comparative analysis of Groundwater of the study area

Impact Parameters	Range Wet season	Mean	SD	DIL EIA 2018	FMEnv Limit	WHO Limit
pH	6.5 - 6.9	6.6	0.23	8.4	6.5-8.5	6.5-8.5
Temp (°C)	29.2 -30.1	29.6	0.47	31.8	NA	NA
EC (µs/cm)	412 -1131	868.0	396.46	190	NA	1200
TDS (mg/l)	227 - 642	492.0	230.16	137	500	1000
DO (mg/l)	2.9 - 4.1	3.6	0.64	NA	NA	4.0-6.0
Turbidity (NTU)	2.7 - 4.2	3.6	0.81	14.24	1	5
Alkalinity (mg/l)	50 - 80	63.3	15.28	NA	NA	200
TSS (mg/l)	0.6 -15	8.2	7.23	19.0	<10	NA
BOD (mg/l)	1.7 - 2.25	1.9	0.30	NA	0	4.0-6.0
COD (mg/j)	3.4 - 4.5	3.8	0.61	NA	NA	NA
THC (mg/l)	<0.1	<0.1	0	NA	0.05	NA
NO_3^- (mg/l)	0.16 - 1.2	0.6	0.53	<0.01	10	10
Impact Parameters	**Range Wet season**	**Mean**	**SD**	**DIL EIA 2018**	**FMEnv Limit**	**WHO Limit**
PO_4^{3-} (mg/l)	0.13 -1.3	0.7	0.60	NA	<5	0.5
SO_4^{2-} (mg/l)	2.11	1.7	0.66	0.1	500	250

Na (mg/kg)	2.4 - 3.8	3.1	0.70	1.3	200	200
K (mg/kg)	2.8 - 3.2	3.0	0.21	4.0	NA	10
Ca (mg/kg)	8 - 10	8.7	1.15	1.15	NA	200
Mn (mg/kg)	0.75 - 0.78	0.8	0.02	<0.001	0.05	0.1
Mg (mg/kg)	4.8 - 6	5.6	0.69	<0.001	NA	150
Fe (mg/l)	0.98 - 1.11	1.0	0.07	0.05	1.0	0.3
Cd (mg/l)	<0.001	<0.001	<0.001	<0.001	0.01	0.003
Cr (mg/l)	<0.001	<0.001	<0.001	<0.001	0.05	0.05
Ni (mg/l)	0.58 - 0.62	0.6	0.02	<0.001	0.05	NA
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	0.01	NA
Pb (mg/l)	<0.001 -0.002	<0.001	<0.001	<0.001	0.05	0.01
Zn (mg/l)	0.43	0.5	0.10	0.014	5.0	5
Hg (mg/kg)	<0.001	<0.001	0	<0.001	0.001	0.001

Source: Field work 2020, DIL EIA 2018, FMEnv Std., WHO Std.

The hydrogeological findings indicated that the aquifer in the area is porous, permeable and prolific. The observed wide ranges and high standard deviations and mean in the geochemical data are evidence that there are substantial differences in the quality/composition of the groundwater within the study area. Groundwater sample pH ranged from 6.5 to 6.9, control was 6.90 indicating slightly acidic to neutral and the EIA 2018 dry season mean was slightly alkaline at 8.4. Total Dissolved Solids (TDS) ranged from 227 to 642 with mean at 492 compared to the control at 310 and EIA 2018 result of 137 in dry season. The results all compiled to FMEnv drinking water limit of 500mg/l. Turbidity values did not comply to FMEnv and WHO limit of 1 NTU and 5 NTU respectively in rainy season ranged from 2.27 – 6.42 NTU with 3.6 NTU mean and dry season EIA result of 14.24. Total hydrocarbon content (THC) for the groundwater within the study area and hand dug wells sampled within the community were <0.1mg/l indicating absence of hydrocarbon contamination. Heavy metal enrichment index revealed low concentrations, low iron content, no indication of salt intrusion and the recorded values could be termed to be a baseline data or the 23 constituents of the bedrock materials. The values recorded for wet season were relatively lower probably due to dilution from availability of rainwater compared to the secondary data values (DIL EIA 2018) obtained during dry season.

4.5.7 Surface water quality

4.5.7.1 Physicochemical conditions

Badagry Creeks is located in Lagos, Lagos State, Nigeria. The Creek separates the mainland sedimentary basin from the Atlantic Coastline. It lies within Longitude 2° 42'mE and 3° 42'mE and stretches between Latitude 6° 22'mN and 6° 42'mN, sharing boundary with Republic of Benin.

Badagry Creek is approximately 177km long and directly connects with Nigeria 960km of coastline bordering the Atlantic Ocean in the Gulf of Guinea, a marine area of 46,500km with depth of up to 50m and an exclusive Zone of 210,900km^2. The water in Badagry Creek is not shallow. The Creek is important for both artisanal and commercial fisheries, and as well as transportation, recreation and domestic purposes. The baseline characteristics of the Badagry creek and associated surface waters contiguous to the project area is recorded and analyzed. Such information is necessary as basis for understanding the characteristics of the existing environment and as benchmark for the subsequent evaluation of project impacts. The summary of the physicochemical characteristics of surface waters are presented in Table 4.20 and 4.21.

Table 4.20: Physicochemical parameters of surface waters of the study area

Impact Parameters	SW1	SW2	SW3	SW4	SW5	SW6	SWC
pH	6.30	5.80	5.70	6.00	5.90	5.90	6.00
Temperature (°C)	28.5	28.8	29.0	27.8	28.6	28.8	29.0
EC (µs/cm)	7050	7529	5372	7629	8382	8380	7180
TDS (mg/l)	4725	5017	3719	5172	5721	5718	4628
DO (mg/l)	4.90	5.20	4.90	4.90	4.80	4.90	5.10
Turbidity (NTU)	5.80	5.90	5.50	5.80	5.60	5.60	5.00
Salinity as Cl^- (mg/l)	2895	3015	2345	3150	3350	3320	2850
Alkalinity (mg/l)	350.0	300.0	250.0	100.0	250.0	150.0	200.0
TSS (mg/l)	27.5	34.5	67.8	38.5	126.5	516.0	29.0
THC (mg/l)	11.0	18.0	19.0	24.0	19.0	12.0	1.0
Total hardness (mg/l)	35.0	30.0	25.0	30.0	25.0	15.0	20.0
BOD_5, mg/l	8.21	2.60	6.30	6.80	3.05	7.10	5.70
COD, mg/l	13.56	5.80	10.20	13.60	14.90	14.20	11.50
Oil Grease (mg/l)	11.0	18.0	19.0	24.0	19.0	12.0	1.0
PO_4^{3-} (mg/l)	3.0	18.0	52.0	10.0	84.0	22.0	2.0
SO_4^{2-} (mg/l)	0.10	1.21	0.01	0.01	0.24	0.01	0.01
NO_3-N (mg/l)	0.15	0.22	<0.001	1.00	0.83	0.01	0.01
Fe (mg/kg)	10.24	8.13	6.82	11.11	7.19	9.14	6.21
Cd (mg/kg)	0.06	0.05	0.04	0.04	0.02	0.06	0.04
Cr (mg/kg)	0.06	0.05	0.04	0.04	0.02	0.06	0.04
Ni (mg/kg)	0.82	0.68	1.12	1.12	0.81	0.74	0.64
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb (mg/kg)	0.01	0.01	<0.001	<0.001	0.01	0.01	<0.001
Zn (mg/kg)	0.46	0.43	0.50	0.39	0.46	0.51	0.37
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Coliform MPN/100 ml	23.0	16.0	26.0	31.0	17.0	19.0	9.00
HUB (cfu/100g) $x10^3$	2.5	2.0	2.1	2.2	2.0	2.2	2.1
HUF(cfu/100g) $x10^3$	1.5	1.1	2.0	1.1	1.6	1.0	1.3
THB (cfu/100g) $x10^3$	2.0	2.2	2.3	2.5	2.0	2.1	2.1
THF (cfu/100g) $x10^3$	1.0	1.2	1.0	1.5	1.1	1.0	1.1

Source: Field Survey 2020

The average pH for Badagry creek was 7.40 and control was 7.38 respectively indicating being neutral characteristic. The average TDS of the creek was 5012 µS/cm and 4628 µS/cm for the control respectively. Nutrient status of the water is primarily productivity index and gives a true indication of abundance and activity of aquatic life. Levels of all physicochemical parameters measured are within concentrations commonly encountered in rivers of Southern Nigeria (Akpan *et al.*, 2002) and considered adequate for aquatic life (McNeely *et al.*, 1979, Chapman, 1996). The high level of total hydrocarbons in the creek is a reflection of human inputs associated with shipping/boating, surface run-off and oil production activities within the zone. Most of the onshore

oil activities are located within the Kirikiri Lighter Terminal where several oil pollution events have also been recorded (RPI, 1985; Nwilo and Badejo, 2005). The increase in salinity from the Badagry creek towards (SWC<SW1 –SW6) Apapa and the ocean is a reflection of salt water intrusion and mixing with fresh water discharge from rivers.

Table 4.21: Comparative analysis of Surface water results

Impact Parameters	Range Wet season	Mean	Control	SD	FMEnv Limit Aquatic Life
pH	5.7 - 6.3	5.9	6.00	0.21	6.0 – 9.0
Temperature (°C)	27.8 - 29.0	28.6	29.0	0.42	20 - 33
Conductivity (µs/cm)	5372 – 8382	7360.3	7180	1116.1	NA
TDS (mg/l)	3719 – 5721	5012	4628	745.78	NA
DO (mg/l)	4.8 - 5.2	4.9	5.10	0.14	6.8
Turbidity (NTU)	5.5 - 5.9	5.70	5.00	0.16	NA
Salinity as Cl- (mg/l)	2893 – 3350	3012.5	2850		NA
Alkalinity (mg/l)	100.0 - 350.0	233.3	200.0	93.10	NA
TSS (mg/l)	27.5 - 516.0	135.1	29.0	190.12	NS
THC (mg/l)	11.0 – 24.0	17.2	1.0	4.87	NA
Total hardness (mg/l)	15.0 - 35.0	26.7	20.0	6.83	NA
BOD (mg/l)	2.60 – 8.21	5.68	5.70	2.30	4.0
COD (mg/l)	5.80 – 14.9	12.04	11.50	3.46	NA
Oil Grease (mg/l)	11.0 – 24.0	17.17	1.0	4.88	NS
PO_4^{3-} (mg/l)	3.0 – 84.0	31.5	2.0	30.74	NS
SO_4^{2-} (mg/l)	0.01 – 1.21	0.26	0.01	0.47	NA
NO_3-N (mg/l)	0.01 – 1.00	0.44	0.01	0.44	NS
Fe (mg/l)	6.82 – 11.11	8.77	6.21	1.71	1.0
Cd (mg/kg)	0.02 – 0.06	0.045	0.04	0.015	0.0002 – 0.0018
Cr (mg/kg)	0.02 – 0.06	0.045	0.04	0.015	0.00002 – 0.002
Ni (mg/kg)	0.68 – 1.12	0.88	0.64	0.19	0.002 – 0.004
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	NA
Pb (mg/kg)	0.01	0.01	<0.001	0.01	0.0017
Zn (mg/kg)	0.39 – 0.51	0.46	0.37	0.05	0.03
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	0.001
Total Coliform MPN/100 ml	16.0 – 31.0	22.0	9.00	5.80	NA
HUB (cfu/ml) $x10^3$	2.0 - 2.5	2.2	2.1	0.19	NA
HUF(cfu/ml) $x10^3$	1.0 – 2.0	1.4	1.3	0.39	NA
THB (cfu/ml) $x10^3$	2.0 – 2.5	2.2	2.1	0.19	NA
THF (cfu/ml) $x10^3$	1.0 – 1.5	1.2	1.1	0.21	NA

Source: Field work 2020

Table 4.21 summarizes the heavy metal concentrations of surface waters in the study area. Heavy metal levels were slightly high and a little above limits of the Nigerian Guidelines for aquatic life (FEPA, 1991) and levels known to harm biota. Iron ranged from 6.82 – 11.11 mg/l in with mean of

8.77 mg/l similar values were observed for other metals except lead, mercury and vanadium which were lower than the stipulated limits in all locations.

4.5.7.2 Surface water microbiology

Data on the microbiology of the surface water samples collected from the area are summarized in Table 4.21 shows Total heterotrophic bacterial (THB) load ranged from 2.0-2.5 x 10^3 cfu/ml with a mean of 2.2 x 10^3 cfu/ml and (THF) load ranged from 1.0-1.5 x 10^3 cfu/ml with a mean of 1.2 x 10^3 cfu/ml. The percentage of hydrocarbon utilizing bacteria (HUB) and hydrocarbon utilizing fungi (HUF) are however high suggesting a high level of hydrocarbon pollution in the creek. Coliforms commonly referred to as indicators of recent contamination (bio monitors) of water were present in the surface water samples. The faecal coliforms ranged from 16 to 31 MPN/100ml and 9.0 MPN/100ml at the control station respectively.

Plate 4.13: Aquatic biology sampling

Plate 4.14: Sieving of sediment sample

4.5.7.3 Sediments Physicochemical Characteristics

In aquatic ecosystem, the sediments act as sink and therefore preserve or retain the quality of the environment. In aquatic ecosystem, the sediments act as sink and therefore preserve or retain the quality of the environment. The summary of physicochemical state of the bottom sediment in project area situated along the Badagry creek is presented in Table 4.22.

4.22: Physicochemical results of sediment

Impact Parameters	SD1	SD2	SD3	SD4	SD5	SD6	SDC
pH	8.56	7.33	6.78	7.84	7.22	6.51	7.38
THC (mg/kg)	<0.001	<0.001	<0.001	0.26	1.00	<0.001	<0.001
Fe (mg/kg)	70.4	90.7	130.4	120.3	110.2	120.1	60.1
Ni (mg/kg)	1.12	1.43	0.94	1.26	0.97	1.15	1.31
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd (mg/kg)	0.03	0.02	0.02	0.02	0.02	0.02	0.01
Cr (mg/kg)	0.01	<0.001	<0.001	0.01	0.01	<0.001	0.01
Pb (mg/kg)	<0.001	<0.001	<0.001	0.01	0.01	0.01	<0.001
Zn (mg/kg)	0.28	0.22	0.32	2.40	0.31	0.26	0.33
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HUB (cfu/100g) x 10^2	1.3	1.4	1.0	1.2	1.1	1.3	1.1
HUF(cfu/100g) x 10^2	2.0	1.1	1.3	1.3	1.0	1.6	1.5
THB (cfu/100g) x 10^2	1.5	1.3	2.1	1.5	1.2	1.1	1.0
THF (cfu/100g) x 10^2	2.3	2.0	2.3	1.2	1.1	2.2	1.3

Source: Field work 2020

The average sediment pH was 6.50<pH>6.50 in the entire project study area. The nature and quality of sediment is determined from information on the status of the physico-chemical properties. Such information is also vital in determining the parameters that would also be responsible for specific changes and effects in this environment. The colour of the sediment samples ranged from white to dark grey colouration. The silt fraction was higher than the sand and clay content making the sediment Silty in texture especially towards the bank. Heavy metal levels in sediments of the study area are shown in Table 4.22 and 4.23. Vanadium, mercury and lead were not detected in the sediments and concentration of metals generally low except iron. Although iron levels were moderate it is usually not considered a pollutant in sediments.

Table 4.23: Comparative analysis of Sediment characteristics

Impact Parameters	Range Wet Season	Mean	SD	Control	DIL EIA 2018 Dry Season
pH	6.51 - 8.56	7.4	0.74	7.38	6.5
THC (mg/kg)	0.26 – 1.0	0.6	0.52	NA	<0.001
Oil & Grease (mg/kg)	0.26 -1	0.6	0.52	10.09	NA
Fe (mg/kg)	0.1-0.6	0.3	0.19	0.12	1.08
Ni (mg/kg)	0.94 -1.43	1.1	0.18	<0.001	<0.001
V (mg/kg)	<0.01	<0.001	0.00	0.12	<0.001
Cd (mg/kg)	0.02 -0.03	<0.001	<0.001	1.31	<0.001
Cr (mg/kg)	0.01	<0.001	<0.001	<0.001	<0.001
Pb (mg/kg)	0.01	<0.001	<0.001	0.02	<0.001
Zn (mg/kg)	0.22 -2.4	0.6	0.87	0.01	0.06
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	NA
HUB (cfu/100g) x 10^2	1.0 - 1.4	1.2	0.15	0.33	1.0
HUF(cfu/100g) x 10^2	1.0 - 2.0	1.4	0.37	<0.001	NA
THB (cfu/100g) x 10^2	1.1 - 2.1	1.5	0.36	1.1	NA
THF (cfu/100g) x 10^2	1.1 - 2.3	1.9	0.55	1.5	NA

Source: Fieldwork 2020, DIL EIA 2018

4.5.7.4 Phytoplankton

The phytoplankton community were represented by five (5) taxonomic groups in the wet and dry season; Bacillariophyceae, Dinophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae with a total number of fifty-nine (59) species. The Bacillariophyta were the most abundant taxonomic phylum with a percentage composition of 41.63% (3043cells/1000L). Well represented species in both climatic regimes include: *Coscinodiscus grani, Aulocosiera granulate, Biddulphia aurita, Rhizosolenia erensis, Amphora ovalis, Hantzschia amphioxys* and *Chaetoceros gracilis*. The presence of these diverse population of diatoms is suggestive of high organic inputs from discharges and poor waste management practices along the Badagry creek. The dominance of Bacillariophyceae is characteristic of the phytoplankton community structure in estuarine water systems. The Cyanophyta emerged the second dominant phylum with a percentage composition of 29.24% (2137cells/1000L). Well represented taxa in both climatic regimes include but not limited to the following: *Anabaena flos-aquae, Gleocapsa rupestris, Lyngbya aeruginneocoerulea, Oscillatoria terebriformis* and *Lyngbya lutea*. High Cyanophyta population maybe attributed to the influx of rich biodegradable materials into the creek. The dominance pattern of the phyla was Bacillariophyta > Cyanophyta > Chlorophyta> Dinophyta > Euglenophyta. The percentage composition of the phytoplankton community is presented in Figure 4.17.

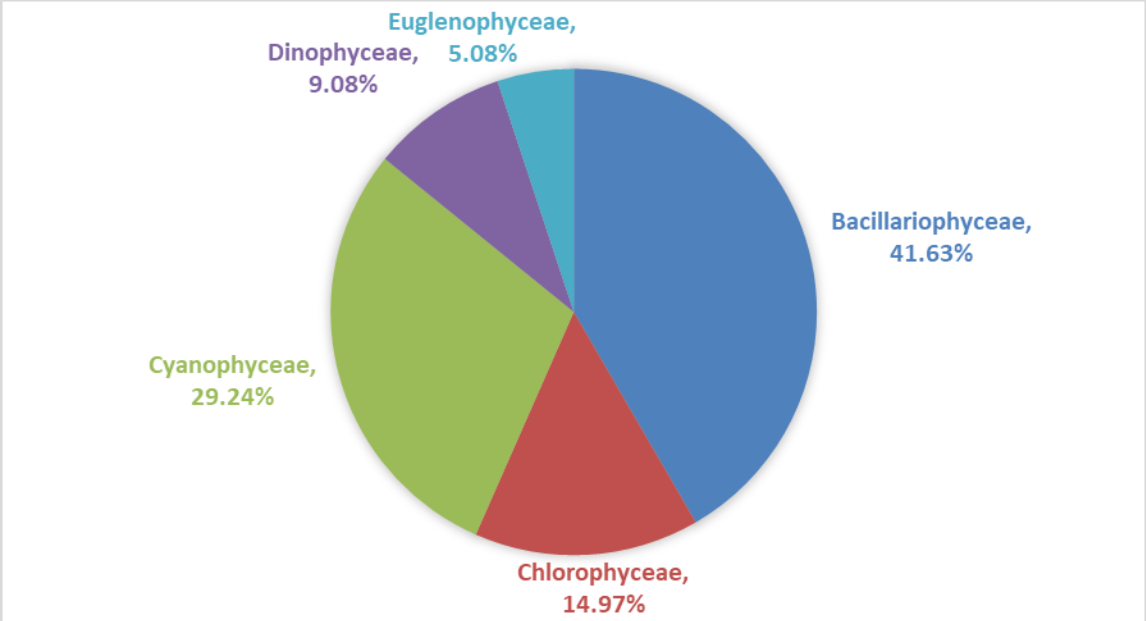


Figure 4.17: Percentage composition of the Phytoplankton phylum in the study area

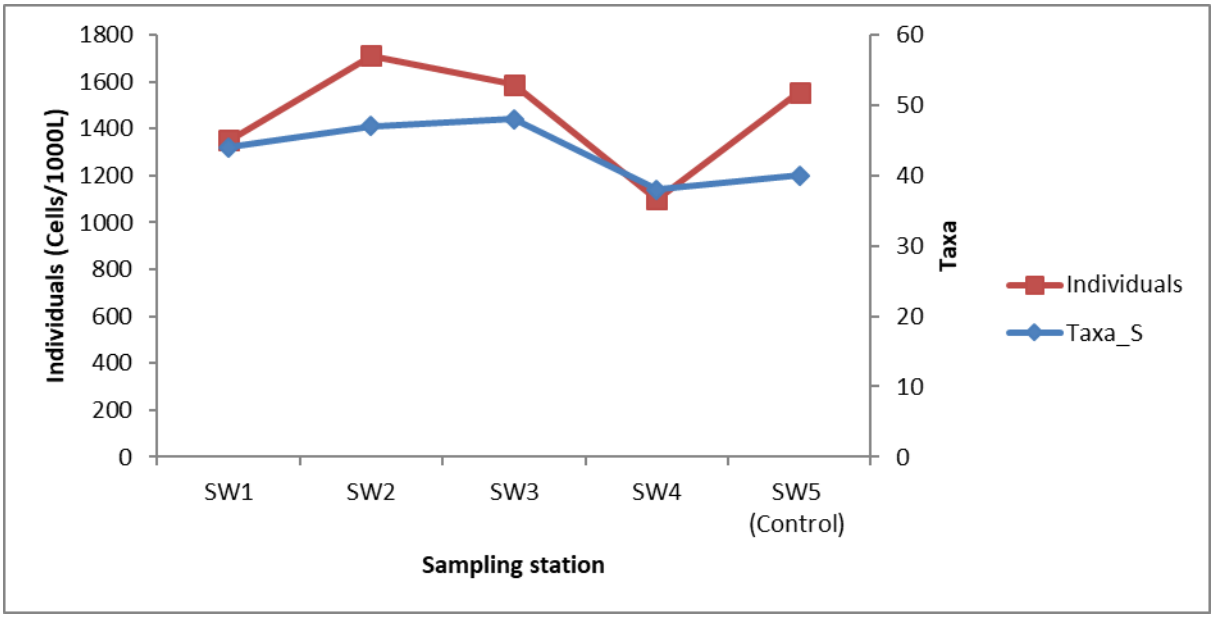


Figure 4.18: Spatial variation in Phytoplankton number and density

Species diversity

The Shannon diversity index (H'), Evenness or Equitability index (E') and the species index (d) were used to characterize the community. The presence of *Biddulphia aurita, Biddulphia rhombus* and *Biddulphia longicaris* suggests the creek is a recipient of organic matter inputs and resilience of the water body. The Shannon index (>3.0) indicates a stable ecosystem and further lends credence to the phytoplanktonic distribution in the Badagry. The dominance index showed no significant difference ($p<0.05$) in all the sampling station and may be attributed their self-sustaining natural mechanisms (Davies *et al.*, 2009, Nkwoji *et al.*, 2010).

Table 4.24: Ecological indices of across the sampling stations

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)
Taxa_S	44	47	48	38	40
Individuals	1351	1713	1588	1100	1557
Dominance_D	0.04	0.03	0.03	0.04	0.041
Shannon_H	3.488	3.605	3.608	3.434	3.485
Simpson_1-D	0.9609	0.9677	0.9678	0.9624	0.9647
Evenness_e^H/S	0.7433	0.7824	0.7683	0.8154	0.8152
Menhinick	1.197	1.136	1.205	1.146	1.014
Margalef	5.965	6.178	6.377	5.283	5.306
Equitability_J	0.9216	0.9363	0.9319	0.9439	0.9446

4.5.7.5 Zooplankton

The zooplankton fauna comprised of Rotifers, Molluscs, Crustaceans (Cladocera, Copepods and decapods) and Pisces in both climatic regimes. The Crustaceans were the most dominant occupying >50% of the zooplankton community. Well represented crustacean taxonomic group include Cladocera, Copepods and Decapods. The distribution of the zooplankton taxa maybe attributed to the availability of large population of phytoplankton which compliments its feeding adaptation (Food chain sequence). The Rotifers were the second most dominant taxonomic group representing 20.11% of the zooplankton structure. Nine (9) species were well represented and include *Asplanchia brightweli, Condonella ucinata* and *Brachionus caliciflorus*. In increasing order, the dominance pattern of the Zooplankton community were Crustaceans > Rotifera > Pisces.

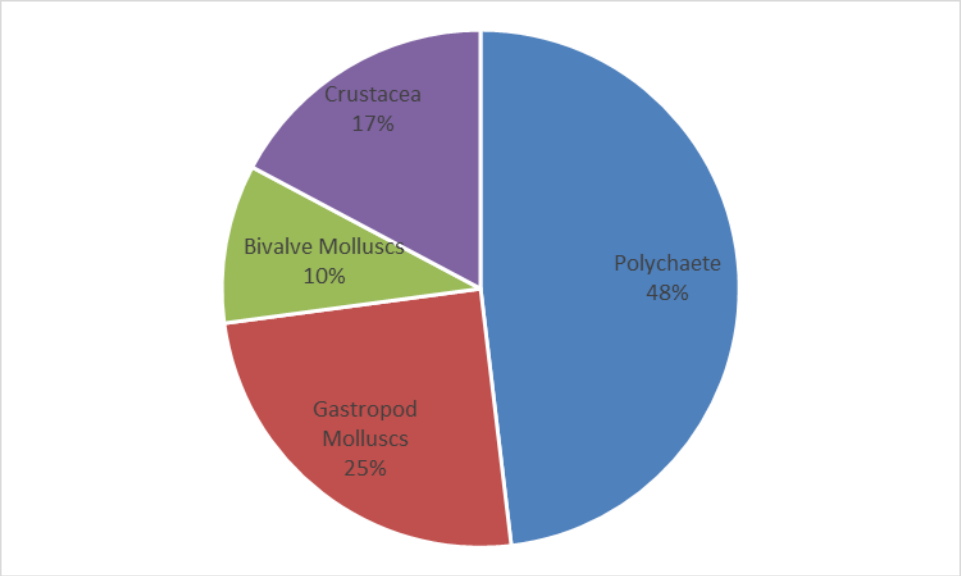


Figure 4.19: Percentage composition of the zooplankton population in the study area

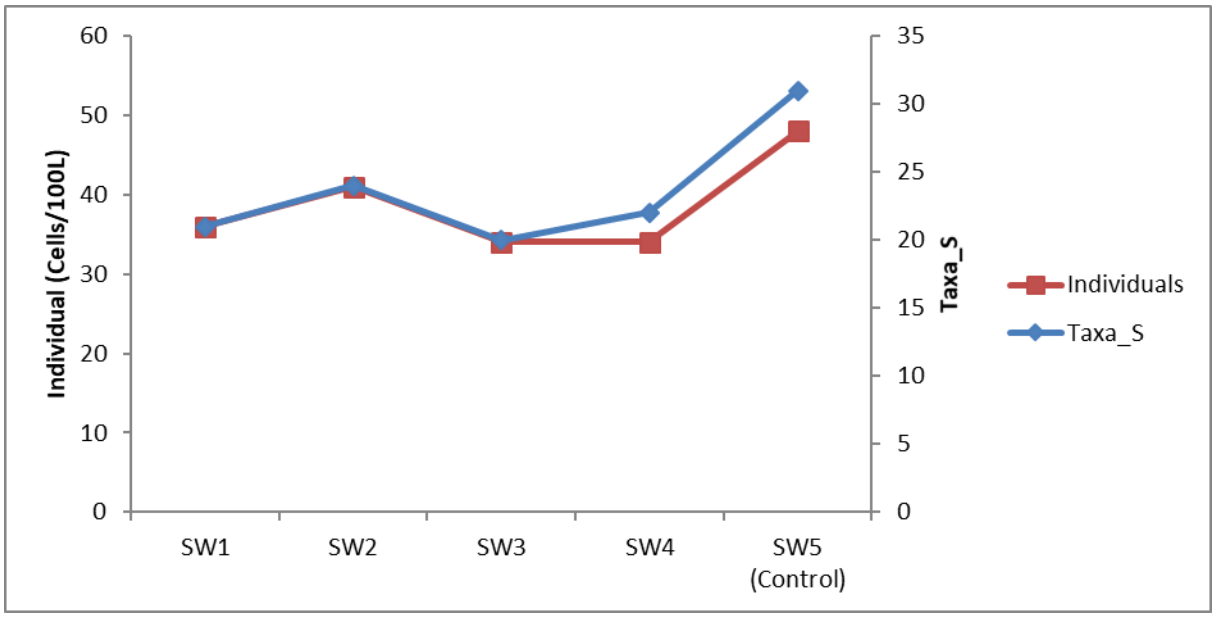


Figure 4.20: Spatial variation in Phytoplankton number and density

Species diversity

The results of the ecological indices compared favourably with those of the phytoplankton community. The Shannon-Weiner diversity Index suggests a stable ecosystem across the sampling stations as values were >2, notwithstanding the heavy organic inputs into the Badagry creek from Vessel discharges and poor waste management practices. However, the taxa distribution was low. The low population maybe attributed to some environmental stressors (high turbidity and the dominance of a few taxa across the sampling stations. The species diversity of the zooplankton in the sampling stations is presented in Table 4.25.

Table 4.25: Ecological indices of across the sampling stations

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)
Taxa_S	21	24	20	22	31
Individuals	36	41	34	34	48
Dominance_D	0.05556	0.05413	0.06055	0.05709	0.03733
Shannon_H	2.962	3.046	2.894	2.976	3.358
Simpson_1-D	0.9444	0.9459	0.9394	0.9429	0.9627
Evenness_e^H/S	0.9211	0.876	0.9032	0.8909	0.9272
Menhinick	3.5	3.748	3.43	3.773	4.474
Margalef	5.581	6.193	5.388	5.955	7.75
Equitability_J	0.973	0.9583	0.966	0.9626	0.978

4.5.7.6 Benthic fauna

The benthic fauna were represented by four (4) major taxonomic groupings: Polychaetes, Crustaceans, Gastropod Molluscs and Bivalve Molluscs and comprised of eighteen (18)

species. The Polychaeta dominated the benthic fauna population comprising of 48.11% and suggestive of biodegradable organic matter inputs in the sediment. Other well represented fauna includes: *Notomastus latericus* and *Scolopsis uniramus*. The dominance pattern of the benthic fauna was Polychaeta > Gastropod mollusk > Crustacean > Bivalve mollusk and Polychaeta > Gastropod mollusk. The percentage composition and spatial variation in the Benthic fauna community is presented in Figure 4.21.

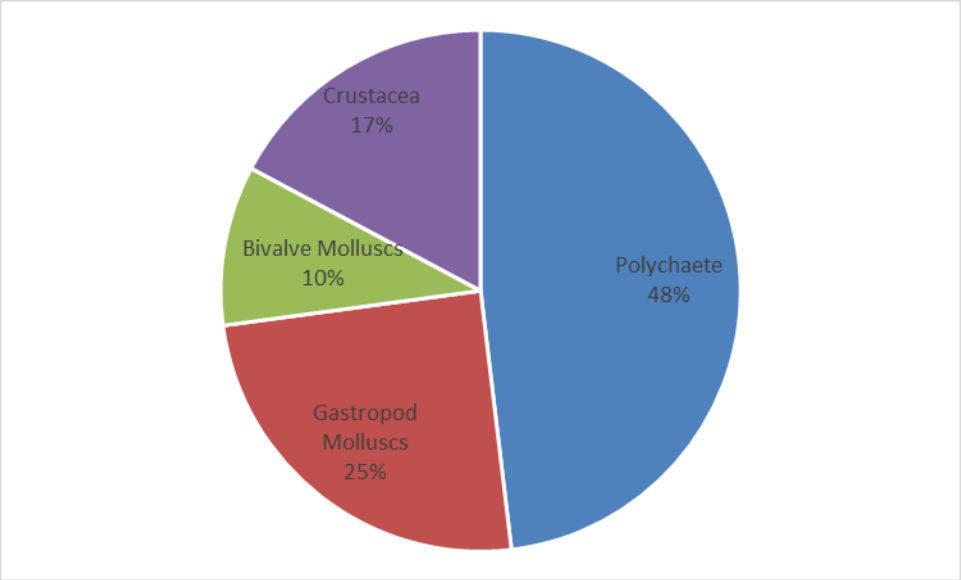


Figure 4.21: Percentage composition of the benthic fauna in the study area

Species Diversity Indices

The Shannon diversity index (H'), Evenness or Equitability index (E') and the species richness index (d) were used to characterize the community. The study area and control station showed a moderate diversity index in the wet season and poor diversity in the dry season caused by varying levels of organic matter inputs in the sediment. The presence of polychaeta suggests moderate levels of pollution and stress in the sediment in both climatic regimes. The species indices of the benthic fauna are presented in Table 4.26.

Table 4.26: Ecological indices of across the sampling stations

	SD1	SD2	SD3/SD4	SD5/SD6	SDC (Control)
Taxa_S	29	25	31	24	27
Individuals	436	247	324	397	336
Dominance_D	0.06404	0.08571	0.05133	0.06774	0.06436
Shannon_H	2.991	2.808	3.159	2.885	2.953
Simpson_1-D	0.936	0.9143	0.9487	0.9323	0.9356
Evenness_e^H/S	0.6864	0.6628	0.7592	0.7463	0.7099
Menhinick	1.389	1.591	1.722	1.205	1.473
Margalef	4.607	4.356	5.19	3.844	4.47
Equitability_J	0.8883	0.8722	0.9198	0.9079	0.896

Plate 4.15: A Polychaete identified in sediment sample 4

Plate 4.16: Sampled sediment in sieve

Table 4.27: Diversity and Relative abundance of Phytoplankton in the study area

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)	Total	%Total
Bacillariophyceae							
Amphora ovalis	0	18	0	0	38	**56**	
Aulocosiera granulate	0	68	66	0	94	**228**	
Bacillaria paradoxa	0	0	32	65	47	**144**	
Bacillaria paxillifera	28	10	13	28	0	**79**	
Biddulphia aurita	76	57	32	16	39	**220**	
Biddulphia rhombus	0	0	80	0	78	**158**	
Biddulphia longicaris	42	0	3	38	0	**83**	
Chaetoceros gracilis	0	91	105	0	27	**223**	
Cheatoceros decipens	0	18	21	21	14	**74**	
Coscinodiscus concinnus	17	35	39	15	11	**117**	
Coscinodiscus grani	19	0	0	0	71	**90**	
Eunotia gracilis	10	11	24	17	82	**144**	
Fragillariopsis atlantica	47	20	24	0	26	**117**	
Fragillriopsis oceanica	24	23	26	17	31	**121**	
Gyrosigma	29	4	10	29	5	**77**	
Hantzschia amphioxys	17	104	45	47	0	**213**	
Navicula cuspidate	0	51	56	0	0	**107**	
Navicula gracilis	32	10	83	29	0	**154**	
Navicula minima	45	4	28	45	0	**122**	
Nitzschia closterium	93	0	0	0	0	**93**	
Pinnularia appendiculata	7	17	10	0	0	**34**	
Rhizosolenia erensis	19	28	35	17	38	**137**	
Rhizosolenia habetata	17	18	18	45	0	**98**	
Rhizosolenia longiseta	12	39	45	11	47	**154**	
Subtotal	**534**	**626**	**795**	**440**	**648**	**3043**	**41.63**
Chlorophyceae							
Closterium lineatum	17	14	27	38	69	**165**	
Eudorina sp	9	37	65	39	28	**178**	
Scenedesmus excelcia	81	21	5	0	65	**172**	
Scenedesmus quadricauda	24	0	0	0	28	**52**	
Scenedesmus acuminatus	11	41	18	93	0	**163**	
Micrasterias sol	17	27	19	61	0	**124**	
Micrasterias truncate	36	72	86	0	46	**240**	
Sub-Total	**195**	**212**	**220**	**231**	**236**	**1094**	**14.97**
Cyanophyceae							
Anabaena flos-aquae	6	28	48	49	0	**131**	
A. spiroides	29	4	28	27	39	**127**	
Aphanozemenun flos-aquae	0	73	0	7	0	**80**	
Gleocapsa rupestris	29	36	27	51	6	**149**	
G. turgid	0	42	0	29	91	**162**	

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)	Total	%Total
Isocystis planktonica	67	78	5	0	22	**172**	
Isocystis sp.	0	84	0	45	0	**129**	
Lyngbya lutea	0	8	6	37	69	**120**	
L. aeruginneocoerulea	103	90	11	19	28	**251**	
L. kutzingiana	0	8	0	0	0	**8**	
Merismopedia elegans	13	20	29	36	16	**114**	
Microcystis aeuroginosa	111	91	73	0	0	**275**	
Oscillatoria Formosa	7	0	27	0	20	**54**	
O. limosa	35	0	32	15	11	**93**	
O. pseudomina	18	22	12	0	29	**81**	
O. terebriformis	12	0	11	0	81	**104**	
O. bonnemaisonii	0	35	0	17	35	**87**	
Sub-Total	**430**	**619**	**309**	**332**	**447**	**2137**	**29.24**
Dinophyceae							
Ceratium hirundinella	28	29	2	4	0	**63**	
Ceratium sp	28	37	9	0	30	**104**	
Ceratium tripos	13	28	39	21	0	**101**	
Dinophysis caudate	0	0	35	9	9	**53**	
Gonyaulax sp	8	45	49	4	0	**106**	
Gonyaulax hurida	12	39	45	11	73	**180**	
Pyrocystis sp.	6	0	0	19	32	**57**	
Sub-Total	**95**	**178**	**179**	**68**	**144**	**664**	**9.08**
Euglenophyceae							
Euglena acus	17	28	0	24	20	89	
Euglena caudate	0	22	5	5	10	42	
Phacus caudatus	34	28	18	0	15	95	
Trachelomonas sp	46	0	62	0	37	145	
Subtotal	**97**	**78**	**85**	**29**	**82**	**371**	**5.08**

Table 4.28: Diversity and Relative abundance of zooplankton in the study area

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)	Total	%Total
Rotifera							
Brachionus caliciflorus	0	10	1	0	14	**25**	
Brachionus ureolaris	4	5	34	0	15	**58**	
Collotheca pelagica	0	0	0	0	0	**0**	
Condonella ucinata	0	8	11	18	2	**39**	
Lecane bulla	4	2	2	0	19	**27**	
Lecane petica	7	0	3	0	0	**10**	
Asplanchia prodonta	1	3	3	0	0	**7**	
Asplanchia brightweli	67	5	11	28	5	**116**	
Euchlanis sp	21	6	22	0	19	**68**	
Sub-Total	**104**	**39**	**87**	**46**	**74**	**350**	**20.11**
Cladocera							
Alona affinis	17	15	20	0	0	**52**	
Alona intermidia	16	19	4	8	0	**47**	
Bosmina sp.	21	10	0	8	0	**39**	
Daphnia carinata	0	5	0	4	3	**12**	
Chydorus sp	35	7	15	16	9	**82**	
Polyphemus pediculus	0	10	0	32	20	**62**	
Sub-Total	**89**	**66**	**39**	**68**	**32**	**294**	**16.90**
Molluscan larvae							
Tympanotonus sp	7	2	9	0	0	**18**	
Pachymelania sp	21	0	2	28	9	**60**	
Oxygiris sp.	6	53	4	25	0	**88**	
Sub-Total	**34**	**55**	**15**	**53**	**9**	**166**	**9.54**
Crustaceans (Copepoda)							
Acartia longiremis	28	0	0	8	0	**36**	
Anomalocera patersoni	7	1	4	0	1	**13**	
Calanus finmarchicus	0	0	6	28	3	**37**	
Candacia speciosus	12	19	12	6	0	**49**	
Candacia armatia	18	22	17	0	15	**72**	
Centopages typicus	14	2	4	13	7	**40**	
Coryceaus venustus	25	15	11	36	8	**95**	
Cyclops americanus	0	8	12	6	45	**71**	
Diaphanosoma sp	35	4	10	9	37	**95**	
Diaptomus oregonensis	11	0	7	15	4	**37**	
Enterpina acutifrons	0	1	6	6	4	**17**	
Sub-Total	**150**	**72**	**89**	**127**	**124**	**562**	**32.30**
Crustacea (Decapods)							
Crab larvae	1	0	3	5	0	**9**	
Paelemonates larvae	2	0	17	0	21	**40**	
Lucifer faxoni	15	0	4	17	1	**37**	

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)	Total	%Total
Upogebia nauplii	0	0	0	0	15	**15**	
Alpheus nauplii	25	11	28	57	15	**136**	
Obelia Larvae	1	0	22	0	6	**29**	
Veliger larvae	9	0	12	21	26	**68**	
Ballanus Larvae	4	4	8	2	12	**30**	
Sub-Total	**57**	**15**	**94**	**102**	**96**	**364**	**20.92**
Pisces							
Fish larvae	2	0	0	1	1	**4**	**0.23**

Table 4.29: Diversity and Relative abundance of benthic fauna in the study area

	SW1	SW2	SW3/SW4	SW5/SW6	SWC (Control)	Total	%Total
Polychaete							
Capitella capitata	0	0	13	10	2	**25**	
Cirratulus sp	16	0	2	10	0	**28**	
Nephtys incisa	1	10	2	4	2	**19**	
Nereis sp	5	0	0	1	1	**7**	
Notomastus latericus	7	15	14	21	8	**65**	
Scolopsis uniramus	2	5	12	8	15	**42**	
Sternapsis scutata	3	0	1	4	2	**10**	
Marphysa sanguinea	0	1	0	6	1	**8**	
Sub-Total	**34**	**31**	**44**	**64**	**31**	**204**	**48.11**
Gastropod Molluscs							
Tympanotonus fuscatus	2	2	1	3	1	**9**	
Littorina sp	0	0	2	0	5	**7**	
Neritina oweniana	2	14	17	11	19	**63**	
Tellina nymphalis	3	6	8	7	2	**26**	
Sub-Total	**7**	**22**	**28**	**21**	**27**	**105**	**24.76**
Bivalve Molluscs							
Nucula	11	10	0	3	3	27	
Stylaria	3	2	10	0	0	15	
Sub-Total	**14**	**12**	**10**	**3**	**3**	**42**	**9.91**
Crustacea							
Tianid sp.	0	3	2	4	1	**10**	
Isodus sp	2	4	0	2	1	**9**	
Alpheus monodi	0	19	0	6	4	**29**	
Leplalpheus sp.	4	18	2	1	0	**25**	
Sub-Total	**6**	**44**	**4**	**13**	**6**	**73**	**17.22**

4.5.7.7 Fishery Studies

Artisanal fishing activities is generally predominant along the Badagry creek owing to the strategic economic importance of shipping and port related activities within the Apapa Ports. The creek is not spared from unhealthy discharges of bilge water, ballast water and poor waste management practices from port operations. This study will assess the current fishery composition in the Badagry creek assess the fishing gears used, morphometric measurements of fish species and tissue analysis of the fish species.

4.5.7.7.1 Fishes of the Study area

Fishery resources along the Badagry creek are multi-species stock largely exploited by fisher folks predominantly artisanal fishers operating dug-out wooden canoes of various sizes. The major fish communities exploited by the artisanal fisher folks is the estuarine and creek sciaenid sub-community. The demersal target species exploited are: brackish water catfish (*Chrisichthys*), grunters (Pomadasyidae), groupers (*Epinephelus*), and the estuarine white shrimp (*Palaemon*). Thirty-one (31) fishery resources were recorded from the study area using various fishing gears comprising Gill net, Fish fence, Cast net, Hook and line, Drag net, Wire mesh basket and basket trap. A checklist of the fishery resources sighted and confirmed by fisher folks, preferred fishing location and peak periods of exploitation in the study area is presented in Table 4.30.

Table 4.30: Fish fauna and Fisheries in waters within the Study area

Family	Common Name	Scientific Name	Relative Abundance	Fishing areas	Peak Period	Fishing gear
Bagridae	Cat Fish	*Chrysichthys auratus*	Common	Badagry creek	November to July	Gill net, Fish fence, Cast net, Hook and line
Gerreidae	Guinea striped mojarra	*Gerres nigri*	Common	Badagry creek	May to November	Gill net, Fish fence, Cast net
Carangidae	Common	*Cranx hippos*	Common	Badagry	November	Drag net,

Family	Common Name	Scientific Name	Relative Abundance	Fishing areas	Peak Period	Fishing gear
	jack			creek	to July	Wire mesh basket, basket trap, Gill net, Fish fence,
Clupeidae	Bonga	*Ethmalosa fimbriata*	Common	Badagry creek	August to March	Cast/seine Net
Pristigasteridae	Shad	*Ilisha* sp	Common	Badagry creek	August to March	Cast Net
Mugilidae	Largescaled mullets	*Liza grandisquamis*	Common	Badagry creek	November to July	Cast net & Hook
Mugilidae	Sicklefin mullets	*Liza falcipinnus*	Common	Badagry creek	November to July	Cast net & Hook
Mugilidae	White coloured mullet	*Mugil sp*	Common	Badagry creek	November to July	Cast net
Sciaenidae	Big head Croaker	*Pseudotolichthy elongartus*	Common	Badagry creek	November to July	Set net & Hook
Clupeidae	Round sardinella	*Sardinella maderensis*	Common	Badagry creek	August to March	Drag net, Gill net, Fish fence, Cast net, Hook and line
Cichlidae	Tilapia	*Sarotherodon melanotheron*	Common	Badagry creek	May to November	Cast net
Cichlidae	Jewel fish	*Hemichromis bimaculatus*	Common	Badagry creek	May to November	Cast net
Sphyraenidae	Barracuda	*Sphyraena barracuda*	Common	Badagry creek	November to July	Gill net & Hook
Cichlidae	Tilapia	*Tilapia*	Common	Badagry	May to	Cast net

Family	Common Name	Scientific Name	Relative Abundance	Fishing areas	Peak Period	Fishing gear
		guineensis		creek	November	
Polynemidae	Threadfin	*Polynemus quadrifili*	Common	Badagry creek	November to July	Gill net, Fish fence, Cast net, Hook and line
Polynemidae	Threadfin	*Polynemus galeodes*	Common	Badagry creek	November to July	Gill net, Fish fence, Cast net, Hook and line
Gobiidae	Mudskipper	*Periopthalmus sp*	Common	Badagry creek	August to March	Basket trap
Gobiidae	Mudskipper	*Eleotris africana*	Common	Badagry creek	August to March	Basket trap, fish fence
Gobiidae	Mudskipper	*Batanga sp.*	Common	Badagry creek	August to March	Basket trap, fish fence
Serranidae	Groupers	*Epinephalus aeneus*	Common	Badagry creek	November to July	Set net & Hook
Echippidae	Flat fish	*Achirus* sp	Common	Badagry creek	-	Cast net
Carrangidae	-	*Trichuris* sp	Common	Badagry creek	November to July	Gill net & Hook
Haemulidae	Grunt	*Pomadasys peroteti*	Common	Badagry creek	November to July	Gill net & Hook
Hepsetidae	Hepsetus	*Hepsetus adoe*	Rare	Badagry creek	November to July	Hook
Palaemonidae	Brackish water Shrimp	*Palaemon* sp	Common	Badagry creek	June to November	Drag net, basket trap, fish fence
Palaemonidae	Brackish	*Macrobrachium*	Common	Badagry	June to	Drag net,

Family	Common Name	Scientific Name	Relative Abundance	Fishing areas	Peak Period	Fishing gear
	water Shrimp	*macrobranchion*		creek	November	basket trap, fish fence
Palaemonidae	Creek Shrimp	*Palaemonetes Africans*	Common	Badagry creek	June to November	Drag net, basket trap, fish fence
Penaeidae	Prawns	*Nematopalaemon* sp	Common	Badagry creek	November to May	Drag net, basket trap, fish fence
CRABS						
Ocypodidae	Inter tidal crab	*Uca tangeri*	Common	Mud peat	-	Picking & Plastic container
Sesarmidae	Inter tidal crab	*Sesarma elegans*	Common	Mud peat	-	Picking
Sesarmidae	Inter tidal crab	*Sesarma boticofora*	Common	Mud peat	-	Picking
Portunidae	Swimming crab	*Callinectes sapidus*	Common	Mouth of creek	-	Basket Trap

4.5.7.7.2 Fishing Craft and Fishing Season

Artisanal or traditional fisheries sector belongs also to the class of fisheries characterized as 'small scale fisheries (SSF) and are mandated by law (Sea Fisheries Decree 1992) to fish within 5 Nautical miles. The artisanal canoe fleets of the study area comprise mainly of the dug-out canoes without engines which were observed to be the most predominant fishing craft in the study area with sizes ranging from 2 to 5m. One to three fisherfolks on board the dugout boats extending fishing gears along fishery resources hotspots along the riparian mangrove vegetation. Dug-out canoes with outboard engines also exist but in relatively small numbers. Furthermore, fisher folks generally take advantage of seasonal distribution patterns which are influenced by moon phases, currents, fish movement and behaviour (Sikoki and Otobotekere, 1999). Moon phases are particularly important for pelagic species. "Good" fishing is recorded at the spring tide (often during full moon). The period between July and mid-September

usually experience low fishing activity due to rough water (which is usually pronounced during this period). During this period, fisher folks engage in gear mending and construction in preparation for the next fishing season.

Table 4.31: Characteristics of Dugout boats used

S/N	Characteristics	Dugout boat
1	Length overall (LOA)(m)	2 – 5
2	Maximum width or moulded breadth (m)	0.63 – 1.00
3	Draft/ maximum Depth (moulded) (m	0.12 – 0.45
4	Load water line (LWL) (m)	2.55 – 4.31
5	Number of Thwarts	3 – 4
6	Cubic Number / Size (m)	0.39 – 2.61
7	Free board ratio	2:1`
8	Mode of Propulsion	Paddle

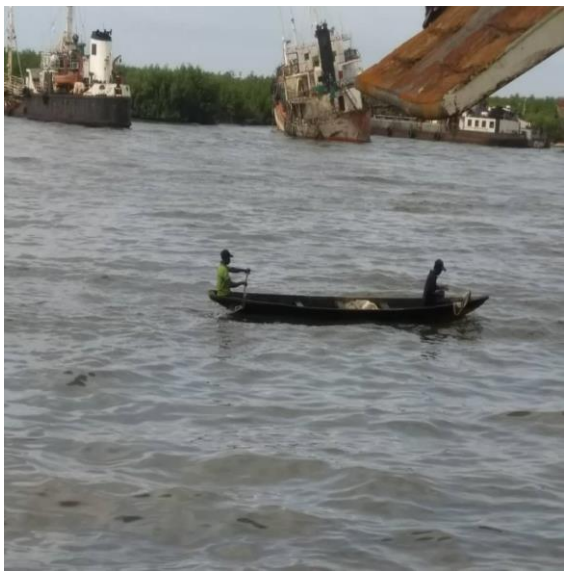


Plate 4.17: A panoramic view of a dug-out boat with two fisher folks onboard along the Badagry creek

Plate 4.18: fishing activity ongoing from a dug out boat

4.5.7.7.3 Fishing Gears

Fishing folks were observed to have a variety of fishing gears due to seasonal changes in both species and abundance status. Survey of the fishing gear used in the study area indicates the use of Gill nets, Fish fence, Cast nets, Hook and lines and Seine net. The gillnets and setnets measure 6-12 m in length and 2-4 meters in width and operated manually using paddles. Fishery resources with larger body-breadth were caught more in larger mesh sizes, while fish with low morphometric measurements swim across nets with larger mesh sizes.

4.5.7.7.4 Total Length (TL) and Weight Measurements

The Length-weight relationships of fish are important fishery management tools. It supports to assess the relative well-being of fish population (Bolger and Connolly, 1989). The Total length and weight of various fish species are location specific as noise from the outboard engines of vessels and passenger speed boats supports the relative distribution of fishery resources of varying fish sizes in different water bodies ((King, 1991; Abowei and Hart, 2008). In order of increasing weight, the fish species were in this order: *Clarias guineensis* < *Chrysichthys nigrodigitatus* < *Tilapia guineensis.* The condition factor which is an index that reflects interaction between biotic and abiotic factors in the physiological conditions of fishes and also includes the stage of gonadal development in the spawning phase. Notwithstanding the poor waste management practices along the Badagry creek, the condition factors of fishery resources surveyed were >1 and indicative of a healthy condition.

Table 4.32: Total Length (TL) and Weight Measurements of fish species in the study area

Fish species	Length (cm)	Width (cm)	Pectoral fin (cm)	Caudal fin (cm)	Pelvic fin (cm)	Body weight (g)	Condition factor	Dietary components
Tilapia guineensis	6.2	5.3	3.9	3.5	2.8	25.9	10.87	Detritus
Chrysichthys nigrodigitatus	11.9	5.5	3.1	5.1	4.2	46.1	2.74	Detritus, Shrimps
Clarias gariepinus	13.1	5.0	2.5	3.7	3.5	35.6	1.58	Detritus

4.5.7.7.5 Tissue Analysis

Copper, Manganese, Nickel, Chromium, Zinc, Lead, Cadmium, Iron and Total Petroleum Hydrocarbon were analysed in fishery resources surveyed. Heavy metals analysed were at variance with the WHO, 1989; FAO, 1983 and USFDA 1993 standards for fish quality. These metals showed great potential for sublethal effects in the tissues of *Clarias gariepinus , Tilapia guineensis and Chrysichthys nigrodigitatus* and considered unfit for human consumption. The high concentration of metals maybe attributed to consistent discharge of waste water and solid wastes materials along the Badagry creek.

Table 4.33: Results of tissue analysis of fishery resources of the study area

Parameter (mg/kg)	*Clarias gariepinus*					*Tilapia guineensis*					*Chrysichthys nigrodigitatus*					WHO (1989)	FAO (1983)	USFDA (1993)
	Gills	Spleen	Liver	Gonads	Kidneys	Gills	Spleen	Liver	Gonads	Kidneys	Gills	Spleen	Liver	Gonads	Kidneys			
Cu	3.19	0.01	3.33	0.47	0.30	0.31	2.09	3.41	0.13	0.06	0.54	1.61	2.22	0.16	1.77			
Mn	1.39	0.51	2.35	0.47	0.87	0.63	0.50	1.33	0.54	0.25	1.41	3.55	5.21	0.88	2.72			
Ni	6.4	3.1	2.2	3.7	5.5	8.5	6.6	5.1	7.4	3.5	9.3	7.1	4.4	3.0	1.9			
Cr	6.1	3.4	5.2	3.3	3.1	4.4	1.8	6.0	2.8	1.7	3.2	2.4	3.8	5.2	3.1	0.5		12-13
Zn	8.5	6.1	7.4	4.1	2.8	1.2	5.3	4.5	2.3	1.1	2.4	3.2	1.4	5.6	3.2		30	
Pb	3.3	5.9	3.8	2.1	4.2	6.1	3.1	4.7	6.1	10.2	6.1	4.6	7.5	3.3	2.4	2	0.5	
Cd	2.3	9.0	4.2	5.1	2.2	3.5	7.1	9.4	4.2	2.2	5.0	2.2	2.6	2.0	9.7	2	0.5	
Fe	4.0	3.2	2.8	1.6	6.5	4.3	5.8	3.5	2.1	4.5	2.6	1.8	6.0	2.8	4.1			
TPH	13.1	8.2	4.1	3.3	2.5	18.5	10.4	15.0	7.3	5.0	6.2	21.5	15.8	11.6	5.9			

Plate 4.19: Solid Waste materials along the Bank of the Badagry creek

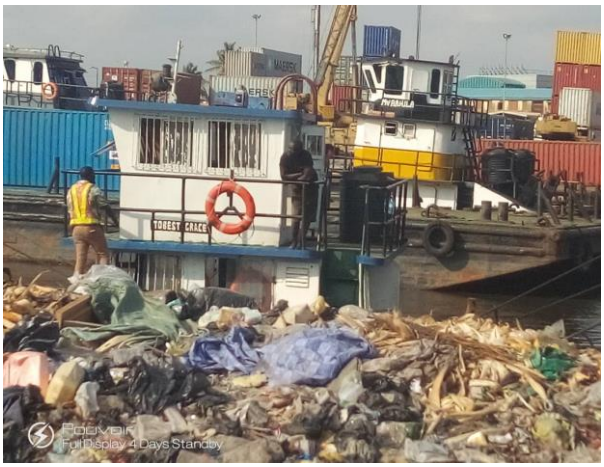


Plate 4.20: Waste heap beside the banks of the project site

4.5.8 Socio-Economics

4.5.8.1 Approach

Primary data collection was through the use of structured questionnaire which was pre-tested to ensure reliability, Focus Group Discussions (FGDs) guide, In-Depth Interviews (IDIs) guide, Questionnaires (Appendix 4.4), Health Index measurement, Ethnographic field research and participatory observation techniques (Crewell, 2003; WHO, 2010; Bernard, 2011; Ritchie and Lewis, 2012; Akpabio, 2013). Secondary data from relevant literatures was also consulted to complement the result of the study. All these techniques were complemented by visual photography sessions. At least four (4) focus group discussion sessions were held in the community. An estimated three hundred (300) people made up of indigenes, residents, women, men and youths were randomly interviewed. A total of a Sixty (60) questionnaires were distributed, filled and retrieved. This was done to validate and/or complement the information given by the general respondents.

Plate 4.21: Focus group discussions and filing of questionnaires

Plate 4.22: Consultation with a community leadership

4.5.8.2 Study Community

The ancestral owners of the host community (Kirikiri) are the Awori Family-the family of Imore and Apapa Beach who later sold the land to Alhaji Nurudeen Lasis Shokunbi family and Alhaji Babatunde Cardoso. After the Land use decree of 1978, all lands were vested on the government, holding same on trust for the people by either the federal, state or local government depending on where the land situates. Kirikiri Town is under Amuwo Odofin Local Government Area of Lagos State, Nigeria. According to the Key informants over 70% of the total internally generated revenue for the Local government of Amuwo Odofin comes from Kirikiri. It is the industrial and business hub of Apapa area with hundreds of companies operating in the area. These included but not limited to the following—Swift Oil, Techno Oil, Bovas, Total, Chisco Oil, MRS Oil, Henry & Henry, SCOA Motors, Taraba Fishing, Karflex Fishing, Vanguard Newspaper, The Sun Newspaper, Sara phone, Elega Stiff to mention but a few. It is unfortunate to note however that despite the fact that Kirikiri can be compared to the proverbial bird that lays the golden egg, Kirikiri Town has nothing to show for it especially in terms of both social and physical infrastructural facilities. The roads leading into the Town and the link roads are in very deplorable conditions. Traffic congestion/jam is a regular feature as tankers belonging to NUPENG and major oil companies located in the area block the entire roads which is further compounded by container terminals and car sellers. The three tiers of government at various fora and time have been formerly approached by the leaders of the community on fixing the internal roads but a s at the time of this study, no reply has been received from the authority. There is urgent need for the state, the local government and companies located in the area to team up and fix the roads and other infrastructural facilities urgently needed in the area.

4.5.8.3 Social Organization and Traditional Governance

Cultural diversity stands as one of the most critical characteristics of Nigeria as a country. Diversity is the word from language, religion, cultural insignia to the economic setting with examples like the linguistic diversity where Nigeria has more languages than any other African country. While this diversity provides more localized identity for millions of Nigerians, this diversity can and has posed challenges. Lagos, now a Mega City with its diverse ethnic and linguistic groups, is also very rich in culture and the arts. Several cultural bonds exist, particularly in music, dances, plays and masquerades. The region therefore, has a very distinctive & diverse culture. Overall, the socio-cultural aspects of the population in the

different ethnic groups are highly dependent on their ethnic background and religion. The paramount ruler of Kirikiri is called or addressed as the Baale. The Baale administers towns and villages and pay royalties to the Oba at specified times of the year. He is the chief security officer of the community, the paramount authority or natural ruler in any given community. The Baale provides a system of administration from which law and order can provide a stable system of governance, plays very significant roles in informally managing conflicts and arranging peacemaking meetings when matters get out of hand. Possess accurate knowledge and may have good network communications with the grassroots through titleholders, plays advisory roles to local chiefs. In between the hierarchy, are family heads or chiefs who usually sit with the Baale in council. In most communities, the structure is that, the elders and traditional rulers enjoy very powerful positions. Government can explore the highly influential position to the advantage of the public. It is possible to strengthen local capacity for management and settlement of disputes, rather than imposing the formal state legal system. However, their power in the community is highly variable and in some areas are opposed by youth groups, while elsewhere, their power is subverted by LGA officials as is the case in Kirikiri where there are two contenders to the throne –Chief Anthony Babatunde Folarin and High Chief Babatunde Babalola Shabi after the demise of the former Baale of Kirikiri –Chief J. D Sumonu who died in controversial circumstances on march 26, 2020. Within the leadership structure are influential groups such as the CDC and the Youths. The CDC comprises representatives from the various units that make up the community. Notable individuals are co-opted as members if they feel they could be resourceful in contributing to the progress of the community even if they are not initially proposed from their own unit. The youth council in Kirikiri is active in conversing issues such as employment, scholarship, industrial relations and culture. In the community governance chiefs were rated highest, followed by the youths, elders, women and age groups.,

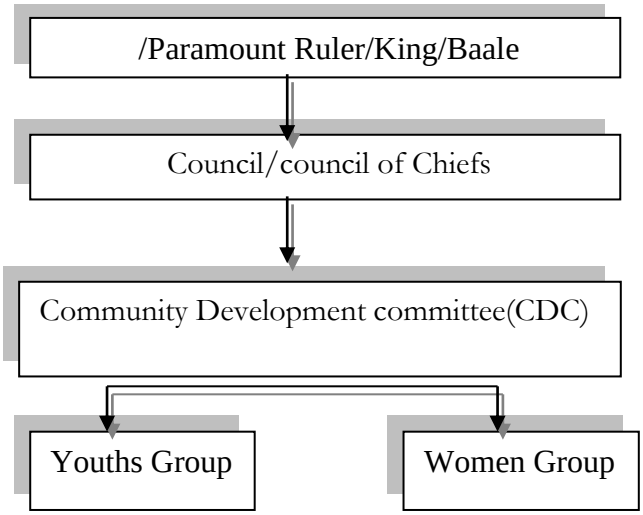


Figure 4.22: Chart Showing Power Flow

Plate 4.23: Women representatives at a Focus group discussion

Plate 4.24: Consultation with Kirikiri town people with Bestaf representative present

4.5.8.4 Conflict Management and Resolution Mechanism

Observations indicate a peaceful co-existence among the numerous tribes and ethnic nationalities that live in the communities. There were also good and cordial relationships among the various groups- youth, elders, and the women organization as at the time of this study. There has been some level of conflicts in the bid for succession to the throne among the different ruling house in the study area. According to our key informants, conflicts were rare, except sometimes over land boundaries and fishing rights. Our informant, an elder in the community told us that land ownership right is by family inheritance and the individual. Land could also be acquired through outright sale, gift, transfer of ownership through lease,

so conflicts relating to land is very rare. Women are not given land unless there is no male child in the family or she could buy land from the original owner. Fishing rights are given to foreigners but may be required to buy drinks. Disputes also arise when any multi-national oil company establishes project(s) at the boundaries of communities. This could lead to inter and intra -community clashes, minor conflicts could occur over fishing rights. Conflicts and contentious issues are resolved in the communities and settlement is by collaboration among the village chiefs/heads, the Executives, the council of Chiefs, youth and women wing. The rungs of power are well established and guided by unwritten byelaws The Baale has the final authority over all issues including management of conflicts. In the event that a matter is not resolved on the spot when the community member runs foul of the law, the matter is handed over to the lower organ, such as family heads, (youth and women) ie. Action group, council of chiefs and council of elders. The Baale has a final say and the deviant are punished according to the gravity of the offence. Serious cases therefore involve meting out serious punishments including ostracism or handing over the criminal to the police. In most cases or more often than not cases/disputes were amicably settled without resort to the police or court proceedings. It was noted that legally/ according to the rule of law, it might not be easy to pronounce banishment on an individual but in the community, a subtle way of doing this is by banning the individual from taking part in certain activities within a certain period depending on the gravity of the offence.

4.5.8.5 Religion and Worship

In communities of the project area, there used to be many traditional sites of cultural importance to the people, shrines, sacred forests and rivers. But today most of the Deities and shrines have lost their identity due to education, development and aggressiveness of the churches especially the new Pentecostal sect. In the community, Christianity predominates, although there are strong influences from traditional religious beliefs. The presence of churches of different denominations in the communities/settlements of the study area is evidence of the peoples' beliefs in the Christian faith. The churches are both orthodox and Pentecostals The orthodox churches counted during the survey include catholic, Anglican, Methodist, Jehovah Witnesses etc. Pentecostal churches counted include Redeemed Christian Church of God, Assemblies of God, Mountain of Fire, Living Faith church, Church of God mission. There are also many Muslim faithfuls in the area, ranked second with about 6 Mosques within the town. It is possible there are free thinkers and atheists in the community as diverse as Lagos but none was encountered during the study. In spite of the Christian

stance of the people in the area however, some remnant cultural practices are celebrated with a religious fervor in their seasons.

Plate 4.25: Church within the community

Plate 4.26: Community mosque

There are several traditional sites of local cultural importance to the communities which are mainly small shrines and deities, sacred grooves/ bushes, and burial grounds. Ibunako Shrine is a community ancestral ground, celebrated every march. During this festival, the Baale and the community leader pray for the people for peace and appease the gods for whatever wrong or lapses made. The celebration extends up to Badagry. At Ikpabe, the Baale is initiated, crowned and stays there for 100 days, after which the Baale prays for the people who in turn prays for the Baale. This is the symbol of authority of the people. When there is a threat to peace, all necessary rituals are performed in the place. The ancestral ground has now been fenced round to keep it sacred and ward off people from the place. Kirikiri ancestral ground is where the Baale is buried after his demise unless with permission from the Baale and the Local Government Authority, he can be buried in front of his house. The priest in charge are ranked according to their status in the rung of power. The levels include which Baba Idaso, Baba Maji, Baba Sokiala, Etiko, Ishiaba, Babosha, Ideji, Saba. During this festival, a lot of eating and drinking takes place, in fact everything that has to do with tradition is exhibited including dancing with relatives and neighbours invited to grace the ceremony/occasion. Kirikiri ancestral ground is a place where Kings and other titleholders are initiated, the Akoko tree on the ancestral ground are used for the installation of the Baale and other titled chiefs. The Traditional wrestling within and between communities is one of the mass recreations in the community. It comes up in the third and last quarter of the year during and after harvest. Dances and cultural display go with the ceremony. This is traditionally called olotu festival

performed by the Ijaws of the Niger Delta. The tradition is however fading as long as formal education and Christianity are taking the place of these festivals. Today Christmas and Easter festivals are the greatest annual festival/ceremonies with mass participation. In the rating of cultural activities, according to their perceived importance, respondents scored Christmas and wrestling equally as the highest followed by traditional marriage, masquerade display, Easter, birthday and local boxing. Festivals and cultural calendar observed in the area included but not limited to easter, Christmas, masquerades, wrestling, traditional marriages and birthday.

Table 4.34: Festivals and Period of Celebration

Type of festival	Period of celebration
Wrestling Festival	October / early November
Christmas	25th December
Easter	End of March/April
Ibunako festival	March.
Muslim Festival (Salah)	Various dates

Source: Field work 2020

There are other belief systems, which revolve around common taboos and forbid the doing of some things at certain times, typical example is killing /murder, incest, adultery and violations are frowned at and punished. Food taboos are drinking blood, eating vulture and dead animals.

4.5.8.6 Settlement Sizes and Demography

The population of Kirikiri Community, a subset of Lagos is broad at the bottom with children and adolescent 14 years and below comprising 36 percentage of the total population. The working population class/ age of 15-65 years comprised of 66%. Almost 90% of the people that live and work in the area are children or young adults on the age bracket of 0-40, estimated at 250,000. The population is therefore very young and the implication is that it will continue to grow rapidly in the near future. The household size was estimated at 6.1, which is about the same as the National average with 50 households surveyed in the study and they reported 328 household members. The 1991 population census is the most current that is published at community level in Nigeria. The total number of people who lived in Kirikiri town by the 1991 census was approximately 11, 729 where 6,559 were males and 5,170 females. The wide disparity from demographic perspective in the sexes is explained by the large proportion of migrants in the community who are more likely young males who have come to look for greener pastures. The 1996 projection of the population was 13,999 while

2020 when this survey was carried out, it was 21,166. The population was based on 3.4% annual growth rate although Kirikiri is Urban and as such grows faster than the National average. The current real estimated population of Kirikiri is believed to be significantly higher. In addition, thousands of people commute to work in Kirikiri because of the various industrial facilities and seaport in the area.

The age composition of the community reveals the characteristic trends and spread of the people. The distribution of the population by age showed that 0 -5 has 35%, 6-15 has 20%, 16-65 has 35% and 65 above has 10%. The population shows a pyramidal structure loaded with more people at the base while it tapers at the apex where there are older people, this is one of the characteristics of developing countries demography, a growing population. The active age involved in economic activities contributing to family income is 35% the rest are either children of school age or very old people. These groups cannot contribute to family income. They rather depend on others making dependency ratio very high, higher than 1:1. As indicated earlier, the average number of people per dwelling unit is 8 but there are variances, more people reside in makeshift houses than a modern house for example, less number of people are found per dwelling units in Ikoyi, Victoria Island and Victoria Garden City, Lekki, Epe.

4.5.8.7 Migration

Majority of the residents are non- natives, a large population of these migrants are from the different parts of Nigeria while the remaining few are from abroad in this survey. 70% of the migrants encountered were Nigerians of other state origin. More than 40% of the migrants were from South East, 15% from South South or Niger Delta states, 15% from the North, while the remainder of the migrants are from other parts of West Africa, Africa. (Ghana, Togo, Cameroon, and Niger). A small number of foreigners came from America, Europe, Asia. Most of the non-Nigerians work in the large industrial and commercial firms or are sailors passing through the Port. All the migrants interviewed fall into two categories of those who came to seek jobs 50% and those who came to trade 50%. Majority of the migrants 90% have lived 1-10 years in Lagos and they all reported an improvement in their condition since arrival. As with most migrants they are speculative about how long they wish to stay in Lagos, none has made up his mind on whether to stay permanently for the rest of their lives.

4.5.8.8 Settlement Pattern

The settlement exhibited similar housing patterns and local architecture. About 15-25% is makeshift while about 75-80% is modern. The dilapidated housing cannot provide safe and adequate shelter. The structure design and location of the housing and population density within it can influence health both physical and mental. The actual structure of a dwelling can be important for health in a number of ways. Make shift structures as was found in the communities' almost invariable fail to guide against extreme temperatures, heat and cold, which can increase sickliness and death rates. Overcrowded houses spread tuberculosis and large proportions of chronic respiratory disorders. The settlements are located close to the road and River banks/creeks. The settlement is urban and cosmopolitan both linear and closed with some squatter settlements. Some of the community's initial status as reflected in layout and housing types and structure was that of a rural setting but over time, they are fast evolving into a permanent residential, business and industrial settlement. Kirkiri area is no doubt one of the industrial hubs of Lagos with a large number of Tanks farms, Petrol Filling stations, fishing companies, container terminals the communities of the project-affected areas are becoming well planned with the exception of some areas towards the Creek. Some of the individual housing units are makeshifts, old, dilapidated houses without any form of aesthetics and modern amenities. However, many of the houses are designed and built with block/brick walls with corrugated galvanized aluminum sheet, with modern amenities. Most of them are rooming houses built in tenement style with both kitchen and toilets outside the main building. There are also many bungalows, one- storey buildings, detached and semi-detached houses with modern amenities such as water cistern, television, DSTV modem, fans and air conditioners.

4.5.8.9 Marital Status

Married people are believed to be more suspicious, careful and meticulous about the effect of any facility or development on the people especially their children fearing increased accident, pollution, leakage etc. About 70% of the respondents are married while 10% are single and others 20% (see Figure 3.9).

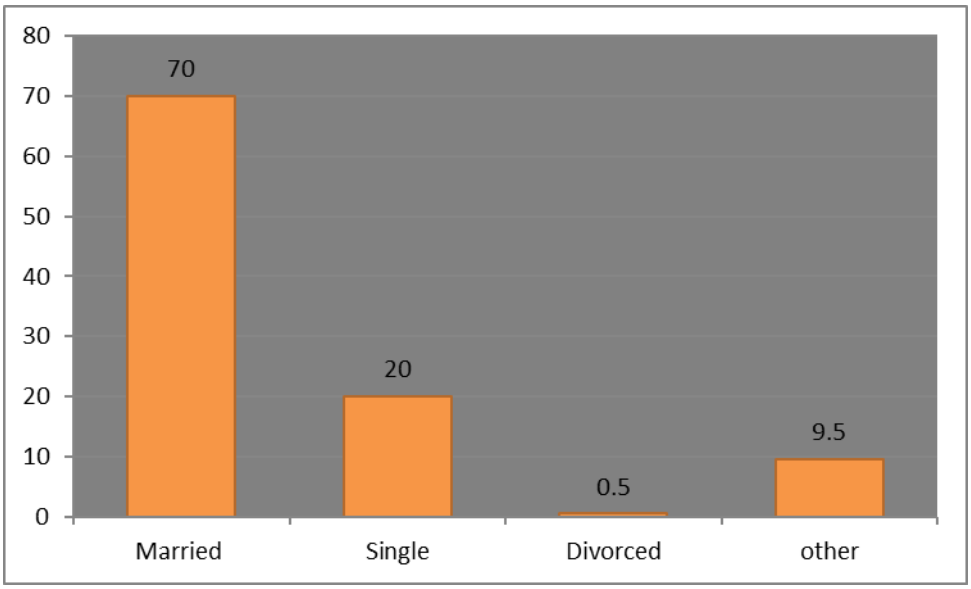


Figure 4.23: Marital status of the study area

Marriage is a valued socio-cultural norm and is practiced among the people of Kirikiri town as in all lands. In the past, marriage ceremonies were very much revered. It involved very elaborate celebration and fanfare but in recent times. marriage ceremonies are becoming less elaborate and private, so can also serve as a rite of passage from adolescent to womanhood. There is no particular specified age for marriage, it varies from community to community and is controlled and dictated by circumstances such as being the only son, financial position and by the occupation. Anybody who is up to occupation age needs a helping hand and is therefore, qualified to marry; whether man or woman. For Girls, it is between 20-25 years, while for boys 25 years and above". Polygamy is a practiced form of matrimony; Polygamy is practiced in the community but not a common feature. bride price/dowry payment is regarded highly while inheritance is patrilineal accordingly. With increasing level of education, economic hardship and hard stance of Christian religion, polygamy is being discouraged.

4.5.8.10 Educational Attainment/ Literacy Level

A large proportion of the inhabitants and sampled population has received some formal educational training indicating a sufficiently literate society. According to a 2006 survey, the adult literacy rate is 90%, the respective rates are 95% for men and 85% for women The modal educational attainment amongst the population in the communities/settlements proximate to study environment however, is the primary with a mean of about 82 percent. 80% percent of the sampled population has the post primary education and close to 20% has

some form of tertiary education. Slightly less than (5%) reported of no formal education (NFE) and this is particular with the aged members of the communities. The educational status of the area is very satisfactory. Primary and secondary schools are available in the communities of the project area. Central primary school and the Local authority primary school Kirikiri and private primary primary schools. Only one secondary school, Dr. Lucas secondary school formerly called Kirikiri community secondary school.

4.5.8.11 Social Life

There are social groups/ clubs in the communities eg women social clubs, political groups, church groups, educational groups and other social groups Landlord association. People become affiliated to these social groupings depending on their personal inclination. They perform social functions, these clubs/groups are organized based on common interest, choice and affiliations and also mostly on gender basis. The women with common social identity like marriage or visions such as fostering, friendship and solidarity within their community can form their own social clubs. These social clubs fill the void for people who do not belong to any of the social categories. These clubs have a lot of cultural trappings which are usually indicated in their names and strict adherence to traditional dresses at public functions. Often, the goals of these clubs are not for pecuniary gains but exists to support members in times of merriment or grief. Entertainment through dances at functions is another area of culture, which is commonly practiced by the social clubs. The social clubs provide mutual support for their members in times of childbirth, marriage, bereavement and other celebrations. They also provide common fronts for support of community development programs, like donations of equipment, physical infrastructures and other items for public use. Women are also known to intercede for peace during inter/intra community crises. In the study area, the most frequently reported group affiliation in the order of magnitude is religious, social clubs, education, and political parties. The less patronized one is the co-operative

4.5.8.12 Social Infrastructures

The level of infrastructure and amenities available and functional in any area or community has direct implications on the quality of life in that area, and therefore the willingness of people to live and remain there. It also influences other socio-cultural and economic variables in the area. The field study and observations of humanities/settlements study area reveal a general lack of most basic amenities, for quality living. It was observed also that government at both the local and state level have had little or no presence in the study area especially in

the communities of the project area; it was only at the local government headquarters that some modicum of basic amenities, considered grossly inadequate by the leaders and population were some government presence seen. Amenities whether in the towns or villages are the requisites of a happy and comfortable life. The availability is an indicator of development and progress. Apart from drinking water which is available in all the areas, the amenities of Education, Health facility, power, communications, roads are inadequate, although the host community is connected to the National grid, power is epileptic in supply.

Communities in the project-affected areas have access to energy supply, through PHCN now privatized to Lagos Electricity Distribution Company, private generators readily come to assist and they also buy the diesel required to fuel the generators. In most cases, the diesel is in short supply due sometimes to artificial scarcity. The old time reliable hurricane lanterns and candles are used for illumination while those on petty trading operate small generators to cool their drinks and hence attract customers, light up their restaurants and bars. Access to public communication facilities like the telephone and postal services in the study area was available but found to be greatly limited. Postal facilities and services with the introduction of modern telecommunications such as the GSM telephony have since been rendered redundant. However, MTN, Airtel, and the GLO mast that is popular in the Lagos are seen .in the community.

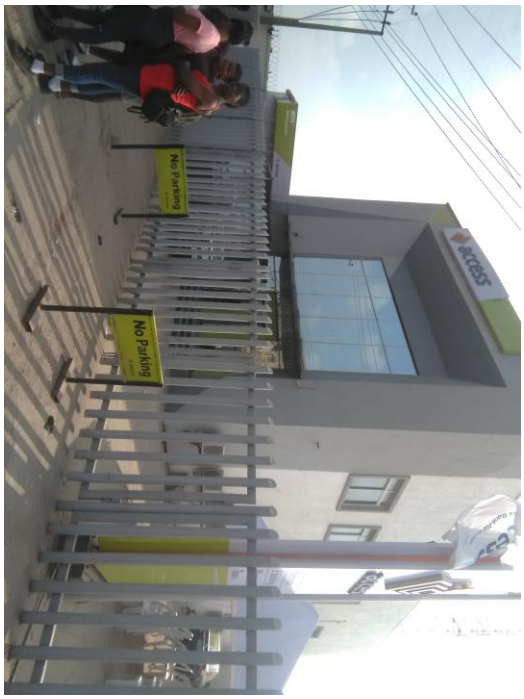


Plate 4.27: typical bank in the community

Plate 4.28: Local authority Primary school Kirikiri town

4.5.8.13 Waste Management

In the study area /community, there are no designated spots or place provided for dumping of refuse, in some places you find waste being dumped indiscriminately or clandestinely. The accredited waste management company LAWMA- Lagos waste management authority brings in their truck to cart away waste to their designated area but not regularly. Sometimes the waste dumps overflow to cover the road making access very difficult. Solid waste materials mainly rubbish and garbage are dumped into the watercourses, drainages or bushes and allowed to rot or burnt, buried as a form of disposal. The quantity of refuse varies from one locality to the other depending on the food habits and customs of the people and other economic and industrial activities in the area coupled with the waste management practices. The quantity of refuse in the rural parts of the project area is less than that of the more urbanized 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, dustbins must be provided to collect the waste, which must be water resistant. It must also be provided with a coverlid.

Plate 4.29: Waste management system within the community

Plate 4.30: Waste along the creek banks

4.5.8.14 Occupation, Employment and Income

The Kirikiri people are engaged in all walks of life, civil service, petty trading, fishing and agriculture, artisans, company workers, contractors are the two major traditional occupations of the peoples (UNDP, 2006) and this applies to the host community. The urban sector, with its concentration of informal sector activities, plays a growing role in the economy of the state. Trading (15 per cent), self-employed (48 per cent) and is the largest, company workers (31 per cent), public sector 2% are the most important areas of employment, others include

fishing and agro-allied businesses. The unemployed consists of job seekers, those made redundant and students. Trading is the second most important income-generating activities in the area, and on very few exceptions, the females do more of the petty trading; dispensing goods from stores and open places since structured community market are not common, there is only one structured community market built long ago during the tenure of governor Jakande currently requiring upgrading. However, there are other smaller markets that are not well structured as well. A few respondents were also observed engaged in other fisheries-related industry activities such as boat making and repairs, boat engine servicing, sale and mending of nets among others while fashion designing and hair-dressing were artisan occupations found to engage some women-folks in the host community.

There is very high rate of prostitution in the community. There are more than 6 Hotels, 4 brothels, 2 night clubs, more than 20 beer parlous, etc. Most of these sex workers are migrant sex workers, camp followers, camp stragglers, local prostitutes who are attracted by expatriate workers, oil company workers, sailors and numerous businesses in the area. The government needs to put stringent measures in place such as license, constant medical examination of the prostitutes especially during this period of pandemic. With the increasing economic downturn in the country, prostitution is bound to increase by leaps and bounds, efforts should be made to rehabilitate them, create alternative means of livelihood for the teeming population of young unemployed youths in the state and carry out vigorous campaigns against prostitution,

4.5.8.15 Household Assets

Many members of the community possess valuable household items such as television, radio sets, fans; DSTV, air conditioners etc. The enjoyment of these facilities is limited by the near absence of electrical power.

4.5.8.16 Vulnerable Groups

During the field work, a number of physically challenged people although few in number, were seen in the community carrying about their normal businesses. According to our key informant and some elders of the community, there is no form of social exclusion of the physically challenged persons but all are completely absorbed/assimilated into the system in the kingdom. According to the elders, the foundation of the kingdom is built on justice, equity and fair play; therefore, physically challenged people are accorded equal rights and opportunities in the community affairs.

4.5.8.17 Road Traffic Study

4.5.8.17.1 Traffic Volumetric Survey

Traffic volumetric survey was undertaken by trained assistants at points along hypothetical cordons traversed by vehicular traffic on the roads of interest. Routine Survey was carried out for seven days (24/08/2020 - 30/02/2020) at regular time interval. Night time survey was also carried out due to significant truck movement during the night. Survey points and their coordinates are given in Table 4.35.

Table 4.35: Coordinates of Traffic Volumetric Survey Points

S/No.	Survey Point	Coordinates	
		Northing (N)	Easting (E)
1	Kirikiri Bridge	6^0 26' 44.32"	3^0 18' 50.13"
2	Cardoso Road	6^0 26' 30.49"	3^0 18' 43.47"
3	Karimu Road	6^0 26' 29.61"	3^0 18' 38.70"

Source: Field Survey 2020

In order to properly account for all types of traffic of interest as deemed necessary and to be able to carry out basic arithmetical operations, vehicles were delineated into categories as

- Container Truck
- Tanker Truck
- Motorcycle (Okada)
- Others (private cars, light Vans, buses etc.)

Due to difficulties involved in motorcycle count from the bridge, an estimated value was derived from the summation of the count at Karimu and Cardoso streets, being the two main entryway into the town from the bridge. Traffic Volumetric Survey Results is presented in Table 4.36.

Table 4.36: Daily Road Traffic Volume

Vehicle Type	Mon 24/08	Tues 25/08	Wed 26/08	Thurs 27/08	Fri 28/08	Sat 29/08	Sun 30/08	Total
Tanker	170	140	139	159	113	137	48	906
Container	323	289	215	272	234	188	24	1545
Motorcycles	515	485	505	557	470	646	426	3604
Others	611	581	569	517	690	601	388	3957
Total	1619	1495	1428	1505	1507	1572	886	

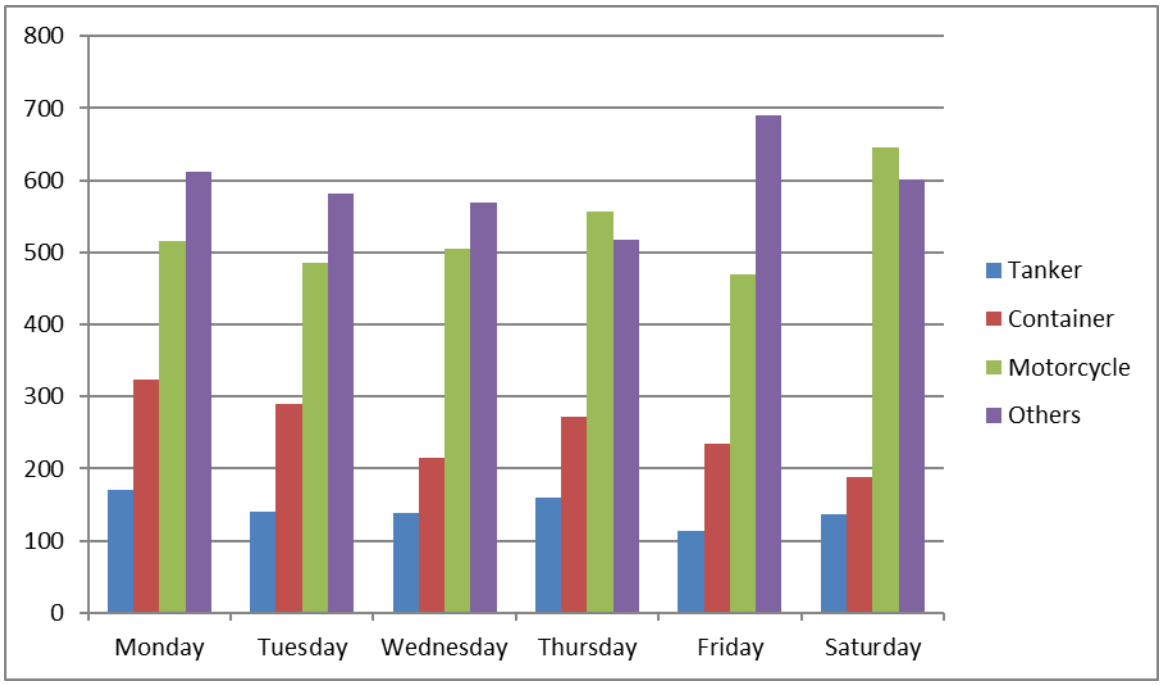


Figure 4.24: Daily Road Traffic Volume

Table 4.37: Time interval of total volume of vehicles

	Time Interval				
Time Interval	6:01 – 9:00hr	9:01 – 12:00hr	12:01 – 15:00hr	15:01 – 19:00hr	19:01 – 6:00hr
No of Vehicles	2219	2199	2057	1811	1726

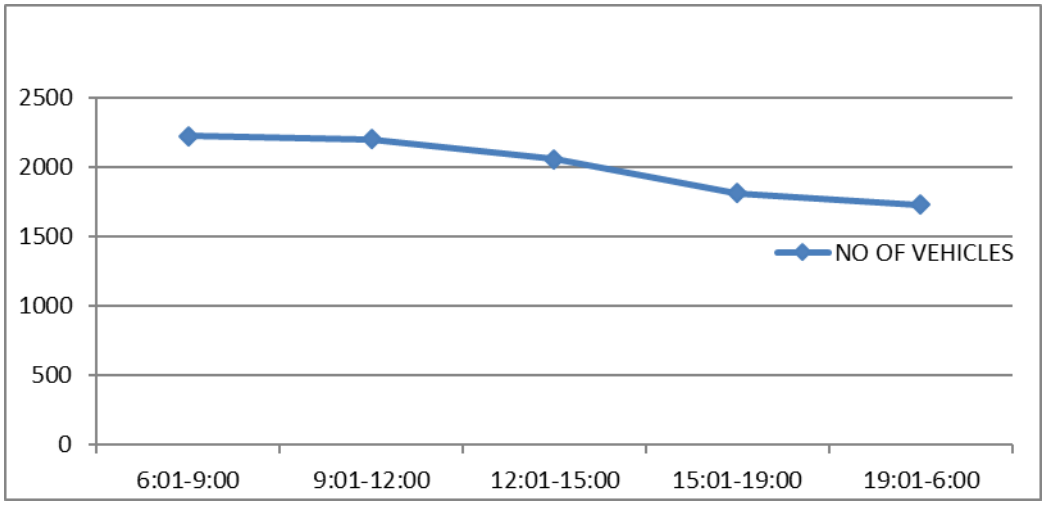


Figure 4.25: Weekly Average Road Traffic Volume

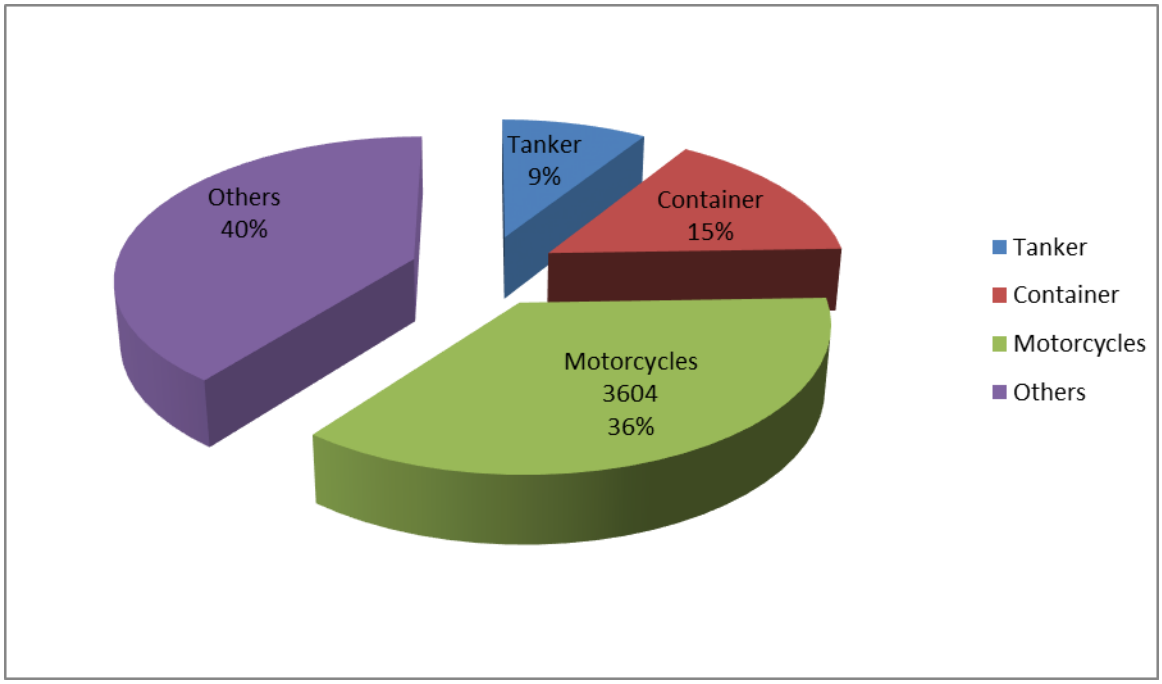


Figure 4.26: Percentage Contribution to Total Road Traffic Volume

Plate 4.31: Container Traffic at Kirikiri Town

Plate 4.32: Motorcycle and Car traffic at Kirikiri Town

Table 4.38: Detailed Road Traffic Count Data

TYPE	Monday					Tuesday					Wednesday				
	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am
Tanker	27	42	37	29	35	16	23	30	22	49	19	33	56	14	17
Container	63	75	91	77	17	47	99	93	39	11	29	71	75	31	9
Motorcycle	73	130	125	84	103	71	135	119	68	92	69	115	129	76	116
Others	167	93	85	149	117	147	102	72	129	131	161	89	72	129	118

Table 4.38 (Cont.)

TYPE	Thursday					Friday					Saturday				Sunday					
	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am	6am - 9am	9am - 12pm	12pm - 3pm	3pm - 7pm	7pm - 6am
Tanker	31	39	28	51	10	23	28	11`	6	56	20	27	47	19	24	6	9	14	7	12
Container	59	64	74	62	13	40	91	61	32	10	21	65	72	26	4	3	7	3	1	10
Motorcycle	152	141	117	80	67	82	106	103	73	106	142	115	132	127	130	104	92	89	80	61
Others	169	79	107	70	92	185	150	83	123	149	173	106	84	118	120	120	73	59	89	47

4.5.8.17.2 Traffic analysis

The results of the road traffic survey are shown in Tables 36 and 37, while Figures 25 and 26 graphically present the same information. Over the 7-day survey period, the highest volume of traffic was recorded on a Monday with a total of 1619 units with other vehicles comprising private cars, small buses, tricycles and vans having the highest number of 611 units. The lowest was recorded on a Sunday with a total of 886 units due to minimal activities on this day being a weekend and work-free day for most people. The weekly average time interval volume of traffic was highest between 6:01hr – 9:00hr and 9:01hrs – 12:00hr with 2219 unit and 2199 units respectively. Container and tanker make up 15% and 9% of the total vehicular traffic respectively surveyed for this period. Motoring accident constitutes a grave problem in the community and adjoining Apapa Oshodi express way. A problem in the study community because there are no paved, good and fast road transport developments in the communities due to the rugged nature and hydrology of the terrain and due in part to lack of maintenance, industrial congestion. The roads are not well paved with potholes, abandoned vehicles, old tyres, fallen cargo containers, long vehicles, tankers, trucks, fuel tankers because of numerous depots and container terminals. The rate of accident is very high, sometimes causing traffic congestion for long hours. The Host community lies along Oshodi/Apapa Express way, a very busy road leading to Apapa which hosts, major industrial belt, Apapa wharf, Tin Can Port and the recently completed Port at cocoanut area coupled with Apapa residential area and Apapa Local Government Headquarters. Despite a wide outcry and repeated calls and appeals for the government to fix the roads, decongest the area, and develop other seaports around the Nation, these have met with deaf ears. The consultants were told by key informants that the community has applied for permission to repair the roads but till the time of this study the community has not gotten a response from the Local Government Authority.

Resolutions between the community and companies

1. Bestaf marine services limited shall periodically carry out road maintenance on the Karimu and Cardoso roads, like grading of the road and filling of potholes with chippings to ease vehicular movement

2. Bestaf marine services limited will construct and expand existing road drainage to manage erosion and runoffs during the raining season to ease vehicular movement

A speed limit will be set for all truck movement in town to reduce accident

3. As much as possible, trucks will not be allowed into the town except when scheduled for loading

4. Trucks will not be allowed to park anywhere on the streets of kirikiri town overnight. A fine will be imposed on defaulters.

5. Signage will be raised at major junctions to control truck movement in town

4.5.8.18 Marine Traffic Study

The observation point for the traffic management study for the Badagry creek also locally known as the Imore creek was along the bank close to the Project site at N 06°26'19.9" and E03°18'32.3" coordinates. Volumetric survey was undertaken from the 24th to 30th September 2020 by trained assistants at a fixed point in the project site along the waterway traversed by vessel traffic on the Kirikiri axis of the Badagry creek. Routine Survey was carried out for seven days at regular time interval during the daytime from 06:00hr to 19:00hrs. In order to properly account for all types of vessel traffic of interest as deemed necessary and to be able to carry out basic arithmetical operations, boat types were delineated into categories as

- Speed/Passenger Boat
- Sand Boat
- Vessel
- Barge/Tugboat
- Canoes (Fishing)

Table 4.39: Daily Waterway Traffic Count

Vehicle Type	Mon 24/08	Tues 25/08	Wed 26/08	Thurs 27/08	Fri 28/08	Sat 29/08	Sun 30/08	Total
Speed boat	429	328	116	422	333	86	30	1744
Sand boat	51	37	3	36	34	5	9	175
Vessel	4	1	0	3	3	0	1	12
Barges/tugboat	8	6	0	11	8	1	0	34
Canoe	7	3	1	14	5	3	9	42
Total	499	375	120	486	383	95	49	

Source: Field work 2020

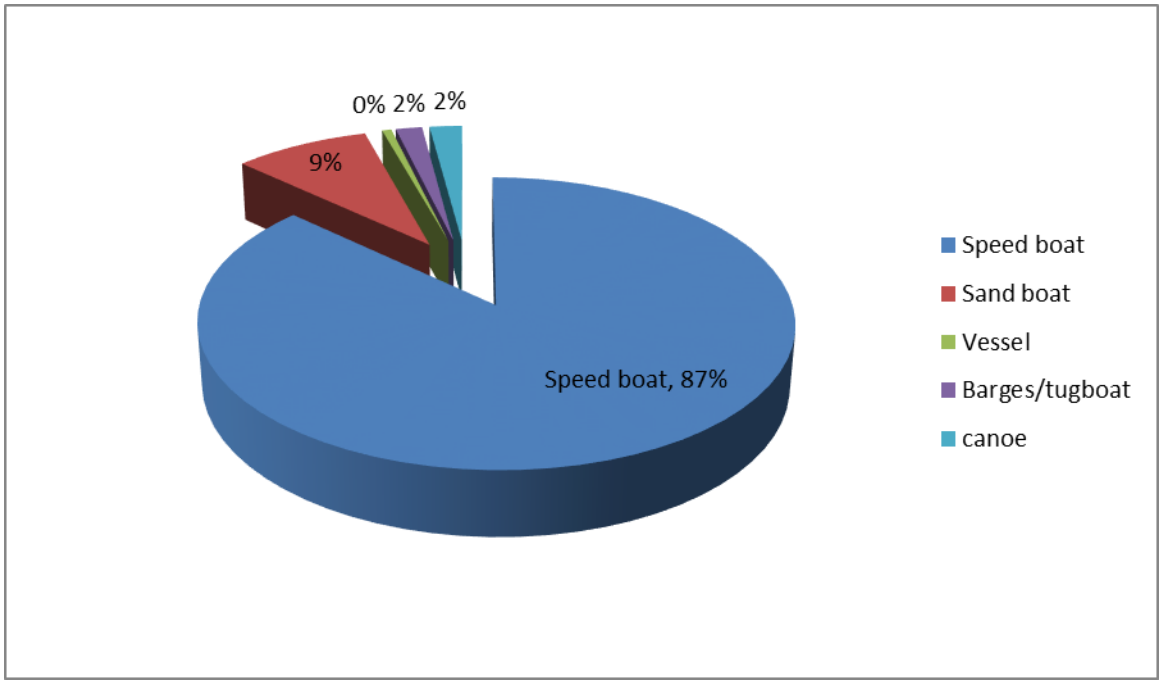


Figure 4.27: Percentage Contribution to Total Waterway Traffic Volume

Table 4.40: Hourly Volume of waterway traffic

Time Interval			
6:00 – 9:00hr	9:01 – 12:00hr	12:01 – 15:00hr	15:01 – 19:00hr
711	362	247	687

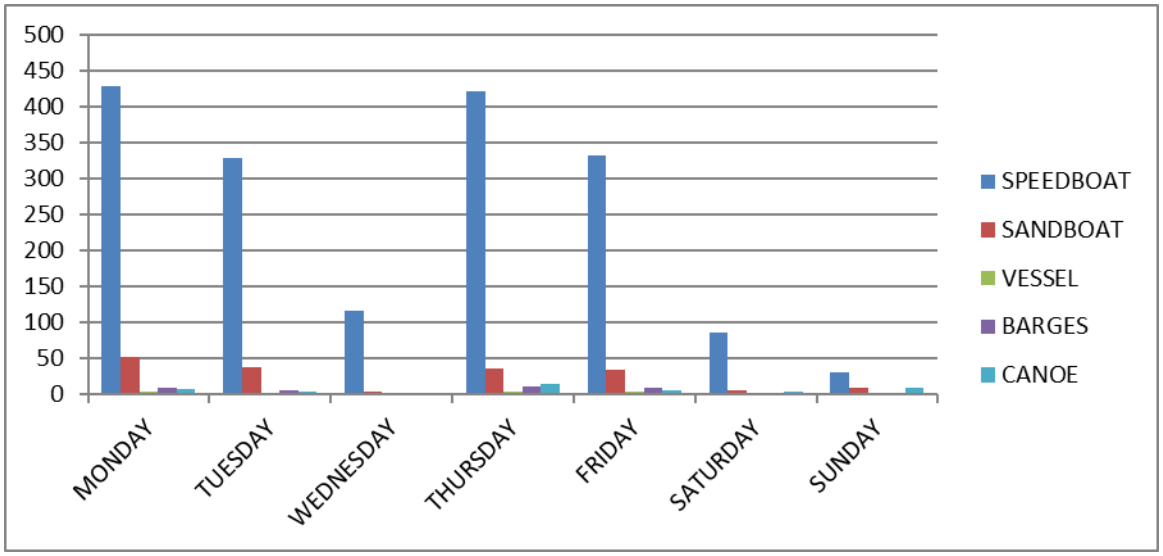


Figure 4.28: Daily Vessel Traffic Volume

Plate 4.33: Speedboat loaded with passengers and a Vessel at the background

Plate 4.34: Observed Vessel and Canoe

Table 4.41a: Detailed Waterway Traffic Count Data

Type	Mon				Tues				Wed			
	6am-9am	9am-12pm	12pm-3pm	3pm-7pm	6am-9am	9am-12pm	12pm-3pm	3pm-7pm	6am-9am	9am-12pm	12pm-3pm	
Speed boat	142	87	60	140	98	44	38	148	65	12	5	34
Sand boat	20	11	14	6	14	9	10	4	1	1	1	0
Vessel	1	2	1	0	1	0	0	0	0	0	0	0
Barge	1	4	2	1	2	3	1	0	0	0	0	0
Fishing boat	3	1	1	2	2	0	0	1	1	0	0	0

Table 4.41 (Cont.)

Type	Thursday				Friday				Saturday				Sunday			
	6am-9am	9am-12pm	12pm-3pm	3pm-7pm	6am-9am	9am-12pm	12pm-3pm	3pm-7pm	6am-9am	9am-12pm	12pm-3pm	3pm-7pm	6am-9am	9am-12pm	12pm-3pm	3pm-7pm
Speed boat	148	95	52	127	91	50	33	159	41	12	2	31	17	6	0	7
Sand boat	18	5	11	2	18	7	3	6	2	1	1	1	4	1	2	2
Vessel	0	2	1	0	1	1	1	0	0	`2	0	0	0	0	0	1
Barge	2	4	2	3	4	2	1	1	0	1	0	0	0	0	0	0
Fishing boat	6	1	2	5	3	0	1	1	2	0	1	0	3	0	1	5

4.5.8.18.1 Vessel traffic analysis

The results of the water way traffic survey are shown in Tables 4.39, 4.40 and 4.41. Figures 4.27 and 4.28 graphically present the same information. They reveal that over the 7-day survey period, the highest volume of traffic was recorded on a Monday with a total of 499 units with speedboat which is used majorly for the transportation of passengers having the highest number of traffic count of 429units. The lowest was on a Sunday with a total of 49 units which is due to minimal activities on this day being a weekend and work-free day for most people. The weekly average time interval volume of traffic was highest between 6:00hr – 9:00hr and 15:01hrs – 19:00hr with 711 units and 687 units respectively. These periods are the time that passengers are either going to work or returning. Speedboat had 87% of the total waterway traffic surveyed while vessels and barges which are the traffic of major interest in this study both had <2% of the total waterway traffic volume.

People's Perceptions Fears and Expectations

The general populace in the area is pleased and excited with the proposal for the establishment of the container terminal, dredging, sweeping and construction of channels, office buildings because the project will help to create employment improve revenue and increase incomes. This will also lead to the construction of physical infrastructure like, drainages, roads and bridge in the community to link the various communities with other parts of the state and improve business. Therefore, the population sees additional benefits to the project. Responses from semi structured interviews, key informants and focus group discussions with the surveyed community members (elders, women and youth respectively) confirmed the same excitement of the people. The respondents generally agree that the presence of the facility will among other things bring improvement in the way of the people, lead to the expansion of the city and will even link other cities beyond the community The Roads and bridges when constructed will enable people who come back home during festivities to have opportunities to stay in accommodations comparable to the ones abroad where they reside and are also hopeful that increased employment opportunities, social and infrastructural development accruable from the project, if properly executed shall more than compensate for the negative externalities of the project. It is also believed that the project will help revamp and boost the economy that has been comatose in the area. Equally, the other

part of the kingdom is expanding so advantage will be taken of this expansion to locate community based schools and hospitals.

Community Suggestions to Mitigate Negative Impacts

The primary concerns of the people focus on the quick construction of the international standard port facilities (container terminal) considering the enormous benefits they have been getting from similar projects. Their suggestions therefore, bother on how this proposed project will improve their socioeconomic conditions and lessen the negative impacts on their livelihoods. Community members appreciated and gave several instances of how they have been under-developed suffered from the activities of other companies without much benefits to show for their operations, its social responsibilities, carrying the communities along. However, all have high expectations that the project under consideration will turn things around for them the need for development is therefore, imperative. It is against this backdrop that communities that are stakeholders and hosts to the project come with a long list of suggestions, some usually outside the scope and budget of companies that are put in place to maximize opportunities available.

Table 4.42: Expectations, Priority Needs/Demands and Fears

Communities and Settlements	Needs/Demands and Expectations
Kirikiri.	• Provision of scholarships, toilet facilities and assistance with fishing occupation (gears and equipment) • Upgrading of the existing health centers. • Provision of credit facilities for the women folk. • Provision of employment and youth empowerment • Provision of potable water • Building of a more befitting Town hall/civic hall • Monitoring and subsequent reduction of environmental nuisance. • The road built by the government should have overlay and a good drainage system and construction of new ones. • Building of more schools.
	• Provision of secondary schools.

4.5.9 Health Assessment

Health Care Facilities

In the communities assessed, there were few health facilities/ centers, one private primary health centre run by the catholic church, the saint, Josephs Primary Health centre, Kirikiri, the public primary Health Centre compound has been taken over by the Nigerian Police Force, there is no General Hospital in Kirikiri, the nearest is the Apapa General Hospital not far from Kirikiri town. Major cases are referred to Apapa General Hospital, Lagos University Teaching Hospital Lagoon Hospital; Ajoromi General Hospital, The General Hospitals handle more cases that are difficult. The Model Health centre at Saint Joseph's Catholic Church was established primarily to help parishioners. An outpatient consultation, observation and treatment centre handles cases like, delivery, health education, immunization, treatment of minor injuries, provision of drugs. It is to be noted that the Model Health centre is newly commissioned and well equipped to provide quality Health care services. The community members agree that they are satisfied with the services. Doctor patient/contact time is short but some people live further than 1.5km to the hospital which is the recommended travel distance. The health center is an NIHS accredited model/ National health insurance accredited centre. The services rendered by the center included the delivery services, Maternal and child care, Family planning services, Immunization and minor ailments, HIV/AIDS clinic, Sickle cell anaemia, Diabetes Management and Health Education/Health Promotion. Problem of logistics, poverty and ignorance, lack of drug revolving scheme, financial constraints limit health care delivery in the health centre. In some cases, some essential drugs are not available, and electricity is epileptic. However, a few private hospitals compliment the effort of the public health sector. Traditional Medical practitioners are many and readily come to aid orthodox medical practice. In the community, there were traditional medicine practitioners, traditional birth attendants and trado-orthopedic/Bone setting practitioners in their limited capacity assist and compliment orthodox healthcare delivery. These people lack adequate training in hygienic procedure. Although some TBA has been trained by NGOS, some by Oil giants, only few of them are resident in the host community. There is urgent need to further train them in the area of hygiene to make their contributions more meaningful. Many patent medicine stores complement orthodox medicine. Facilities for prompt/emergency responses are available in the Model Health centre, Saint. Joseph's catholic church, Kirikiri and General Hospital, Apapa. As already stated Poor economic and

financial resources, problem of trained personnel, lack of infrastructural facilities limited the quality and type of Healthcare delivery in some of the public Health institutions/facilities

4.5.9.1 Health Survey

Health impact assessment (HIA) is a very necessary companion of all development projects as they all have health implications that must be examined and predicted before the commencement of such a project. This is because the health effects of such projects could be far reaching. This study is therefore being carried out to determine how the planned Port facility development will interact with the health of the community as well as available health facilities in the host community. According to WHO (2000). HIA is a practical approach that should be used to judge potential Health effects of a policy, programme, and project on a population particularly on a vulnerable or disadvantaged group.

Field campaign and observations carried out in the project affected areas identified three types of health hazards namely, physical, chemical and biological hazards. Common Health hazards could undermine or endanger the health of the residents. They were classified by their nature of origin. The most prominent biological hazards according to the respondents were mosquitoes (30.6), Snakebites (19.4), scorpion stings (11.3), and sand flies (25.3). Chemical hazards include Air pollution, (30%) dust pollution (19.5), Oil and chemical spills (24.5), offensive odour (25%)

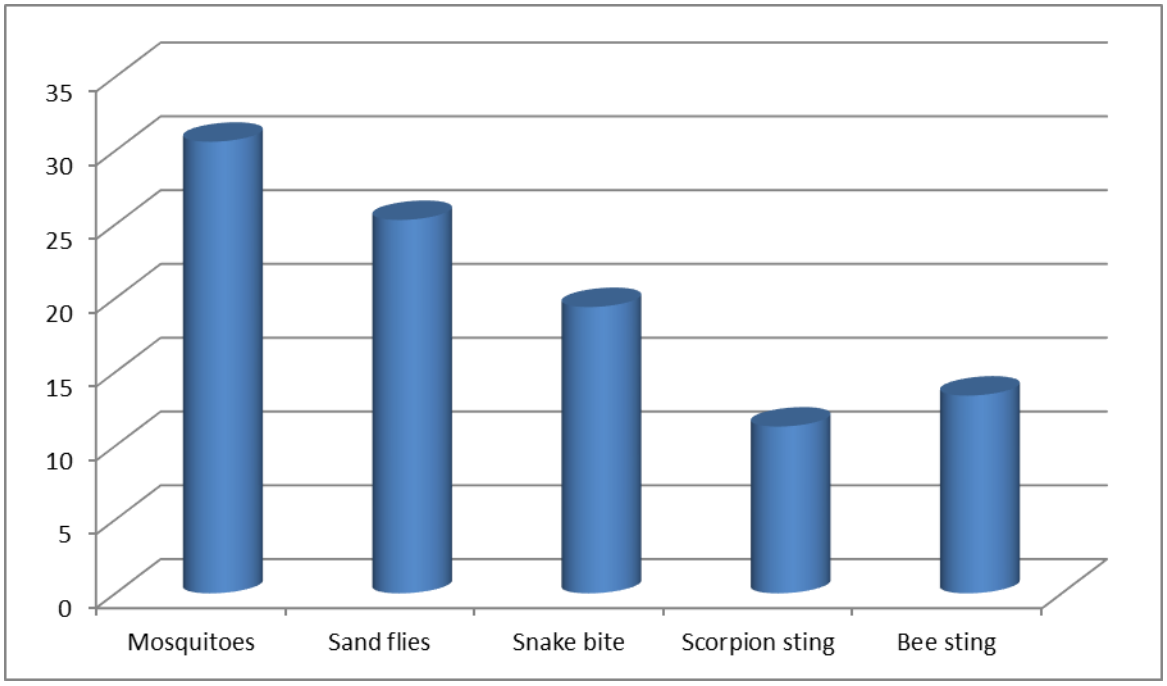


Figure 4.29: Prevalence of biological hazards in the project area

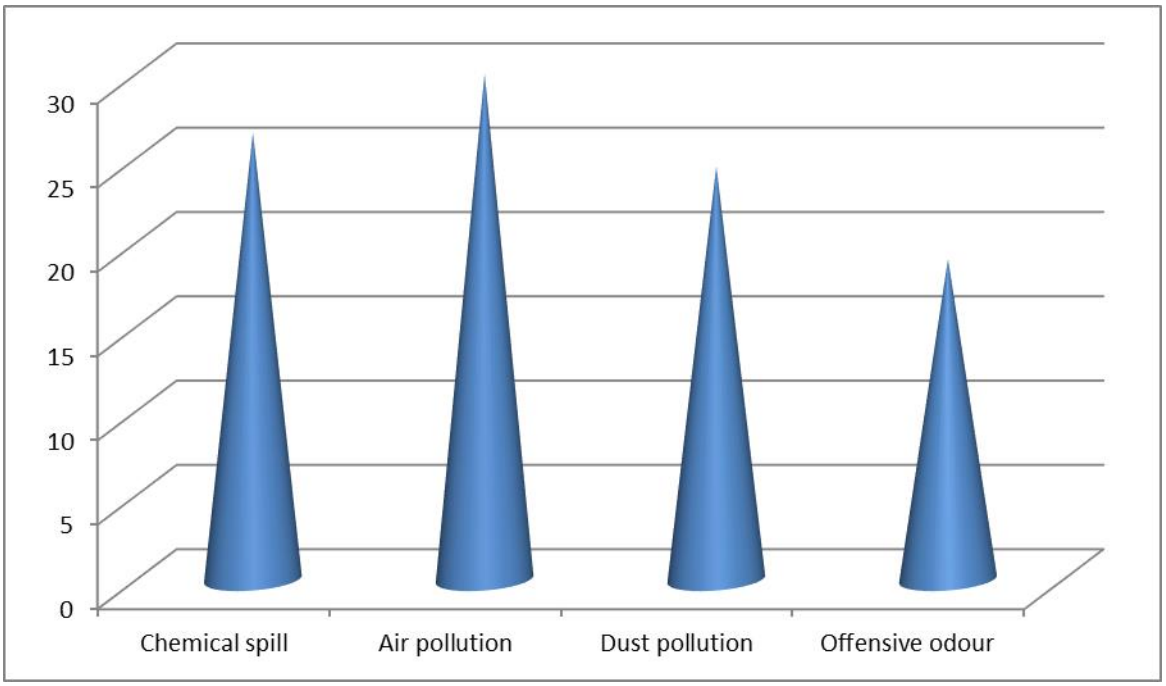


Figure 4.30: Prevalence of Chemical Hazards in the Project Affected Areas

Disease Prevalence

In an attempt to estimate the level of morbidity in the project-affected communities, respondents were asked about the illness episodes suffered by household members in the last 12 months to the study. The responses were validated by asking a series of other questions related to the reported illness. The disease trend in the host community based on household members who have or have had a disease in the past twelve months indicated that the most predominant disease conditions among children in order of importance were malaria, diarrhea, eye problems and acute respiratory tract infections. Others were worm infestation and skin infections (sarcoptei, scabei, fungal dermatitis), Diseases among the adult population were malaria, typhoid fever, diarrhea, pneumonia, hypertension, diabetes, sexually transmissible infections and tuberculosis. The table below shows the commonest diseases and conditions in the studied area and the proportional morbidity.

Table 4.43: Distribution of illness episodes among Respondents

DISEAES	NUMBER OF CASES	PROPORTIONAL %
Malaria	343	28.1
RTI	132	10.8
Diarrhea	139	11.4
Skin disease	100	8.2
Typhoid	32	2.6
Fever / Convulsion	40	3.3
Eye problems	60	4.9
Arthritis	30	2.5
Hypertension	40	3.3
Peptic ulcer	9	0.7
Measles	13	1.1
STI	7	0.6
Pregnancy Related complications	34	2.8
Tuberculosis	9	0.7
Anaemia	49	4.0
Accident/ injury	32	2.6
Hernia	16	1.3
Toothache	5	0.4
Headache	119	9.8
Asthma	9	0.7
Diabetes	2	0.2
TOTAL	**120**	**100**

Source: Field survey 2020

Malaria is reportedly the leading cause of illness in the project-affected area even though there is abnormally slightly higher proportion of deaths from diarrheal disease. Malaria however contributes to anaemia in children in the study communities and this undermines their growth and development. The field survey also revealed that apart from the direct effect on the child survival, malaria exacerbates poverty in the communities through diminishing productivity and mortgaged household income. All these have negative consequences on the standard of living and by implication health. Women of reproductive age bracket who make up 23% of the total population are vulnerable to complications of pregnancy and childbirth this is mostly due to low access by this group to quality reproductive health services including antenatal and postnatal programs. This can result in high maternal mortality ratio.

Vulnerable Groups

Apart from women of reproductive age, children, and migrant workers are the most vulnerable groups in the project-affected area to communicable diseases. Records from secondary data/sources indicate that some of these illnesses reported in the Host communities account for over 70% of the morbidity among children. Adolescents and adults in the project areas however would be less vulnerable in this regard than younger children and pregnant women are the most vulnerable to most of the infectious diseases in the area and yet a significant proportion of them prefer home remedies to coming to health centres for treatment hence high mortality ratio due to childbirth and other puerile causes.

Morbidity

From secondary sources (Hospital health statistics from st. Josephs model health centre, Apapa General hospital and some private hospitals in the study area and oral interviews), the survey established a picture of the present morbidity and mortality patterns in Kirikiri. Analysis of the medical history, shows that malaria, gastro-enteritis, upper respiratory tract infection (in the form of cataarh and cough), skin diseases, diabetes, hypertension, typhoid fever, , cholera and chronic back and waist pain were the dominant ailments suffered in the area. These findings indicate the high prevalence of communicable (as compared to non-communicable) diseases in the population

Mortality Patterns

From key informants, and interviews, it was established that the greatest causes of death in the area were malaria, gastroenteritis, respiratory problems, typhoid fever, hypertension and diabetes mellitus in that order. The present study did not reveal any observable change in the mortality pattern as experienced in the population over the last five years or so. Mortality pattern in the host communities was determined using the crude death Rate (CDR), infant mortality Rate (IMR), and Under-five Mortality Rate (U-5MR) Maternal Mortality Ratio ((MMR).

Crude Death Rate (CDR)

Crude mortality rate was /estimated from the estimated total population of the sampled household and the total number of deaths reported by the respondents. Death rate from all causes in the communities showed that 12 deaths occurred per 1000 persons per annum. The leading causes of death were malaria fever, respiratory tract infections and diarrheal diseases

among children and hypertension, stroke and chronic liver failure among the adult population.

Health care Practice

The knowledge of the practice of malaria control was good, as much as 40% households were in possession of insecticide treated bed nets for the control while 60% had none. Other methods of malaria control assessed included cleaning of the environment and the use of insecticide aerosol sprays (pyrethroids). Bed net prevalence was quite impressive as it far exceeded South-West zonal prevalence of 10% and the National prevalence of 8% (NDHS 2008), but yet to attain the revised National target of 80% set by the National Strategic Plan of action 2009, 2013 (FMoH 20090). The use of insecticide treated bed nets has been designated as the main method employed for malaria prevention in Nigeria. This is because insecticide treated bed nets have proved successful in the prevention of malaria as a result of both personal protection which they provide the users and also the mass effect on the local mosquito population when they are used on a community wide basis (Soremekun et al 2004) (Langeler and Snow 1996) Knowledge of control of malaria graph). Knowledge of respondents on the management of diarrhea is presented; Use anti-diarrhoeals (62%), use of herbs (20%), use of oral rehydration solution (15,5%), others are (3%). The correct knowledge of the causes of the prevention of sexually transmitted infections (STIs) including HIV/AIDS was low. Knowledge of abstinence was 8.9%, condom use was 45.4% and mutual fidelity was 15.3%. It was obvious that most community members lacked the correct knowledge of STI and HIV prevention. This could result from poor information or misconceptions about the diseases even as some respondents were insinuating that HIV could be prevented by taking drugs and prayer.

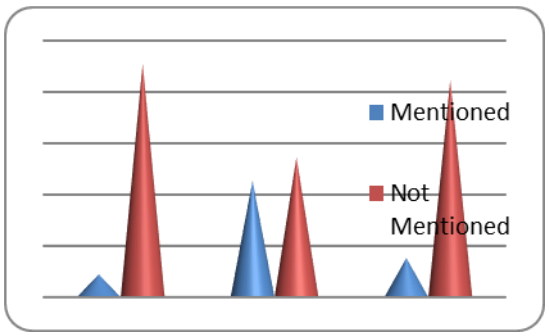


Figure 4.31: Knowledge of Prevention of HIV/AIDS by Respondents.

The use of modern family planning methods was 48.9%, traditional methods (21.80%) and those eligible but did not use them were 29.3%. This result however, exceeds the national and south-West regional prevalence rates of 14.6% and 16% respectively (USAID 2009), (NDHS 2008).

Family planning

The use of modern family planning methods was 18%, traditional methods 51% and those eligible but did not use them were 31%. This result however exceeds the national and South-West regional prevalence rates of 14.6% and 16% respectively (USAID 2009), NDHS 2008). Three major reasons for non-use of family planning were given as fear of adverse reaction (53%), -fear that it could cause damage to the reproductive system and compromise future fertility potentials (33.6%), religion forbids (4.2%%), spouse not in support (7.6%) and sex of child (1.8%). Family planning allows individuals and couples anticipate and attain their desired number of children. This is usually unmet as there have always been discrepancies between individual contraceptive behaviours and their stated fertility preferences (Bhandari et al 2006).

Sexual Reproductive Health

As a concept, it encompasses a set of health problems or diseases associated with the physical and social risk of human sexuality and reproduction. It referred to clusters of health problem that impeded healthy sexual and reproductive functions and varies according to health circumstances of diverse population. Good reproductive health enables people to pursue social economic opportunity as part of individual and social development. During the course of our study in the area a lot of sexual reproductive problems were identified and these included but not limited to sexual promiscuity, teenage Pregnancy, pelvic inflammatory disease(PID), in fertility, self-Medication, maternal and child nutrition, access to procure safe abortion and good contraceptives, use of condom and other protective devices, breast feeding and proper weaning, STI and HIV/AIDS infection, abortion by quacks or criminal abortion, hazardous birthing environment and domestic violence. These reproductive health problems exert an enormously heavy illness burden on adult, young people and children in the project-affected community often with long-term physical and social consequences. About 100 pregnancy related deaths occur each year in the communities of the study area. Of this, a quarter to a third is due to lack of access to safe abortion service and other sexual reproductive health services. Pregnancy related death are only a tip of the iceberg, it is

estimated that for every such death another 100 women surfer significant complications with long term physical and social consequences

Access to safe drinking water/sanitation

Water is a basic human need and access to safe water is critical for health and survival. It is also one of the Millennium Development Goals. Only Oil company facilities and other large companies had water treatment units which treated the water to make it potable and fit for drinking and domestic chores. Water borne diseases (associated with poor water supply) include diarrhea, cholera, typhoid, hookworm and hepatitis. Thus, inhabitants of settlements that lack potable water supply are usually exposed to these ailments, which can lead to potentially fatal complications in sufferers. Kirikiri, the study area lacks any form of treated water supply (pipe-borne water) Kirikiri as a community/ project affected area had no municipal water scheme, only private boreholes without treatment facilities. Members of the project communities depended mostly on open hand dug wells, private boreholes without treatment facilities, rain harvesting and surface water. In the same vein, certain diseases are exacerbated by poor living conditions viz scabies, meningitis, respiratory infections. Most parts of Kirikiri were found to be in poor sanitary conditions as open dumping (in the backyard and along the road and defecation on the road constituted domestic and human waste disposal methods. This practice is unhealthy as germs and other disease vectors proliferate in the dumpsite and toilet environment and by contact infect food and water or by biting and transmitting diseases such as dysentery, cholera, diarrhea, typhoid into humans.

Refuse Disposal and Access to Sanitation Facilities

Refuse is mostly disposed of in the project communities by open dumping around the surroundings, near the houses or along the road, so that the people are virtually surrounded by their wastes. Access to acceptable means of faecal disposal in the form of ideal sanitary latrines is another important determinant of health. Many households in the project communities lacked sanitary latrines and therefore practice open defecation in nearby bushes, along the road and rivers. Standard houses in the project area had water-closet system or pit latrines. The company quarters had functional sanitary toilets, water closet, VIP toiles with septic tanks while the squatter settlements lack these facilities.

Refuse is mostly disposed of in the project communities by open dumping, along the roads, into the rivers, peri-domestic farmlands and in most cases into water courses and drainage

channel, open burning of refuse and burying. These methods are very poor refuse disposal methods with serious health implications especially as they promote the multiplication of disease vectors such as rodents/vermins, cockroaches. Access to acceptable means of faecal disposal in the form of ideal sanitary latrines is another important determinant of health. Here in the project-affected communities, sewage disposal is a major challenge. Many households in the project communities lacked sanitary latrines and therefore practice open defecation in nearby bushes and along the road as already stated. The company quarters had functional sanitary toilet. Most community members who do not have toilets have no alternative than to defecate in nearby water courses or defecate into a nylon bag and thrown into water courses. Unhygienic handling and disposal of faeces also contributes to the spread of communicable diseases especially those transmitted by water and food like diarrhea, cholera, typhoid cholera, typhoid and intestinal helminthiasis as a result of water pollutions.

Cooking Practices

The most commonly used fuel for cooking in the affected area is kerosene. The most commonly used fuel for cooking from observation and from respondent's comments. Few members of the community especially the squatter settlements and those living close to the water fronts and creeks use firewood especially the red mangrove indoors exposes individuals to indoor pollution and is known to contribute /exaggerate respiratory problems such as asthma, chronic bronchitis, and respiratory distress

Nutritional Status.

Pregnant and lactating women and children below the age of three years are the most susceptible to the effects of malnutrition on health and well-being. Malnutrition is known to be an associated risk factor in 6 out of every 10 deaths in children below the age of five years. Malnutrition among children less than five years was used as the proxy for assessing malnutrition in the project communities. Nutritional status of these children was assessed by determining the prevalence of underweight (low weight for age), stunting (low height for age) and wasting (low weight for height). The results showed that compared with the 2008 national estimates (NDHS 2008), a much higher proportion of children were underweight in the project communities compared to the national estimate (Figure 4.32). For stunting and wasting, the figures are comparable to the national estimates (2008 NDHS). The high rates of malnutrition observed in the project communities are probably related to the level of poverty,

illiteracy, ignorance and perhaps to mal-absorption syndrome. It is anticipated that the projects over might impact positively in this respect through compensation, social responsibility, and opportunities for employment.

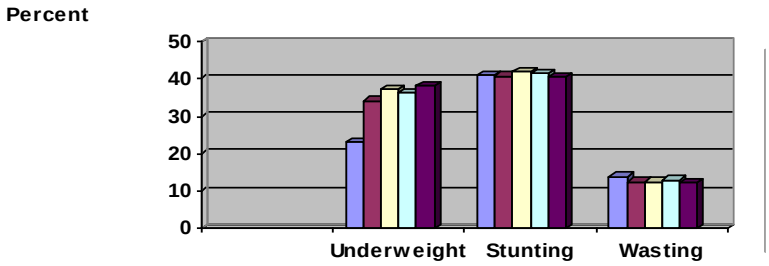


Figure 4.32: Nutritional Status of Under-Fives in the project areas.

Health Risk Behaviour

Health risk behavior in the community was assessed based on the prevalence of the following factors, alcohol indulgence, smoking status, participation in physical exercise and the presence of commercial sex workers. The results show that those who indulged in alcohol were (45%), smokers (32.57physical exercise (29.2%) and those who confirm the presence of commercial sex workers (48.2%) especially at the bush bars close to the waterfront.

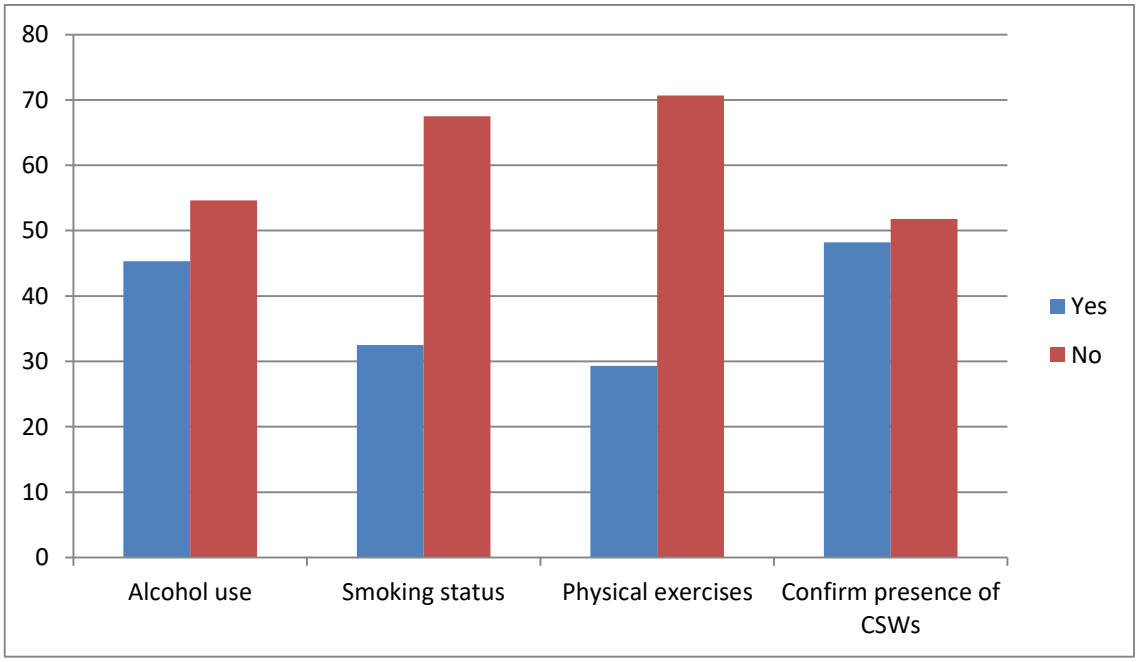


Figure 4.33: health risk behaviours

Alcohol consumption was found to be very common among the people, and in some cases, as reported by key informants; they are consumed very early in the morning (as much as 4 shots of local gin-kai-kai or other refined spirits) even before eating any form of food. This poor eating habit can lead to malnutrition, which makes them more susceptible to diseases. On the whole 45% of the interviewees admit taking alcohol as stated

Commercial sex workers

The growing industrial profile of Kirikiri and the consequent population migration to the area have resulted in the increase influx of commercial sex workers who find ready customers in the young men scattered around the settlements hunting for jobs and the male company workers (local and foreigners) seeking some funs after the day's work. Thisphenomena as reported by our key informant has led to an unusual increase in the rate of sexually transmissible disease (STI), including HIV/AIDS in the study area, According to our key informants, many people (in hospitals, clinics, and patent medicine stores) have reported cases of gonorrhea, syphilis and fungal infections.

Health/Disease Conditions

The common diseases suffered by community members in the last one year based on the integrated Disease Surveillance and Response (IDSR) data in the area among children 0-5 years showed that malaria was (51%), respiratory tract infection (ARI S) 23.7% and diarrhoeal diseases (24%) Among the adult population , the prevalent diseases were malaria (28.1%), hypertension (3.3%) , typhoid fever (2..6%), pneumonia (7.8%), liver conditions, diabetes, skin rashes (scabies) and other infective pathologies. Malaria is holoendemic in Nigeria and is responsible for nearly 30% of childhood deaths. Pregnant women are also at high risk as the disease is responsible for up to 60% of fetal loss and over 11% of maternal deaths and huge economic loss of about 132 billion naira annually from cost of treatment and transport to sources of treatment (FMoH 2005). Malaria is responsible for high school and work absenteeism, neuro-disability and impairment of cognitive development in children (Kihara et al 2006, John et al 2009). Skin rashes particularly of fungal, and bacteria origin occur as a result of unhygienic conditions and where household water supply was limited and crowding conditions existed

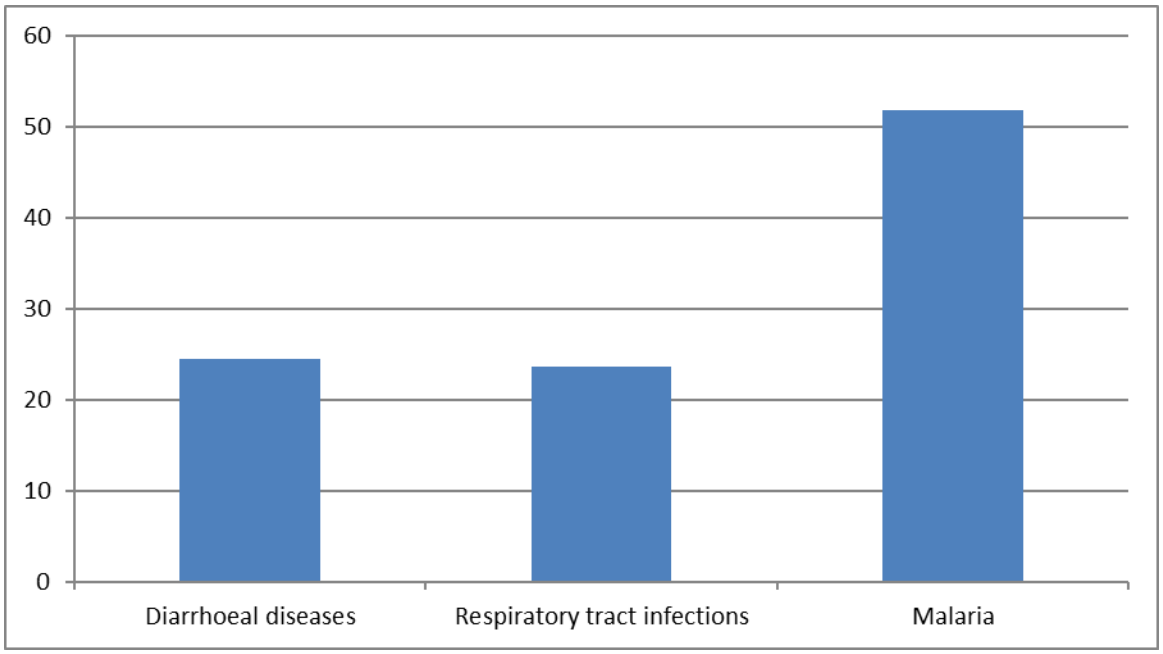


Figure 4.34: Prevalence of diseases among children 0-5 year (source; Field work 2020)

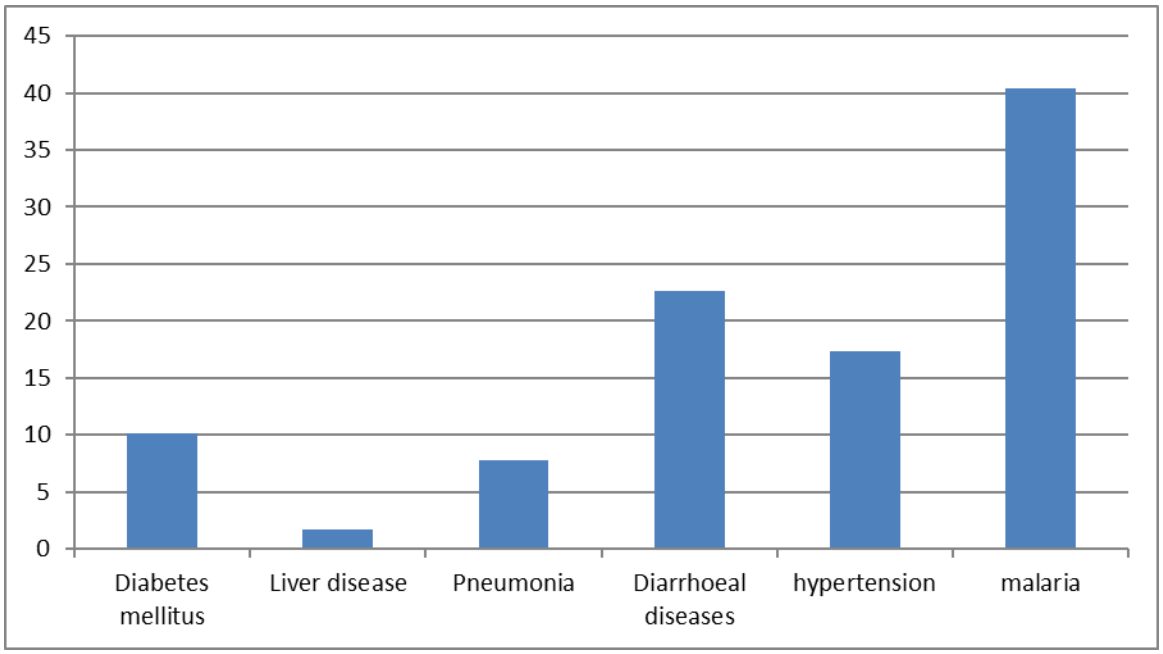


Figure 4.35: Prevalence of diseases among Adults in the project area (source Field work 2020)

Community Food Security

The level of poverty in the host community revealed that the average income earned by 50% of the sampled respondents is less than N20, 000 per month. This is an affront to the people's potentials to assess medical care as well as quality care. This high level of poverty is manifested in the low access to adequate food. More than 80% of the respondents in the

communities reported that they lacked access to adequate food. The effect of good food on health and quality of life is well known. Diets poor in nutrition jeopardizes health and increases the risk of diseases such as Type 2 diabetes, heart diseases, high cholesterol level, obesity, high blood pressure, osteoporosis and cancer. In children, poor cognitive and motor skills have also been established (Engle and Fernandez 2010), Martorell 2010). Food security in the communities was assessed by the availability of foods in households and by 72 hours dietary recall of food items consumed within the period. Staple foods available in the households were classified as energy giving foods, growth foods and immune boosting foods. The results showed that though there was no evidence of acute food shortage in households, there was sufficient evidence that most households lacked sufficient food for healthy living especially foods that are rich in carbohydrates and vitamins.

Table 4.44: Foods in Households

Category of food	Sufficiently available	Not sufficiently available	Not available
Foods which provide energy e.g. Cassava, yam. Rice, Fats and oils (Red palm oil, groundnut oil)	41.3%	54.3%	4.4%
Foods that promote growth e.g. fish, meat, crayfish, beans, melon, milk, groundnuts, eggs etc.	38.6%	53.5%	7.8%
Foods that protect the body against diseases e.g. Fruits (Oranges, pineapples, bananas, green leafy vegetables, carrots, tomatoes, okra etc.	23.1%	66.8%	10.2%

Disease Vectors

Disease occurs in a population when the delicate balance (steady state) between man and his physical environment (air, water, food, dust, blood products, body fluids, faeces, soil and animal bites) as well as his social environment (work, leisure, cultural habits and patterns) are upset (Miller 1975). Diseases can be classified as infectious and non-infectious. In this report, we are interested in the mode and manner of transmission of infectious diseases among the population of Kirikiri. To this end the predominant disease vectors or transmitting agents as reported by inhabitants of Kirikiri were mosquitoes, housefly, lice, cockroaches, bedbugs, rodents, schistosoma and snakes. The vector identified in the areas included Mosquito

(particularly anopheles species and culex species) were abundant in the area especially in stagnant waters, drains, bushes and in swamps where they breed. They transmit plasmodium, which causes malaria resulting in anaemia, chronic intermittent fever, a weakened condition and a number of potentially fatal complications schistosoma, a trematode worm localized in intra-abdominal blood vessels, matures and mates, and deposits eggs in the surrounding tissues, causes chronic inflammation, swelling and pains. The urinary bladder and liver are usually susceptible to attacks. Bedbugs and lice suck blood, which can result in anaemia and skin infections. Tsetse fly (glossino species) transmits trypanosome, which causes sleeping sickness in humans. These were also seen in almost all the project area. Sand flies (phlebotomies) House Fly (Musca domestica) and latrine fly (fannia canicularis) were common in refuse dumps scattered everywhere in the project affected communities. They transmitted a wild array of disease agents including those of diarrhoea and dysentery, typhoid fever, gastroenteritis, leishmanism, tryponosomiasis (sleeping sicknesses were reported to abound during the dry season Snails occurred in the swamps, bushes and are host to schistosoma (s.haematobium and s.mansoni) that cause shistosomiasis characterized by frequent painful and bloody urination and blood in the stool respectively. It must be pointed out that the vegetation and climate type of the area, environmental conditions, waste disposal methods and general sanitation of the settlement are some of the factors that favour the prevalence of these disease vectors as reported in the study area.

Health Needs of the Communities

The needs of the community as regards good health include uninterrupted sources of potable water as well as improved and accessible health care facilities. Training of health manpower (ie community health workers CHEW, nurses, doctors, medical lab scientist, occupational health therapist's radiographers and radiologists; Training traditional birth attendance and traditional medical practitioners on hygienic procedures. Regular Immunization Programs, provision of facility for prompt/emergency response such as ambulance, mobile clinics, Monitoring and surveillance for early detection of epidemics, another health problem, Health insurance schemes to make health care accessible and affordable to the people. Companies operating in the area including NGOs, the government (state and Federal) and Local Government should join hands to finance health care. Prompt handling of environmental issues such as Noise, vibration, chemical and dust pollution to avoid serious water pollution, immediate closure of abandoned drilling sites. Constant monitoring and surveillance of the

area to ensure early detection of outbreak of epidemics such as Cholera, whooping cough, measles etc.

Conclusion and Recommendations

The health-care facilities in many communities of the project area were inadequate, poor and rudimentary to basic in standard operation, except at the local government Headquarters and Apapa where there were a few functional private health institutions, the Model Primary Health center, and Apapa General Hospital. Nigeria currently has 28 primary health care clinics, PHCs per local government area (LGA) total (21,808) 26 secondary facilities per state (969) and 79 specialist hospital across the country. There are a total of 8,290 private PHCs, 3023 secondary facilities and 10 tertiary facilities. The Health status indicators for Nigeria are among the worst in the World. In general, interactions with the workers, the communities have been positive and there has been a widespread appreciation of the consultation process undertaken, the communities regard it as the first of its kind between the community and the company. The project communities used the opportunity to express their disenchantment about the Oil companies, the attitude of the proponents and performance in the area with reference to its social responsibility. Among the issues identified were the impacts of the project on the health and socio-economic activities of the project communities, the resultant change in the quality of life of the project communities, the impact of Oil spill, emissions, smoke, greenhouse effects noise and vibrations, on the quality of life of third parties, the causes of agitation, legacy issues and the issue of employment creation.

CHAPTER FIVE
POTENTIAL AND ASSOCIATED IMPACT ASSESSMENT

5.1 Impact Assessment Methodology

Project activities and environmental interfaces generally encompass a broad range of issues including air pollution, land pollution, effects on employment and community structure. There are several approaches and techniques developed for evaluating potential impacts of any project on the environment. The ISO 14001 method is simple to apply, provides a high level of detail and also relies on limited data. The ISO 14001, therefore is selected for the identification and evaluation of impacts for the proposed port facility. The Bestaf Marine Port facility could have impacts on the biophysical, social and health components of the environment. The impact assessment process is used to identify and qualify these potential impacts, evaluate their likelihood of occurrence, magnitude and significance. This is essentially a qualitative model that relies on the following:

- the professional judgment of the EIA Consultants
- knowledge of the dredging process and procedures to be used
- the baseline environmental status of the dredging works area
- experiences from similar port facilities in the region and elsewhere
- the terms of reference for the EIA as generated from the scoping workshop
- issues raised during consultation with stakeholders

Step 1 – Establishing the Basis for Impact Assessment

- **Baseline development**

- Collection of environmental (biophysical, social and health) baseline data in the project area.

- Integration of environmental (biophysical, social and health) baseline data to develop an integrated understanding of the existing natural and social environment. baseline data have been described in Chapter 3 and 4.

- **Determination of sensitivities**

Determination of sensitivities that characterize the natural and social environment by the expert environmental teams (biophysical, social and health) using their knowledge of the integrated baseline data.

- **Determination of project activities**

Determination of individual project activities undertaken in the respective project phases: pre-construction; construction; operation and maintenance; and decommissioning, restoration and abandonment.

Step 2 – Interaction Matrix

- **Assessment of interaction**

Assessment of interactions between project activities and sensitivities (describing the biophysical, social and health environment) in a workshop setting with the environmental, social and health expert teams.

- **Description of interaction**

Brief description of anticipated interaction between the project and the sensitivities on the biophysical, social and health environment of the project. These interactions and the sensitivities were developed into a matrix.

- **Identification of primary impacts based on interaction matrix**

Identification of impacts based on the interactions between project activities and sensitivities as identified in the interaction matrix. The identification of the impacts was phase-sensitive. The relevant project phases include pre-construction; construction; commissioning; operation and maintenance; and decommissioning, restoration and abandonment. This approach helped in identifying impacts that cut across most of the project phases.

Step 3 – Integrated Impact Assessment

- **Integration of Identified Impacts**

Identification of the significant impacts of the project taking a high level, integrated perspective while using information from the previous steps and expert opinions in the process, including the identification of residual impacts.

- **Description of Impacts**

Development of a brief description of the impacts including a description of the impacts of different project activities on a single sensitivity, using the integrated impact list and expert judgment of the specifics of the project and its natural and social environment.

- **Impact Classification**

From these exercises, a list of impacts was developed. These impacts were classified as either

- adverse or beneficial
- short term or long term
- reversible) or irreversible

- short term < 3 months; long term > 3 months

- **Impact Evaluation**

mind the interaction and/or connections between the project activities and the biophysical, social and health issues so that accurate predictions about what may happen can be made. This exercise identified the significant positive and significant negative impacts arising from the project.

- **Mitigation Measures**
  - Development of mitigation measures based on the integrated list of significant impacts, clearly connecting impacts and mitigation measures.
  - Assessment of residual impact after implementation of mitigation measures and a demonstration that any residual impact is as low as reasonably practicable (ALARP).
  - Enhancement of significant positive impacts.

5.2 Development of Interaction Matrix

5.2.1 Sensitivities

Based on the baseline, as described in Chapter 3, a list of sensitivities that characterize the biophysical, social and health environment of the proposed port facility. The aim of impact identification is to ensure that both significant and insignificant potential and associated bio-physical, social and health impacts are accounted for. The anticipated impacts were determined based on the interaction between project activities and environmental sensitivities. Environmental sensitive components likely to be affected by the activities of the proposed project are presented in Table 5.1:

Table 5.1: Impact Indicators

Components		Impact Indicators
Biophysical	Soil	Changes to soil quality indices (physicochemical properties, hydrocarbons, heavy metals, Microbiology.
	Air	Emissions of NO_2, SO_2, $PM_{2.5}$, PM_{10}, CO, VOC, greenhouse gases (CO_2, CH_4)
	Noise	Change in noise levels at sensitive receptors
Social	Population	Changes in population indices, total population, gender ratio,
	Infrastructure	Improvement or pressure on existing urban/rural infrastructure including waste handling facilities

	Macro and micro economy	Change in macro and micro economy, employment, standard of living, occupation,
	Social and Cultural Structure	Disruption in local authority and governance structure; change in social behaviour, intra- and inter-ethnic clashes
	Transportation	Alteration in means of transportation or ability to move efficiently
	Education	Change in primary, secondary and tertiary education school enrolment and attendance
Health	Pollution Related Health Effects	Increase in concentration of air pollutants of concern (NO_2, SO_2, $PM_{2.5}$, PM_{10}, CO, VOC) and contamination of surface waters and potable ground water, increased noise beyond regulatory limits, increased night time beyond acceptable
	Communicable and Non-Communicable diseases	Change in incidence of communicable and non-communicable diseases or disease-causing factors
	Morbidity and mortality	Change in health of workers and general public, change in security of the area
	Health care / recreational facilities	Changes in availability of and access to health care and recreational facilities
	Psychosocial factors	Drug use/abuse, communal violence, crime, suicide, depression and prostitution; changing expectations of quality of life
	Accidents / Fires / Explosions	Changes to rate of occurrence and severity of accidents / fires / explosions

5.2.2 Project Activities

A list of activities which interact with the social and natural environment in a distinct way either due to their nature or due to timing was compiled. The full list of project activities used in the interaction matrix has been summarized in four (4) phases of pre-construction, construction, operation and decommissioning. Based on these interactions, the identified negative impacts were rated as High, Medium and Low. Positive impacts arising from the project were not further classified.

Table 5.2: Project Phase Potential Impacts

Description of Impact	Project Phases			
	Pre-Construction	Construction	Operation and Maintenance	Decommissioning, Restoration and Abandonment
Increase in economic activities				•
Increase in employment and business opportunities		•	•	•
Skills acquisition			•	
Decrease in commercial waste generation			•	•
Increase in National income and GDP			•	
Increase in corporate social welfare projects		•	•	
Community concern	•	•	•	•
Loss of habitat	•	•		
Loss of biodiversity		•		
Loss of income			•	•
Increase in potential for road traffic volume	•		•	•
Increase in potential for road traffic incidents	•	•	•	•
Increase in noise		•	•	•
Stress on existing security structures	•	•	•	•

Table 5.2 (continued)

Description of Impacts	Project Phase			
	Pre-Construction	Construction	Operation and Maintenance	Decommissioning, Restoration and Abandonment
Reduction in air quality (dust, exhaust fumes)		•		•
Damage to existing roads	•	•		
Loss of flora and fauna		•	•	•
Increase in dust and noise		•	•	•
Changes in landscape		•		•
Changes in local population		•		
Pressure on existing infrastructures and utilities	•	•	•	
Increase in erosion potential		•		•
Soil degradation		•	•	•
Injuries to workers		•	•	•
Loss of biodiversity		•		•
Reduction in air quality		•	•	•

Table 5.2 (continued)

Description of Impacts	Project Phase			
	Pre-Construction	**Construction**	**Operation and Maintenance**	**Decommissioning, Restoration and Abandonment**
Pressure on existing waste Management system		•	•	•
Increase in noise and vibration levels		•		•
Increase in periods of brightness			•	
Contamination of environment by Construction and operational wastes		•	•	
Reduction in air quality (emissions)			•	•
Change in aesthetic quality of the environment		•	•	
Contamination of the environment by products			•	
Threat to health of workers		•	•	•
Pollution of surface water sources		•	•	•
Reduction of flora and fauna population		•		

Table 5.2 (continued)

Description of Impacts	Project Phase			
	Pre-Construction	Construction	Operation and Maintenance	Decommissioning, Restoration and Abandonment
Degradation from soil compaction		•		
Potential for inhalation of welding fumes		•		
Potential for conflicts arising from labour issues (welders)				
Degradation of soil and surface water from spills and leaks		•	•	
Increase in industrial waste generation (rags, filters, lubricating oil etc)		•	•	•
Potential for community unrest (from employment, pollution and resistance to dismantling of equipment)			•	•

5.3 Identified Impacts

Based on the information from the discussions, the impacts from the port facility Project were identified and categorized as presented below.

Table 5.3: categorization of identified impacts

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Negative / Positive
Pre-construction	Preliminary development Site Preparation Procurement	Ecological degradation	-
		Exposure to allergic plants	-
		Opportunity for business	+
	Mobilization of personnel, materials and equipment to site by road.	Air/Noise pollution from increased vehicular movement	-
		Damage to existing access roads	-
		Kidnappings	-
		Road traffic accidents with injuries from increased vehicular movements on local roads	-
	Employment of local labour and award of contracts to members of the host communities	Increased cash flow and stimulation of local economies within the Host Communities	+
		Localized economic benefits from materials supplies by local contractors	+
		Third party agitations	
	Influx of workers into the host Communities	Increased sexual immorality especially among young women	-
		Increase pressure on existing social amenities and infrastructure	-
		Increased prevalence of sexually transmissible infections (STIs) including HIV	-
		Socio-cultural conflicts between the construction team and members of the host communities	-

		Stimulation of local economy and markets from increased demand for food, and other products in the local market.	+

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Positive / Negative
Construction	Excavation and Construction	Damage to roads	-
		Damage to soil Structure and Texture	-
		Increase in dust and SPM during dry season.	-
		Increase in noise and exhaust gases from excavators etc	-
		Temporary vehicular traffic obstruction/diversion at road crossing.	-
	Jetty floor sweeping	Change in topography of the riverbed and land area	-
		Disruption of fishing and water transportation.	-
		Impairment of water quality by increased turbidity/ suspended solids	-
		Increased erosion of the riverbanks.	-
		Disturbance of aquatic life (zooplankton, phytoplankton, benthic communities, fisheries etc)	-
		Third party agitation	-
		Opportunities for business and employment	+
		Nuisance (Noise, emission, Vibration etc) from heavy plant and machinery.	-
		Alterations of the existing hydrological conditions (flow, siltation etc)	-
		Improvement in the navigability/ drainage of the River channel	+

	Operations of machines and vessels	Emission of exhaust gases from the fuel combustion engines can alter the local ambient air quality.	-
		Soil contamination and loss of aesthetics from liquid leaks	-

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Positive / Negative
Operation / Maintenance	Disposal of industrial and domestic wastes	Odour and aesthetic devaluation may result from improper handling.	-
	Maintenance	Release of gases from vessels and equipment.	-
Abandonment / Decommissioning	Excavation to remove infrastructure	Increase in income	-
		Water contamination	-
		Air pollution	-
		Loss of Livelihood	-
		Reduction in economic activities	-
	Transportation of removed structures from site	Occupational and traffic accidents	-

5.4 Interaction Matrix

With the background knowledge of the project and its biophysical, social and health environment, the Project Team determined the interactions between project activities and sensitivities. Each interaction was discussed followed by an assessment as to whether the effect of the interaction was expected to be positive, minor or negative. Many of the project activities, as well as their interactions with the environment, are similar and overlap during the various phases of the project. This overlap has been taken into account in assessing the impacts arising from the port facility project. In the interaction matrix (Table 5.4), an (X) is used to indicate where a project activity interacts with components of the environment.

5.4.1 Impact Assessment

Two stages were involved in assessing the impacts. The first stage classified the impacts as either adverse or beneficial, short term or long reversible or irreversible. An (X) was used to indicate these classifications.

Adverse impacts are those which impact negatively on the biophysical, health, and social environments while beneficial impacts are those which enhance the quality of the environment. For this study, short term means a period of time less than three months while any period greater than three months is considered long term. Reversible/irreversible meant whether the environment can either revert to previous conditions or remain permanent once the activity causing the impact is terminated.

Stage one: Classification

The first stage involved in the assessment of impact is impact classification. Impacts are classified as follows:

- Adverse (-) or Beneficial (+) in nature,
- Short term < 3 months (S) or Long term > 3 months (L), and
- Reversible (R) or Irreversible (I).

Stage two: Significance

The second stage involves evaluation to determine whether or not the impact is significant. The criteria and weighting scale employed in evaluation are as follows:

- Legal/regulatory requirements (L);
- Risk factor (R);
- Frequency of occurrence of impact (F);
- Importance of impact on an affected environmental component (I); and
- Public perception/interest (P).

The quantification scale of 0, 1, 3 and 5 was used. This is a modification of the arbitrary scale proposed by Vesilind, *et al.* (1994). The ratings are as described below and are adapted from the International Organization for Standardization ISO 14001 – Environmental Management System Approach.

- **Legal/Regulatory Requirements (L) – Is there a legal/regulatory requirement or a permit required?**
  - 0 = There is no legal/regulatory requirement
  - 3 = There is legal/regulatory requirement
  - 5= There is a legal/regulatory requirement and permit required

- **Risk Factor (R) – What is the risk/hazard rating based on the Risk Assessment Matrix?**

  1 = Low risk

  3 = Intermediate risk

  5 = High risk

- **Frequency of Impact (F) – What is the frequency rating of impact based on the Risk Assessment Matrix?**

  1= Low frequency (rare)

  3 =Intermediate frequency (likely)

  5 =High frequency (very likely)

- **Public interest/perception (P) – What is the rating of public perception and interest in proposed project and impacts based on consultation with stakeholders?**

  1 = Low interest/perception

  3 = Intermediate interest/perception

  5 = High interest/perception

- **Importance of affected environmental components and impacts (I) – What is the rating of importance based on consensus of opinions?**

  1= Low

  3= Medium

  5 = High

This approach combines the following factors in assessing the overall impact rating of the project on the environment:

- The sensitivity/vulnerability of the ecosystem components;
- The productivity evaluation/rating of the ecosystem components;
- Knowledge of the possible interactions between the proposed project and the environment;
- Envisaged sustainability of the project environment;
- The economic value of the proposed project activities; and
- Projected duration of the impact of each project activity on various environmental components.

The frequency of occurrence of each impact was determined from site-specific research while the importance of affected environmental component was determined through consultation and consensus of opinions. The perception of the communities and the general public on the potential impacts and their effects were determined through consultation with the communities and consensus of opinions of environmental professionals. The overall impact rating is determined as shown in Table 5.1. The potential and associated impacts of the project are presented in Table 5.4.

Table 5.4: Impact Value and Rating

Impact value	Cut off values	Impact Rating
L+R+F+I+P	<8	**Low**
L+R+F+I+P	≥8 but <15	**Medium**
L+R+F+I+P	≥15	**High**
F + I	>6	
P	= 5	
Positive		**Positive**

Table 5.5: Risk Assessment Matrix

Consequence		Increasing Probability				
		A	**B**	**C**	**D**	**E**
Severity	Environment	Never heard of incident in the sector	Incident has occurred in sector	Incident has occurred in Bestaf Projects	Happens several times per year in Bestaf Projects	Happens several times per year in Port facilities
0	No effect					
1	Slight effect		**Low**			
2	Minor effect		**Risk**			
3	Localized effect			**Medium**		
4	Major effect			**Risk**	**High Risk**	

Table 5.6: Further Definition of Consequence – Severity Rating for Risk 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 instance of statutory or prescribed criteria being exceeded, single complaint. No permanent effect on the environment
3	Localized effect	Limited loss of discharges of known toxicity. Repeated examples of statutory or prescribed limit being exceeded. Affecting neighborhood
4	Major effect	Severe environmental damage. The company is required to take extensive measures to restore the contaminated environment to its original state. Extensive range of statutory or prescribed limits exceeded.
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 and high level of statutory or prescribed limits being exceeded.

Source: SIEP (1996)

Table 5.7: Severity Factor code

Likelihood (Severity Factor)	Code	Definition
High		The threat-source is highly motivated and sufficiently capable and controls to prevent the vulnerability from being exercised are ineffective
Medium		The threat-source is motivated and capable, but controls are in place that may impede successful exercise of the vulnerability.
Low		The threat-source lacks motivation or capability, or controls are in place to prevent, or at least significantly impede, the vulnerability from being exercised.

Table 5.8: Impact Evaluation

Project Phase	Project Activity	Description of impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	F+I+P+R	Overall Ranking (High/ Medium /Low)
Pre-construction	Land Leasing or Acquisition	Loss of habitat							0	1	1	1	1	4	L
		Loss of biodiversity							0	1	1	3	1	5	L
Mobilization	Movement of goods, equipment and personnel	Increase in potential for road traffic volume and accidents	X		X		X		3	5	5	5	5	23	H
		Increase in potential for road traffic Incidents	X		X		X		3	5	3	3	3	17	M
		Increase in noise	X		X		X		3	3	5	3	3	17	M
		Stress on existing security structures	X			X		X	0	3	1	3	5	12	M
		Reduction in air quality (dust, exhaust)	X		X		X		0	1	3	3	3	10	M
		Damage to existing roads	X		X		X		0	3	3	3	5	17	M
		Increase in economic activities		X	X		X		0	1	5	5	5	16	M
Construction	Site preparation (Land clearing, Excavation)	Loss of flora and fauna	X			X		X	0	1	3	3	3	10	M
		Community unrest	X		X		X		0	3	3	3	5	14	M
		Stress on existing security structures	X			X		X	0	3	1	3	5	12	M
		Increase in dust and noise	X		X		X		3	3	3	3	3	15	M
		Increase in economic activities		X	X		X		0	1	5	5	5	16	M
		Changes in landscape	X			X		X	3	1	3	1	1	9	M
	Influx of labour and Followers	Changes in local population	X	X	X	X		X	0	3	3	5	5	16	M
		Increase in mortality, morbidity and STIs	X			X	X	X	0	3	3	5	5	16	M
		Increase in social vices	X			X		X	0	3	3	3	3	12	M
		Increase in commercial sex workers	X			X		X	0	3	3	3	3	12	M
		Pressure on existing infrastructure and Utilities	X			X		X	0	1	5	5	5	16	M
		Increase in economic activities		X		X		X	0	-	-	-	-	-	

Project Phase	Project Activity	Description of impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	F+I+P+R	Overall Ranking (High/ Medium /Low)
	Construction of the port facility	Increase in dust and noise	X		X		X		3	3	3	3	3	15	M
		Soil degradation	X			X	X		3	3	3	3	3	15	M
		Skills acquisition		X		X		X	0	1	3	5	5	14	M
		Loss of biodiversity	X			X		X	0	3	3	3	3	12	M
		Reduction in air quality	X			X	X		0	1	3	1	3	8	L
		Jetty sweeping exercise	X			X	X		0	5	5	5	5	20	H

Project Phase	Project Activity	Description of impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	F+I+P+I	Overall Ranking (High/ Medium /Low)
	Waste generation and disposal	Increase in breeding grounds for disease vectors and other agents of diseases	X			X	X		3	3	3	3	3	15	H
		Increase in nuisance/Odour	X		X		X		0	1	3	3	3	10	M
		Blockage of natural drainage	X		X		X		0	1	3	3	1	8	L
		Pressure on existing waste management System	X			X	X		0	3	3	3	3	12	M

Project Phase	Project Activity	Description of impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	F+I+P +R+L	Overall Ranking (High/ Medium /Low)
Operations and Maintenance	Operation and maintenance of Jetty	Increase in noise levels	X			X	X		3	1	3	3	3	13	M
		Reduction in air quality	X			X	X		3	1	1	3	3	11	M
		Degradation of environment from spills and leaks	X			X	X		3	1	3	3	3	13	M
		Decrease in commercial waste generation		X		X	X		0	1	3	1	1	6	L
		Increase in industrial waste generation (rags, filters, lubricating oil, etc)	X			X	X		3	1	1	3	1	9	M
	Jetty operation	Degradation of Soil and surface water from spills and leaks	X			X	X		3	1	3	3	3	13	M
		Stress on existing security structures	X			X		X	0	3	1	3	5	12	M
		Reduction in air quality	X			X	X		3	1	1	3	3	11	M
		Increase in noise levels	X			X	X		3	1	3	3	3	13	M
		Increase in waste generation	X			X	X		0	5	5	5	5	20	H

Decommissioning Restoration and Abandonment	Surface equipment dismantling; Excavation, removal and disposal of concrete works and pipes;	Potential for community unrest (from employment, pollution and resistance to dismantling of equipment)	X			X	X		0	5	3	5	5	18	H
		Stress on existing security structures	X			X		X	0	3	1	3	5	12	M

Project Phase	Project Activity	Description of impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	F+I+P +R+L	Overall Ranking (High/ Medium /Low)
Decommissioning, Restoration and Abandonment	Structure and equipment Dismantling, demolition Excavation.	Reduction in air quality. Increased dust and vehicular emissions during transportation	X			X	X		3	1	1	3	3	7	M
		Increase in ambient noise levels above baseline conditions from movement and activities of decommissioning equipment and automobile	X			X	X		3	1	3	3	3	9	M
		Increase in respiratory tract diseases	X		X		X		0	5	3	3	3	9	M
		Increase in employment and business Opportunities		X		X	X		-	-	-	-	-	-	P
		Increase in waste generation	X			X	X		0	5	5	5	5	15	H
		Potential for community unrest (from employment, pollution and resistance to dismantling of equipment)	X			X	X		0	5	3	5	5	13	H
		Stress on existing security structures	X			X		X	0	3	1	3	5	9	M
		Potential for increase in stock of farmland		X		X		X	3	3	3	5	5	13	H
		Risk of soil and adjoining surface water contamination from accidental oil and hazardous substance leakages and wastes from equipment, vehicles etc during decommissioning	X		X		X		0	5	1	5	5	16	H
		Risk of accident and injury to worker during demolition of structures	X		X		X		0	3	1	5	3	12	M

5.5 Impact Discussion

The impacts associated with the proposed port facility project has been identified and evaluated vis-a-vis the recipient environment. They have also been subjected to the impact severity evaluation. All potential impacts to the environment as summarised are intended to provide an insight into the nature and level of significance of the identified impacts as well as a description of mitigation measures outlined in the various phases of the development.

5.5.1 Negative impacts of the project activities

Pressure on existing infrastructure and utilities

The study area has limited physical, social and economic institutional infrastructure. Potable water, recreational facilities, electricity, clinics, banks and post offices were inadequate. With the influx of labour and followers, there will be pressure on the already grossly inadequate infrastructure of the area, such as recreational facilities, schools, clinics, water supply, communication facilities, markets, housing, hotels, drinking parlours, etc. An influx of people into the area could cause an increase in levels of crime and other social vices. Also the project may increase risks for community unrest, sabotage actions and violent protests. It is unlikely that the existing security forces will be able to cope with such situation based on their current strength.

Increase in morbidity (including STIs and HIV) and mortality

Currently morbidity (and mortality) from communicable diseases such as malaria, respiratory tract infections and diarrhoea diseases is very high. Health services are few with low capabilities. Based on baseline health survey, the current knowledge, attitude and practice with regards to sexually transmitted infections is low. There are practices of multiple sexual partners and condom use is low. The expatriates and other migrant workforce from outside the area may import some communicable diseases such as Tuberculosis, HIV/AIDS, SARS etc. Contact with the communities could lead to transmission of these diseases among the locals. Influx of labour could also act indirectly to cause an increase in the levels of other communicable diseases such as diarrhoea/gastroenteritis, respiratory tract infections and malaria through poor housing and overcrowding. This is likely to occur as the present living standard of the people is low with poor housing, inadequate sanitation and water supply occasioned by pressure on an already deficient and inadequate community infrastructure. The influx of people

including commercial sex workers and migrant workmen, many of whom are likely to be young, sexually active and either single or without their families could therefore increase the potential for casual sex and the transmission of STI including HIV/AIDS. Given the current low level of knowledge of STI, low availability and use of protective mechanisms in the local communities and the public health importance of STI/HIV/AIDS in the nation, this impact cannot be over emphasized.

Increase in potential for road traffic incidents

It is anticipated that road traffic will increase during mobilization of personnel and equipment to site over the period. During the construction phase which is expected to last about six months, intensive movement of personnel and equipment will also take place as well as during operation and maintenance. During the period, an added number of 5 – 10 tonnes truck per day will be added to traffic volume. Given the present condition of the road, there is the potential for increased road traffic accidents/injuries during these phases.

Exposure to Dangerous Animals/ Insects and harmful Plants

The species of reptiles found in the area include crocodiles, snakes, bees, tsetse flies. Contact with harmful plants (*Mimosa sp)* in the area could lead to allergic reactions. The healthcare centres in the area do not have a record of any human injury from these plants. The clearing of the vegetation and Jetty sweeping exercise / dredging could expose the workforce to these animals/ insects thereby triggering attack. The impact is direct, negative, short/ long term, reversible/ irreversible and was rated minor.

Increase in the cost of living

Average monthly income in the study area is about ₦20,000, which is below the national minimum wage. An injection of workers with significantly higher incomes into the project area could create a local inflationary pressure. This impact is described as direct, negative, short term, local, reversible, and the rating is minor.

Emission of exhaust fumes/ noxious gases to the atmosphere

Emission of exhaust fumes/noxious gases to the atmosphere from the crafts will result in the temporary deterioration of ambient air quality. The sources of emissions of noxious gases into the atmosphere related to transportation include; the increased number of boat movements into the area. These are expected to generate an undetermined quantity of gases which are released into the atmosphere. The gases from machinery include SOx, NOx, CO, CO_2, suspended particulate matter (SPM) etc. The inhalation of these gases could trigger respiratory tract diseases and worsen existing ones like asthma, chronic bronchitis. The concentration of these emissions will depend on wind speed and direction. The impact was rated as minor due to the anticipated minimal quantity of emissions. The impact is direct, negative, short term, local and reversible.

Contamination of surface water/ sediment

Major movement of materials will be by water using boats and barges. Unintentional discharges of fuel and oils, including bilge waters and leakages from storage tanks are a potential source of hydrocarbons in the water. Sewage disposal is a potential source of nutrient and microbial inputs. The communities that derive their domestic water from these water bodies stand the risk of water borne diseases. This impact is rated minor, direct, negative, short term local and reversible.

Erosion of river banks from increase in water traffic

Increased water traffic during mobilization and operation could result in increased wave height and intensity leading to the accelerated erosion of riverbanks. This impact is direct, negative, local, long term and irreversible. The consequence of this impact is considered considerable but it is of medium likelihood. Therefore, the impact is rated moderate.

Disruption of fishing and water transportation

Movement of barges and other vessels could interfere with fishing activities such as destruction of fishing gears and impede public water transportation. The impact is qualified as direct, negative, short term, local and reversible and rated minor.

Water Traffic accidents resulting in Injuries, drowning and death.

The volume of water traffic and the prevalence of water traffic accidents in the area is not known. It is anticipated that an increase in water traffic volume due to movement of materials, personnel and equipment will give rise to accidents. In addition, the movement of camp followers and job seekers into the project area is expected to further increase transport volume in and out of the area. The impact was described as direct, negative, short/ long term, local, reversible or irreversible. It was rated moderate.

Insecurity on the waterways

The security situation in the project area and inland waterways is worrisome and reports of pirate attack and hostage taking are not uncommon. The possibility of their occurrence in the project area is high. Movement of personnel and equipment has the potential, therefore, to trigger these attacks. The impact is described as direct, negative, long term, local, irreversible/reversible. The rating is major.

Potential impacts on water quality

Pile driving, deposition of rubble, dredging, sand compaction and other construction work in water cause resuspension of sediments and turbid water. Resuspension of sediments in water leads to an increase in the level of suspended solids (SS) and in the concentration of organic matter, possibly to toxic or harmful levels. It also reduces sunlight penetration. Work vessels are a possible cause of oil spills, garbage discharge, and leakage of other substances into water. Diffusion from concrete work in water and overflows from landfills may be possible sources of water pollution.

Potential impacts on coastal hydrology

The potential impacts of construction on coastal hydrology are nearly the same as the potential impacts of the location of a port. Jetty floor sweeping may cause changes in current patterns and flows as well as salt wedge intrusion into a river mouth or littoral drifts in the shore zone. Changes in littoral drifts lead to beach erosion or accretion. Disposal of swept material on land may possibly cause leakage of harmful substances into ground water or changes in waterfront drainage.

Potential impacts on bottom contamination

Construction work and dredging disturb bottom sediments and induce resuspension, dispersal and settlement of such sediments. Dumping of dredged material directly alters bottom configuration and biota and may disperse toxic or harmful chemicals around the disposal site. Dredging removes bottom habitat and may lead to a loss of fishery resources.

Potential impacts on marine/coastal ecology

Disturbance from construction activities may cause displacement of fishery resources and other mobile bottom biota. Dredging or sweeping removes bottom biota and dumping of dredged material covers bottom habitat, both of which may reduce fishery resources. Settlement of re-suspended sediments on fragile marine fauna and flora damages the ecosystem particularly coral reefs, which are formed by the extracellular product of symbiotic plants. The great number of coral polyps attached need dissolved oxygen for respiration and the plants need sunlight for photosynthesis. Piles, concrete surfaces, rubble mounds and other similar structures in water could form new habitats, which may introduce undesirable species. If toxic substances and other contaminants are re-suspended through dredging or dumping, they may lead to contamination of fishery and shellfishery resources.

Potential impacts on air quality

Emissions from construction equipment, work vessels, trucks and other vehicles used in construction work could be a source of air pollution. Dust from construction activities is also a possible source of air pollution.

Noise and vibration

Construction activities may create a problem of noise and vibration generated by construction equipment, truck traffic, work vessels and other similar sources.

Construction Waste management

Wastes from construction activities are mainly spoils generated by dredging. Disposal of dredged material on land may cause destruction of plants, loss of vegetation, leakage of contaminated materials

and salt, odour, an unsightly view and other nuisances to the local community. Disposal in water may cause problems.

Impairment of water quality by turbidity and suspended solids:

Sweeping or Dredging involving major excavation of bottom materials is usually associated with resuspension of fine particles (fine sand, silt and clay) resulting in elevated turbidity and suspended solid levels in associated water bodies. The levels of turbidity/suspended solids depend on the dredging technique, hydrological conditions and sediment type. About 90% of the people in the area fetch and use water from surface water. Water borne diseases including diarrhea are among the common health problems in the area. This could render the water bodies unsuitable for domestic uses during the active dredging phase. However, the turbidity is expected to return to ambient level within a short while. The impact is direct, negative, short term, local and reversible and was rated major.

Potential impacts on visual quality

The visual quality of a project area is affected by the creation of a port, port facilities, lighting, and other optical disturbances. The landscape may be changed into an artificial scene of industrialization. Some port facilities may give an unpleasant impression to people.

Socio-cultural impacts

Building or expanding a port often requires relocation of the local community, sometimes causing ethnic, cultural, tribal, or religious conflicts with local people. Industrialization and modernization may change the cultural traditions of the local community.

Disruption of fishing and water transportation

Fishing is the most important occupation of communities in the project area. Disturbance of fishing activities is likely to result from this dredging. The presence of floating pipes at dredging environments create obstacles to fishing and water transportation. The impact is qualified as direct, negative, short term local and reversible. This impact rated moderate.

Disturbance of aquatic life (Zooplankton, phytoplankton, macrophytes, macrobenthic fauna, fisheries, wildlife)

Aquatic food web is intricately interwoven with physicochemical properties of water. Increase in water turbidity, reduces transparency and thus phytoplankton productivity. In this way secondary production by zooplankton and tertiary production by fish are also impacted because of their dependence on primary organic carbon production by phytoplankton. In addition, suspended solids and turbidity interfere with communication, migration, feeding and respiration in most fishes and filter feeders. Suspended solids have the potential to smoother sessile macro-benthic communities including fish eggs, leading to reproduction and recruitment failures. This impact was rated major, short term and reversible

Third party agitation

The community agitation could arise from: reduction in the surface water quality of the water bodies in the area, disturbances of fishing activities, discontent from business/ employment issues. The impact is qualified as direct, negative, short/long term, local and reversible. It is rated major.

Nuisance (noise, emission, lighting, vibration) from plant and heavy machinery

The operation of the dredger and ancillary facilities is expected to generate noise, emissions, and vibration which could constitute a nuisance to humans and wildlife in the area. This could have health implications such as sleep disturbances. The impact is direct, negative, short term, local and reversible. It is rated minor.

General Waste Management

As in most other industrial terminals, the wastes generated in this study area included both degradable and non-degradable types. Most of the degradable wastes were mainly kitchen wastes that included food wastes or remnants (garbage), papers etc. The non-degradable wastes were mainly metals, plastics, polythene bags, ashes, cans/tins Oil based mud (OBM), Drill cutting etc. For human waste disposal, vacuum trucks were the most commonly used method of disposal, followed by defecation in the bush and then water cistern. There is deliberate private modern waste management practice in the project area predominant waste disposal method in the area is disposal in burrow pits. The

activities planned for the Port Facility Project will not alter the waste generation and disposal pattern in the Apapa area. These wastes will consist of domestic wastes (hazardous and non-hazardous, sanitary wastes (grey and black water), construction waste, used lubricating oils, rags and filters as well as vegetation and paper. As a result of anticipated increased activities of service providers and followers associated with this project, it can be anticipated that the total quantity of waste generation apart from industrial wastes will not in any dimension adversely increase over and above the capabilities of the existing waste management facilities in the project area. Under the prevailing warm, moist conditions, Waste resulting from the Port Facility may not potentially compound the existing fitly environment in Kirikiri occasioned by the uncontrolled and indiscriminate disposal of waste by the numerous companies in Kirikiri Pathogens, even if absent initially, have easy access to the waste via vectors. With solid wastes, flies, rodents and mosquitoes are the primary vectors. Although the relationship between solid waste and disease has not been well documented, it is known that about 50 different diseases are borne by flies, rodents and mosquitoes (Henry and Heinke, 1989). In addition to the generation of harmful organisms and their transmission, materials such as solvents and chemical containers, and organic waste if present in the waste when it is collected are potentially harmful. Odour is usually a problem not only with solid wastes but also with wastewater treatment plants. Air pollution, caused by particulates and gaseous pollutants from combustion facilities such as generators and construction equipment is additional environmental problems that are likely to be associated with the wastes from this jetty project.

Reduction in Air Quality (dust, exhaust fumes)

Traffic along the Apapa - Kirikiri road is relatively high and as the baseline study shows, this has resulted in poor air quality. The major sources of emissions would be from construction, operation of the jetty machinery and decommissioning activities (dust and particulates). Sources of air quality impairment are dust from land clearing and excavation as well as emissions from exhausts and the machinery. Dust particles and inhalation from emissions may settle in the lungs and therefore have the greatest potential for causing health impacts. Some of the particles may settle out of the atmosphere onto the ground or onto the surrounding structures. This may compromise the visual quality of the affected systems and anger the health of the vegetation. Emissions that contain carbon

dioxide, water vapour and other gases will contribute to existing ozone layer depleting substances, and climate change.

Increase in Breeding Grounds for Disease Vectors and other Agents of Diseases

The baseline study observed that the quality of the environment of the project site was fairly clean with undue presence of breeding grounds for disease vectors and other agents of diseases. The construction, operation and maintenance as well as the decommissioning, restoration and abandonment of the facilities planned as part of the Port facility package will slightly alter the waste generation pattern in the Kirikiri Lighter Terminal (KLT) area and potential location of temporary storage of these wastes before disposal. Under the prevailing warm, moist conditions, organic wastes resulting from the project facility will become ideal breeding places for disease causing organism if not properly contained and managed. Odour is usually a problem not only with solid wastes but also with waste water treatment plants, sewage treatment plants and poor housekeeping.

Contamination of surface water from fuel and oils from generator and storage facilities

Power generation requires the use of refined petroleum products and lubricating oils. Accidental discharges and leakages from generator and storage tanks are a potential source of hydrocarbons in the water. Inorganic additives in fuel and oil can add to heavy metal contents in the environment. This impact is rated minor and is direct, negative, local, short term and reversible

5.5.2 Positive impacts of the project activities

Opportunities for business and employment

The level of unemployment in the area is higher. The process of site preparation will involve the recruitment of local labour. The increase in activity will present new opportunities for business in nearby settlements. The impact is described as direct, short term, local and reversible and is positive.

Opportunities for business and employment

Dredging could create business opportunities for communities through procurement services, minor contracts, and petty trading which will be open to the indigenous people. The impact is positive.

Improvement in the navigability/ drainage of the river channel

The dredging of the river will result in the Improvement of the navigability of the channels. At the same time, the catchment will be efficiently drained thereby reducing the incidence and frequency of floods. This impact is direct, positive, long term, local and reversible. This impact is positive.

5.6 Cumulative Impacts

Cumulative impacts result from actions which may not be significant on their own, but which are significant when added to the impact of other similar actions. Many environmental problems, such as loss of open spaces or increase in air pollution result from the cumulative effects of human activities. Other well-known examples of cumulative effects are climatic change and loss of biodiversity. Cumulative effects are the combined impacts of a single activity or multiple activities. The individual impacts from a single development may not be significant on their own but when combined with other impacts, those effects could become significant. Cumulative effects have been defined as "the net result of environmental impact from a number of projects and activities" (Sadler 1996). The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonable foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions is termed the cummulative impact (Jain et al, 2002). Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. Cumulative effects occur when there is

- Spatial crowding or temporal overland between plans, proposals and actions
- Repeated removal or addition of resources due to proposals and actions
- Repeated alteration of the landscape in the plan area

In this instance the cumulative impacts may arise from the parallel running of the proposed port project. The construction and operation of port facility can also create cumulative impacts in-terms fixed point project. These impacts have been assessed to pose beneficial to medium significant adverse impacts.

Cumulative impacts relating to the construction of the proposed port facility include:

- Pollution (Air & Water)
- Incidents (Road & Marine accidents)
- Population (migrants, Workers, followers)
- Aesthetic value of area where there are existing industries
- Pressure on existing infrastructure

Table 5.8: Cumulative Effects

Type	Main characteristics	Examples
Time crowding	Frequent repetitive and simultaneous impacts on and environmental resource	Incremental noise from a number of separate developments
Space crowding	High spatial density of impacts on an environmental system	Traffic congestion resulting from increase in activities in an area or progressive fragmentation of wildlife habitats from a variety of sources
Indirect effects	Secondary impacts resulting from a primary activity	Induced commercial and residential development associated with road construction
Triggers and thresholds	Fundamental changes in system behaviour or structure	Deterioration of aquatic systems through chemical contamination from run-off and siltation
Nibbling	Incremental or decreasing effects	Gradual loss of natural areas such as woodlands or greenbelt through discreet developments

Based on the individual impact assessment for the projects, majority of the cumulative impacts would occur during the early phases of these projects: mobilization and construction, while a small number would occur during operation of the various facilities.

The cumulative positive impacts identified are

- Business Opportunity/Economic enhancement
- Skills acquisition
- Increase in revenue

The cumulative negative impacts identified are:

- Increase in potential for road traffic volume
- Increase in noise nuisance
- Reduction in air quality (dust, exhaust)
- Stress on existing security structures
- Changes in local population
- Increase in social vices
- Pressure on existing infrastructure and utilities
- Increase in communicable diseases (including STIs)
- Pollution of surface water sources

The significance rating of each of these impacts has been obtained through the process of impact identification, ranking and quantification, in each of the projects.

Table. 5.9 Cumulative Impact Analysis

Impacts	Port Facility
Reduction in biodiversity/Loss of flora and fauna	Low
Increase in cost of living/Inflation	Low
Increase in potential for road traffic volume	High
Increase in noise nuisance	Medium
Reduction in air quality (dust, exhaust)	Medium
Community unrest	Low
Stress on existing security structures	Medium
Business Opportunity/Economic enhancement	High
Changes in local population	Low
Increase in social vices	Medium
Pressure on existing infrastructure and utilities	Medium
Skills acquisition	High
Injury to workers	Low
Increase in communicable diseases	Low
Pollution of surface water sources	High
Soil degradation from spills and leaks	Low

5.7.1 Cumulative Positive Impacts

Business Opportunities/Economic Enhancement

A percentage of the various project costs would be reserved for local contracting. These projects would therefore, create various opportunities for local contractors to take advantage of for the supply of goods and services. This would ultimately enhance the economy of the area and improve the economic well-being of the contractors.

Employment & Skills Acquisition

The project would require skills of various types and there is the potential for the acquisition of new skills by qualified community indigenes in various areas to service the marine industry, civil construction. Acquisition of these skills would improve the chances of such individuals within the labour market of getting similar jobs based on the new skills acquired. Also skills that would be of indirect service to these projects would also be of benefit to the communities. Within the service industry, barbing, tailoring, repairs, waste management, etc would expand to cater for the influx of personnel and waste they would generate, while the supply industry (foodstuff, office consumables, provisions etc) would also expand.

Increase in Revenue to the Government

With the commissioning of the port facility revenue for the company will increase based on the increase activities and objects of the port facility.

5.7.2 Cumulative Negative Impacts

Most of these impacts were individually rated as medium or high for the various projects. Their cumulative effects would most likely be high or medium.

Increase in Road Traffic Volume/ Accidents& Incidents/Noise

There would be a cumulative increase in the volume of traffic plying the Apapa – Kirikiri road as goods, personnel and equipment are being moved into, out and within the area by road. This may also affect other road users and cause traffic hold-up on the road. This also has the potential to cause an increase in road traffic incidents due to dangerous/reckless driving, breakdown of vehicles, pedestrians and other road hazards. There would also be an increase in the noise level especially along the internal Kirikiri roads and close to the various construction locations.

Reduction in air quality (dust & exhaust emissions)

During the dry season, harmattan dust, construction dust and exhaust fumes would be deposited on vegetation, pedestrians, and structures close to the road in higher concentrations due to the increase in traffic volume.

Population Increase

With each influx of construction workers, there would be the attendant increase in camp followers. As the workers for each project would be exclusive to the project it is expected that when the project schedules overlap, and if at the peak of construction, a sizeable number of workers would be on the site. This enlarged population has the slight potential to change the demographic characteristics of the Cardoso area of Kirikiri.

Stress on existing infrastructure & Utilities

Though contractors would provide accommodation, feeding, transport etc for their workers, the camp followers would utilize those services and infrastructure available within the communities. Thus, there would be cumulative stress on the poor infrastructure and utilities with each influx of camp followers.

Increase in communicable diseases

With each influx of construction workers & camp followers, the frequency of STIs would increase as well as the chances of individuals contacting different types of infections. The cumulative effects of different infections in individuals would compromise their health status leading to absence from work, loss of income and, in the extreme case, death.

Water and soil contamination

With simultaneous construction activities at the various locations there is the increased potential for accidental spills and leaks that could cause water and soil contamination. With an increase in the frequency of contamination there is the potential for some of the contaminants to accumulate especially in soil and sediments.

Potential for community unrest

With simultaneous construction activities, the host communities of the project area would experience an increase in population due to the influx of workers, camp followers, contractors, job seekers etc. This could lead to negative stress within the communities of several types. These could be cumulative with the influx of persons for each project and lead to community unrest. Other extraneous factors not related to the projects such as border dispute, inter-communal disputes & politics could also heighten the situation.

CHAPTER SIX
MITIGATION MEASURES/ALTERNATIVES

6.1 Introduction

The actions and measures that Bestaf Marine Services Limited intend to take to reduce (or eliminate) negative impacts and promote positive impacts of the proposed Project are presented in this chapter. In this mitigation measures, emphases are placed on those negative impacts rated as significant (medium and high impacts). The measures are aimed at reducing these impacts to As Low As Reasonably Practicable (ALARP). The residual impacts that could arise despite these mitigation measures were also noted. None significant impacts are expected to be mitigated through effective implementation of BMSL Safety and Environment policies that will be put in place during the different phases of the project.

The mitigation measures proposed for the predicted medium and high-ranking impacts arising from this Project recognised the following:

- Environmental laws in Nigeria, with emphasis on permissible limits for waste streams FMEnv (formerly FEPA, 1991)
- Best Available Technology for Sustainable Development
- Feasibility of application of the measures in Nigeria
- Concerns of stakeholders during consultation meetings, scoping workshops and the socio economic/health status of the host communities.

Mitigation measures are recommended for the potential negatives impacts identified in the impact assessment.

Prevention: Exclude significant potential impacts and risks by design and management measures.

Reduction: Minimize the effects or consequences of those significant associated and potential impacts that cannot be prevented, to a level as low as reasonably practicable by implementing operational and management measures.

Control: Implement operational and management measures to ensure that residual associated impacts are reduced to a level as low as reasonably practicable.

Factors for determining implementation of mitigation measures are:

- Avoiding the impacts altogether by not making a certain action or parts of an action
- Minimizing impacts by monitoring the degree or magnitude of the action and its implementation.
- Rectifying the impacts by repairing, rehabilitating or restoring the affected environment.
- Compensation for the impact by replacing or providing substitute resources
- Feasibility
- Ease of implementation
- Local suitability
- Institutional requirements
- Monitoring requirements
- Training requirement
- Cost (Capital and operating) and
- Cost effectiveness

The mitigation measures are categorized by relevant impact category, potential impact, and affected specific area. The Required General and Specific Mitigation measures are divided into three sections, labelled Environmental, Socioeconomic, and Health and Safety, and subsequently into seven categories of potential impacts. These categories of impacts by section are:

Environmental

- Land Use;
- Topography, Geology, and Soils;
- Habitats, Biological Resources and
- Air Quality (including Noise and Vibration).

Socioeconomic

- Cultural (and Archaeological) Conditions; and
- Socioeconomic Conditions (Means of Livelihood, and Transportation and Infrastructure).

Health and Safety

- Public and Worker Health and Safety.

These mitigation measures are presented in Table 6.1.

Table 6.1: Proposed Mitigation Measures

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating
Mobilization	Movement of goods, equipment and personnel	Potential increase in road traffic volume	High	▪ BMSL will adopt a dedicated traffic management plan for the mobilization of vehicles during the construction, operation and decommissioning phases. ▪ Large and slow moving vehicles should be scheduled during off peak periods ▪ BMSL shall ensure use of the less congested traffic period of the ports operations for their own transportation ▪ BMSL shall ensure Upgrading the land vehicle fleet with less-polluting trucks and vehicles, and using alternative fuels and fuel mixtures ▪ BMSL shall ensure use of Flag men in conjunction with the communities at road crossings and intersections.	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Potential increase in road traffic incidents	Medium	▪ Pre-mobilization of all vehicles ▪ Visible warning signs on roads and vehicles ▪ Speed breakers at sections traversing communities ▪ Defensive driving course for BMSL and contractor drivers ▪ Vehicle monitoring device/BMSL journey management policy/night driving and alcohol policy shall be enforced ▪ First aid training of workforce and provision of first aid boxes in operational vehicles	Low
		Increase in noise levels	Medium	▪ Enforce night driving policy (no night driving except when unavoidable) ▪ BMSL shall ensure that all vehicles and equipment conform to World Bank limits for noise	Low
		Reduction in air quality (dust, exhaust fumes)	Medium	▪ BMSL shall ensure that only vehicles with pre-mobilization certificates are used to reduce emissions from vehicle exhaust	Low
		Damage existing roads	Medium	▪ BMSL shall repair Roads if any damage caused by project during movement of heavy equipment	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
Construction	Site preparation (Land clearing, **excavation)**	Loss of flora and fauna	Medium	▪ Site clearing shall commence from developed to undeveloped areas to provide adequate control of waste materials ▪ BMSL shall educate construction workers on the sensitive nature of the biodiversity of the area and the need for conservation	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Jetty floor sweeping exercise / Dredging (dressing)	High	• BMSL shall use disposal approved by NPA, FMEnv, LSMOE. • BMSL shall ensure Excavation and dredging methods selected shall minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material. • BMSL shall ensure dredging spoils are not disposed close to Areas sensitive for marine life such as feeding, breeding, calving, and spawning areas should be identified. Where sensitive species are present, dredging and dredging spoils shall be conducted in a manner so as to avoid fish migration or spawning seasons, routes, and grounds; • BMSL shall make Use of lateral containment in open water to localize any impact. Use of borrow pits or dikes reduces the spread of sediments and effects on benthic organisms; • BMSL shall ensure dredging spoils are disposed at points where it cannot be washed back into the recipient water body • Dredged spoils shall not be thrown to the area of surface water not dredged.	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Loss of habitat	Low	▪ BMSL shall encourage the re-vegetation/landscaping of land cleared for temporary use where feasible	Low
		Community concern	Medium	▪ BMSL shall ensure that all host communities are represented in the employment of locals during site clearing and excavation to avert any concern that could arise from perceptions of unfairness ▪ BMSL shall ensure site preparation jobs are reserved exclusively for the host communities ▪ BMSL shall abide by all MOUs signed with the host communities	Non – existent
		Alteration of species diversity and structure of benthic communities	Medium	• BMSL shall ensure the Limiting the organic enrichment of the river bed • BMSL shall ensure that the soil removed during dredging operations is not deposited on the banks of the river (so as to avoid its eroding back into the new river bed which often causes the destruction of the bottom fauna and flora).	Low
		Depletion of Dissolved Oxygen	High	• BMSL shall ensure there is no spill of organic liquid which prevents diffuse of oxygen into water surface • BMSL shall ensure that limited organic materials which use up oxygen for decomposition are not disposed into the water. • BMSL shall ensure random agitation of Sediments causing high turbidity and suspended particulate materials.	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Bathymetric Modification	Medium	• BMSL shall ensure that the bottom is levelled after the dredging exercise • BMSL shall carry out an assessment bathymetric survey after the dredging exercise.	Low
		Increase in dust and noise	Medium	• BMSL shall ensure that nose mask and ear muffs are worn by site workers during excavation • Water shall be sprayed on construction sites to reduce dust levels especially during dry season	Low
		Threat to health of workers insect stings, injuries etc)	High	▪ BMSL shall ensure usage of PPE by field workers ▪ BMSL will ensure there are adequately trained and sufficient numbers of first aiders and HSE Inspectors at each site ▪ BMSL shall ensure that anti-venom/anti-histamine is provided on site to mitigate insect stings ▪ BMSL shall ensure that site clinic has standby Ambulance.	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Changes in local population	Medium	▪ Prior to commencement of the construction phase, BMSL shall advertise construction jobs that will be available. This will hopefully discourage unqualified personnel from moving into the project area, thus reducing the rate at which the local population will grow ▪ BMSL will look into the development of off-site job recruitment based on the training provided for local community personnel.	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
Construction		Increase in morbidity (including STIs) and mortality	Medium	▪ Health awareness lectures shall be given to workers on the mode of transmission of STIs (including HIV/AIDS) ▪ As much as possible provide psychological support to persons living with the HIV virus ▪ BMSL shall insure immunization of workforce against as appropriate ▪ Regular spraying of work sites ▪ Provision of insecticide treated nets to field workers to reduce incidence of malaria ▪ Awareness campaign shall be carried out to enlighten the communities/field workers on the common communicable diseases and the health implications of drug and alcohol abuse, unprotected sex, prostitution and the need to sustain cultural values ▪ BMSL shall assist the activities of the state action committee on STIs/HIV/AIDS as part of her stakeholders engagement plan. ▪ BMSL shall ensure site clinic is provided to take care of minor illnesses for all construction workers	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Increase in social vices	Medium	▪ BMSL shall conduct enlightenment campaign and health education for the abatement of abuse of drugs, alcohol among workers throughout the life of the project ▪ BMSL shall ensure that contractor enforces the alcohol and drug policy for staff ▪ BMSL shall encourage contractor to support sporting activities ▪ BMSL shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS ▪ BMSL shall ensure that contractor implements social and health awareness programs for all workers at induction and on a continuous basis throughout the life of the project	Low
		Pressure on existing infrastructures and utilities	High	▪ BMSL shall make adequate accommodation arrangement prior to mobilization on workforce to reduce pressure on local housing ▪ As appropriate, BMSL shall support the development of the health facility.	Medium
		Increase in inflation level	Medium	▪ BMSL shall support skill development and enhancement of the local communities through training and complemented by cooperatives and micro-credit schemes	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
	Construction of the Port facility	Increase in dust, noise and vibration	Medium	▪ BMSL shall ensure that all construction equipment shall be in proper operating condition and fitted with factory standard silencing features if appropriate ▪ BMSL shall provide and enforce the use of PPE (e.g. nose masks and ear muffs) ▪ BMSL shall construct sound proofing walls around stationary power generating sources	Low
		Soil degradation	Medium	▪ BMSL shall provide containment for chemicals and liquid discharges ▪ BMSL shall build well engineered jetty pavement that will cut out seepage of spills (leaks into subsoil) ▪ BMSL waste management policy shall be enforced in cases of domestic waste, scrap metals, non-plastic combustible packaging materials, plastic packaging materials, drums and containers as well as medical wastes ▪ BMSL shall ensure that a controlled fuelling, maintenance and servicing protocol for construction machinery at worksite is established and followed to minimise leaks and spills	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Injury to workers	High	▪ BMSL will ensure there are adequately trained numbers of first aiders on site. ▪ BMSL shall provide and enforce appropriate use of PPEs (e.g. coveralls, hard hats, eye goggles) ▪ BMSL shall ensure that health talks awareness lectures and job hazard analysis are conducted prior to work activities	Medium
		Loss of biodiversity	Medium	▪ BMSL shall ensure that cleared vegetation are not disposed at the banks of the channel ▪ BMSL shall ensure that dredged spoils are not disposed into the surface water. ▪ BMSL shall undertake to educate construction workers and locals on the sensitive nature of the biodiversity of the area and the need for conservation	Low
	Waste generation	Increase in breeding ground for disease vectors and other agents of diseases	Medium	▪ BMSL waste management policy shall be enforced ▪ BMSL shall ensure that wastes are disposed of at appropriate locations provided for waste disposal and collected as quickly as possible	Low
		Increase in nuisance	Medium	▪ BMSL CLOs will ensure there is continuous communication with the communities to allay/reduce fear of the unknown.	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Contamination of the environment Construction waste/fluid if spilled	Medium	▪ BMSL shall ensure that products are properly managed/stored in order to avoid spill. ▪ BMSL shall ensure that Material Safety Data Sheet cards are available at site to provide advice on clean-up in the event of spills and leaks ▪ Edge of Jetty platform will be elevated barricade to hold spill from drainage flowing onto the River	Low
		Contamination of the environment by domestic wastes	Medium	▪ BMSL shall ensure regular collection and disposal of wastes in accordance with the project waste management plan	Low
	Operation and Maintenance Port facility	Increase in noise levels	Medium	▪ BMSL shall ensure that appropriate maintenance programs are in place for all equipment.	Low
		Reduction in air quality	Medium	▪ BMSL shall ensure that appropriate maintenance programs are in place for all equipment	Low
		Degradation of soil and surface water from spills and leaks	Medium	▪ BMSL shall provide containment for chemicals and liquid discharges ▪ BMSL waste management policy shall be enforced ▪ BMSL shall ensure that a controlled fuelling, maintenance and servicing protocol for operation and maintenance of machinery is established and followed to minimise leaks and spills	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
Operation and Maintenance		Relative drop in economic activities	Medium	▪ BMSL shall support skill development and enhancement of the local communities through training	Low
		Effluent (contaminated storm water)	Medium	▪ BMSL shall ensure Quay and urea truck loading bay area which are prone to spillage and the storm water drains originating from such area will lead to a storage tank, store such contaminated water temporarily before being sent to the water treatment plant for treatment and then discharged into the main drains.	Low
		Degradation of environment from spill and leaks	Medium	▪ Covered urea conveyor and collection system. ▪ Better housekeeping especially for area's prone to spillage. ▪ BMSL shall ensure the provision of containment for chemicals and liquid discharges ▪ BMSL waste management policy shall be enforced ▪ BMSL shall ensure that a controlled fuelling, maintenance and servicing protocol for machinery is established and followed to minimise leaks and spills	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
		Traffic congestion (Marine & land)	Medium	▪ BMSL shall ensure use of the less congested traffic period of the ports operations for their own transportation ▪ BMSL shall ensure Upgrading the land vehicle fleet with less-polluting trucks and vehicles, and using alternative fuels and fuel mixtures ▪ BMSL shall ensure use of Flag men in conjunction with the communities at road crossings and intersections for land transport. ▪ BMSL shall liaise with NPA on navigations to avoid sinking community boats as number of shipments ▪ Vessels berthing for import and export must not discharge ballast water into the surface water.	Low
		Threat to health of workers (snake bites, insect stings, injuries etc)	High	▪ BMSL shall ensure that fully equipped first aid boxes, and trained first aiders are available on site at all times in addition to a functional site clinic ▪ BMSL shall enforce appropriate use PPE ▪ BMSL shall ensure that anti-venom/anti-histamine is provided on site to mitigate snake bites and insect stings	Low
Decommissioning	Surface	Increase in dust generation	Medium	▪ BMSL shall ensure proper use of PPEs ▪ BMSL shall ensure that water is sprayed to reduce dust levels	Low

Project Phase	Project Activity	Description of Impact	Significance Rating Before Mitigation	Mitigation	Significance Rating After Mitigatio (Residual Impact Rating)
Restoration and Abandonment	equipment dismantling, Excavation, Removal and Disposal of concrete works and pipes	Increase in noise levels	Medium	▪ BMSL shall inform communities in advance of likely increase in noise level during decommissioning ▪ BMSL shall ensure proper use of PPE (ear muffs)	Low
		Increase in respiratory tract diseases	Medium	▪ BMSL shall ensure that all personnel are medically certified for the operation prior to engagement ▪ BMSL shall enforce appropriate use of PPE (nose mask, eye goggles) ▪ BMSL shall use barriers to separate dusty activities from non-dusty ones	Low
		Increase in waste generation	High	▪ BMSL shall ensure that wastes are disposed of in accordance with her waste management plan for this project	Low
		Potential for community concern (from employment, pollution and resistance to dismantling of equipment)	High	▪ BMSL shall ensure fair community representation. In the employment of local labour ▪ BMSL shall ensure that the waste management plan for this project is implemented ▪ BMSL shall abide by the MOUs signed with the communities for the decommissioning exercise.	Medium

6.2 Mitigation of Impacts

Mitigation measures are measures designed to address the impacts of projects. The measures are largely a function of the adverse social impacts of projects since it is such impacts that require mitigation. The expected impacts of the Port Project include the following:

- Demographic Impacts (redirection of labour, inflation).
- Socio-economic Impacts (redirection of labour, inflation).
- Impacts on Lifestyles (sexual laxity, alcoholism, youth militancy).
- Impacts on Cultural Properties (religious sites/shrines, etc).
- Impacts on Social Infrastructure (health care facilities, water supply).
- Impacts on natural resources (disruption of vegetation and farms).

Table 6.2: Key Mitigation Measures

	Impacts	Mitigation Measures
1	Population growth due to immigration	Use local labour as much as possible
2	Inflation in the local economy	Use local labour as much as possible
3	Pressure on local infrastructure	Use local labour as much as possible in order to minimize additional demand for infrastructure.
		Help increase the capacity of local
		infrastructure
4	Destruction of farms	Compensation
5	Sexual laxity	Disruption
		Public enlightenment about potential health risks (STDs).

6	Youth militancy/unemployment	Use local labour as much as possible to have the youths gainfully employed.
		Facilitate skills acquisition programmes.

Potential impacts on water quality

Careful site selection and port design should be carried out, focusing on the possibility of water stagnation. If the basic pollution level is critically high, a sewage treatment system should be planned as part of the environment management of the area. Regulations on discharges of effluents into water and provision of sanitary treatment facilities are indispensable for reducing pollutants from hinterlands. In a polluted bay or port, it could be effective to dredge or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water.

Potential impacts on coastal hydrology

Careful site selection and port design could minimize changes in current patterns and other coastal hydrology. Model experiments or computer simulations of these changes are useful in developing an appropriate design. Typical measures against beach erosion are construction of sea walls, jetties, offshore breakwaters, and periodical beach nourishment.

Potential impacts on marine/coastal ecology

Adverse effects on marine and coastal ecology usually result from: deterioration of water and air quality; current pattern changes; bottom contamination; physical loss of water area; and changes in natural land habitat. Measures are effective for mitigating changes in aquatic and terrestrial habitat. Careful survey of the ecological characteristics of a project area is indispensable if the welfare of endangered and fragile species is to be considered and disruption of their spawning seasons and areas and migration is to be minimized. Planting of green plants around a port may be an effective means to mitigate adverse effects on terrestrial habitat.

Potential impacts on visual quality

The design of port should cause it to blend with its surroundings. Special attention to the colours of port facilities and landmarks helps improve port scenery. A green belt zone around a port may block an unpleasant view of the port and be a more pleasant sight.

Socio-cultural impacts

An appropriate resettlement plan could minimize the disturbance to the local community and ensure smooth transition to industrialization. Survey of archaeological heritage sites should be undertaken well in advance and a preservation plan included in any port development plan. During the evaluation stage of a development project, following information should be provided:

a) Distribution of population around the project area: Initial population distribution, age composition, households, slums, social solidarity, public peace and order, infrastructure
b) Race composition: Majority and minority groups, cultural gaps, basic resources for life, racial conflicts
c) Removal and resettlement of local people: Removal population, conservation of community, condition of resettlement, opinions on removal and resettlement.
d) Cultural heritage: Location of heritage, importance of heritage, legislation on preservation, possibility of removal

Potential impacts on water quality

The adverse effects of construction work could be minimized by appropriate selection of equipment in pile driving or dredging, proper use of silt curtains, careful planning of settling ponds and overflow weirs for landfills, and suitable transport of construction materials and dredged material. Proper disposal of dredged material plays a critical part in preserving the environment. Deposition in landfills may offset problems being caused by dumping at sea.

Potential impacts on coastal hydrology

The impact of dredging on current flow is usually not serious and can be assessed by current flow simulation. Beach erosion could be avoided by carefully planning the steepness of the dredging slope and the deviation from the shore line

Potential impacts on bottom contamination

A survey of contamination of bottom sediments should be undertaken before dredging. In case substances or materials listed in the annexes of the London Dumping Convention are found during the survey, the dredged material should be treated in accordance with the respective provisions of the convention (See appendix 4). Selection of disposal site, disposal methods and requirements for capping are key issues in undertaking disposal at sea. In shallow water, silt curtains, as well as careful selection of the dredging method, could be effective in minimizing dispersal of resuspended sediments. Specific Guidelines for the Disposal of Dredged Material at Sea have been adopted by the Contracting Parties to the London Dumping Convention.

Potential impacts on air quality

Methods for controlling dust emission are water scattering in the construction site, use of proper transport methods, such as a conveyor belt, for excavated material and screens around the construction site. A green belt zone or open space between the construction site and the local community could be an effective buffer. Temporary pavement of roads in a construction site could considerably reduce dust emission.

Noise and vibration

Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation fences. Green belt of plants can be a good barrier. Limitation of working hours may be a possible means to mitigate the nuisances of construction activities.

Waste management

The adverse effects of disposal of contaminated dredged material or other wastes from construction activities could be offset by including them in land reclamation. Appropriate design, according to the characteristics of the wastes, is a basic requisite for retaining walls, settling ponds, capping of landfills, and land use after completion. Dumping of dredged materials should be treated in accordance with the provisions of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, and the Amendments Adopted in 1978 and 1980, the so called London Dumping Convention, and relevant national regulations (Appendix 4). For some regions specific Conventions or Protocols have been adopted, e.g. the SPDEP, Convention covering the South Pacific.

CHAPTER SEVEN
ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 General

An Environmental Management Plan (EMP) is the essential and stand-alone component of an EIA that provides the assurance that the mitigation measures developed for reducing the effects of adverse associated and potential impacts to as low as reasonably practicable (ALARP) as well as those proposed for enhancing beneficial impacts are implemented and maintained throughout the project life cycle. The EMP for the proposed port facility project, which outlines the strategies for managing hazards, associated and potential impacts and their effects on the environment, is presented in this chapter. This EMP is developed to ensure that mitigation measures and monitoring requirements are provided for environmental impacts described in chapter six of this report. It is also providing the basis for the environmental compliance review that shall be carried out in subsequent stages of the project. EMP is an important management tool which sets out conditions and targets to be met during project implementation. This EMP contains among others the following key items:

- Summary of potential impacts
- Planned mitigation measures
- Planned environmental monitoring
- Planned public consultation process
- Responsibilities and authorities for implementation of mitigation measures and monitoring requirements
- Mechanisms for feedback and adjustment

7.2 EMP Objective

The EMP is designed to:

- ensure progressive reduction of the impacts of the project activities on the biophysical, socio-economic and health environment with the ultimate aim of eliminating them;
- ensure that all mitigation and enhancement measures prescribed during the impact assessment process for eliminating or minimising the adverse project impacts as well as optimally enhancing the beneficial impacts are fully implemented; and

- provide part of the basis and standards needed for overall planning, monitoring, auditing and review of environmental and socio-economic performance throughout the project life cycle.
- Demonstrate that a systematic procedure ensuring that all project activities are executed in compliance with applicable legislations and policies on Health, Safety, Environment, Security and Community Relations have been established for the project;
- Show that mitigation measures for all impacts and effects have been established and shall be maintained throughout the project's life cycle, so that impact risk levels will remain ALARP;
- Demonstrate that emergency response measures will be in place. This will ensure that adequate responses in case of emergency have been established for the project; and

These objectives shall be achieved by:

- ensuring compliance with all stipulated legislation on protection of health, safety and environment policies;
- integrating environmental issues fully into the project development and operational philosophies;
- promoting environmental management awareness among workers;
- rationalising and streamlining existing environmental activities to add value to efficiency and effectiveness; and
- ensuring that only environmentally sound procedures should be employed during the project.

The EMP includes the following plans/programs:

- Environmental Capacity Building Program;
- Environmental Monitoring Program;
- Audit Program;
- Traffic Management Plan;
- Risk Management Plan for polluted Waterway
- Hazardous Materials Management Plan;

- Decommissioning and Closure Plan

7.3 Management Organization

a) BMSL Establishment

Bestaf Marine shall retain the primary responsibility of ensuring that environmental commitments are met through-out the life cycle of this project. The company shall establish a schedule for responsibility and training on matters relating to the environment. Environmental issues shall be a line responsibility for which all levels of personnel are accountable. Top management shall ensure that all environmental considerations are integrated into project execution. The Works and Environment Department of Bestaf shall offer expert advice on protection measures and shall assist to monitor performance. BMSL shall appoint an Environmental Monitoring Team (EMT) to ensure effective implementation of the recommendations of the EIA and its management plan. The EM Team shall verify the effectiveness of the EMP implementation in liaison with Regulators and other stakeholders as appropriate. BMSL shall take responsibility for all environmental matters and ensure that contractors comply with all applicable environmental laws, regulations and policies as they apply to this proposed port facility project. In principle, the Contractor responsible for construction of the transmission line and associated facility project shall be responsible for implementing those aspects of the EIA recommendations that pertain to the engineering, procurement and construction phase. The Contractors for this project shall be required to submit, for approval, their proposal to manage HSE inherent in their contract execution. The Environmental Management Team will operate in an advisory capacity in all matters.

b) HSE Coordinator

The HSE coordinator shall report directly to the transmission line Project Manager (PM). The coordinator shall have the authority to stop work or any activity which poses danger to the environment, workers, or the general public during the project construction phase, until measures are instituted to eliminate the dangers or threats. The responsibilities shall include:

- ensure that mitigation measures outlined in the EIA are implemented;
- liaise with the GM Governmental affairs, contractors and other supervisors to ensure as far as reasonably practical, environmental protection, safe and healthy conditions at all work sites;

- coordinate environmental and safety activities between BMSL and all contractors/organisations providing services at the project site;
- ensure clear communication of safety, health and environmental and socio-cultural information to all categories of workers;
- liaise with management in deciding which environmental and safety concerns could be handled in-house and which matters shall require external assistance; and
- co-ordinate, investigate and review environmental and safety incidents and complaints and maintain separate site incident and complaint records

7.4 Use and Maintenance of the EMP

The EMP shall remain a dynamic working tool and will be owned by the proposed port facility project. BMSL supervisor is, however, the custodian of the document and may exercise auditing role to verify compliance by the project. The EMP shall be updated and revised periodically throughout the project's life span to incorporate improved technologies, better environmental regulations, management systems, guidelines and policies. Constructive suggestions by users (contractors, management, line and operating personnel) shall be assessed by the Environmental Management Team and integrated into the EMP.

7.5 Regulatory Compliance

The FMEnv would closely monitor the EMP implementation and this shall involve a two-way information flow between BMSL and the regulatory body. The FMEnv has the responsibility of enforcing national environmental laws including international environmental laws which Nigeria has subscribed to;

- The FMEnv will serve as a regulatory oversight to the EMP implementation of this project;
- The FMEnv shall in coordination with the Lagos State Ministry of Environment ensure that BMSL periodically make available documentations in form of monthly/quarterly reports or as may be required showing evidences of caring out monitoring requirements, etc. Environment-related regulations as they apply to the Project has been be documented and described in this EIA. BMSL management shall ensure compliance with these regulations throughout the

project's lifecycle in line with measures inherent in the Engineering Project Management Guide (EPMG).

7.6 Detailed Design Guidelines

Health, Safety and Environmental (HSE) premises that cover the minimum performance standards for HSE critical elements to be applied to the design of the facilities for this Port facility project have been established as part of the Engineering Development phase of this project. These standards and criteria are meant to ensure that the design of the facilities for this project is in line with currently accepted HSE principles and policies. In particular, the HSE premise has steered the design towards the goal of preventing/minimising injuries, ill health, and damage to assets and the (natural and social) environment, to avoid/eliminate liabilities in the future. In the design of the facilities for this project, efficient use of natural resources and energy sources as a requirement has been taken into account. This is aimed at resource conservation and the protection of the environment through prevention/minimisation of discharges that have adverse effects on the environment. The HSE premise is flexible enough to permit refinements and extensions arising from formal HSE deliverables that are likely to be produced during successive project development phases. The driving force for the design is the reduction of risks to people, assets, reputation and the environment in compliance with the principle of As Low as Reasonably Practicable (ALARP). Any residual risks/effects after the application of the ALARP principle shall be managed through continuous improvement of the operation of the port facility Project.

7.7 Stakeholders Engagement

BMSL shall welcome suggestions and information from relevant stakeholders, contractors, visitors and the general public, which shall help improve its operations in order to minimise impact on the environment and worker health and safety. The office of the transmission manager shall be open to the general public for complaints and suggestions. Complaints received from the public shall be documented and follow-ups made to ensure that such grievances are addressed accordingly and in line the BMSL's grievance redress mechanism.

7.8 Monitoring

Project activities shall be monitored in order to:

- ensure that the EMP is implemented; and
- assess the efficiency of mitigation actions;
- provide updates where necessary

All contractors shall be required to self-monitor their performance with respect to environmental and social performance. The BMSL HSE Engineer shall also undertake quarterly environmental assessment and random walk through and spot checks throughout the project lifecycle. Assessment findings shall be reviewed by the project management team and where corrective actions are necessary, specific plans (with designated responsibility and timing) shall be developed to ensure continuous performance improvement. In addition to assessing operational aspects and monitoring assessments shall also consider compliance with agreed objectives and targets, and the effectiveness of the EMP and its implementation. The EMP shall, therefore, be subject to ongoing review and development to ensure that it remains appropriate for all aspects of the project. As is typical with all Federal Ministry of Environment approved projects, the ministry will carry out an assessment before the end of the project to confirm compliance of project activities to the terms and conditions of the EIA approval.

7.9 Implementation of Mitigation and Enhancement Measures

The mitigation measures proposed for the significant negative impacts and the measures proposed to enhance the significant positive impacts have been developed into an EMP that provides a detailed action plan with roles and responsibilities for their implementation. Part of the conditions of the approval of the EIA by the Federal Ministry of Environment (FMEnv) is that there will be regulatory monitoring of the approved project impacts mitigations and monitoring measures. The timing and frequency of the monitoring is determined by the FMEnv. FMEnv works closely with the State Ministry of Environment in monitoring the implementation of the EIA approval terms and conditions. Funding of the Impacts Mitigation and Monitoring (IMM) is borne by the proponent, in this case, BMSL. Prior to now, FMEnv will request funding for the monitoring while the project is in progress and the monitoring activity will be carried out after payment of the requested fund. Current

Practice is that FMEnv now issues a pre-approval letter which includes the cost of IMM and other conditions that has to be fulfilled prior to the issuance of the approval. Meeting the conditions, along

with payment of the funds have therefore become prerequisites to the issuance of the EIA approval. Payment prior to approval also ensures that the funding for monitoring is secured and the activity effected as at when due.

7.10 Prevention of Accidents/Incidents

Prevention of workplace accidents and incidents during the proposed project shall be achieved using the Job Hazard Analysis (JHA) tool and written Work Instructions (WIs). Consequently, the HSE and Security Team Leaders shall arrange for JHA to be conducted for all HSE critical activities. Written and explicit work instructions from such activities shall be developed. Compliance to regulatory standards, operations/maintenance codes and specifications as well as HSE guidelines shall form the basis for the execution of the proposed project. However, emergency situations could still occur as a result of equipment failure, weather, negligence and/or sabotage. Consequently, a Contingency Plan shall be developed as back up to other containment systems put in place to handle such occurrences. As a minimum, the contingency plans that shall apply to both BMSL and contractors, shall address the following emergency situations.

- Fires and Explosions;
- Serious injury or illness;
- hydrocarbons/chemical spills
- Weather related disasters; and
- Land vehicle mishaps.
- Civil unrest and kidnapping

The HSE and Security Team Leaders shall ensure that adequate security arrangements are put in place. Such plan shall have inputs from host communities. The team shall also identify, evaluate and manage the risks to personnel and property arising from malicious practices, crime, civil disorder or armed conflict. The security activities shall be co-coordinated from a common viewpoint by all stakeholders and be in line with BMSL security guidelines. In addition, each contractor shall be required to submit a project security plan to BMSL for review and approval. As part of the Environmental Management Plan and with the approval of the Project Manager, the Security Team Leader shall organize security

workshops to identify, evaluate and recommend contingency plans for all security risks associated with the Transmission Line and associated facilities Project.

7.11 Training and Awareness

In order to assure competence and awareness amongst BMSL personnel and Contractor staff, the project management shall establish, maintain and operate a training and awareness programme on health, safety and environmental issues. A great deal of attention shall be devoted to the locals in the contractors' teams. The training shall include accident emergency practices, basic First Aid, the use of Personnel Protective Equipment etc. Environmental Induction Course and subsequent refresher course relating to the project shall be organized for all work forces. The objective of the courses would be to develop environmental awareness and sensitivity amongst the personnel. The training and awareness programme shall be reviewed periodically by top management and shall include but not restricted to the following aspects

- **Module I:** Environmental Overview
- **Module II:** Environmental Regulations and Acts
- **Module III:** Pollution
- **Module IV:** Environmental Impact Assessment
- **Module V:** Environmental Management System
- **Module VI:** Mobilization and Environmental Issues
- **Module VII:** Environmental Issues in the Project
- **Module VIII:** The Environmental Management Plan for construction Projects
- **Module IX:** Environmentally Sound Construction Management
- **Module X:** Long Term Environmental Issues in Management

Certificates of attendance shall be issued to successful participants. BMSL shall also conduct HSE awareness campaigns for the host communities and general public with the aim of sensitizing them to

the potential impacts and hazards associated with its operations and the appropriate response to accidents/incidents. The public awareness campaigns shall be conducted periodically and the proceedings documented for subsequent Environmental Audits. The training modules are combined into different training components. There are overlaps in the composition of the target groups and the constitution of the training components. However, each training module would be developed keeping in view the composition and responsibilities of the target group members. Other Components may be imparted throughout the implementation period and held in the initial months of project implementation, preferably on site. The following tools are expected for the implementation of environmental training programme:

- Informal Training Sessions;
- Audio-Visual Communications;
- Case Studies;
- Lecture Sessions;
- Workshops;
- Group Discussions;
- Short-Term Training Courses;
- Seminars;
- Full-term Training Courses.

7.12 Maintenance Programme

The maintenance officer to be employed by the contractors for the project shall develop a comprehensive maintenance programme for all equipment. The maintenance schedule contained in the programme shall be designed in line with manufacturer's specifications for each of the equipment. A maintenance logbook shall also be operated and it shall be regularly audited/checked by the HSE and Security Team Leader. In addition, the maintenance status (last and next service dates) shall be displayed at appropriate and clearly visible points on each equipment and machine.

7.13 Construction Guidelines

7.13.1 Site Preparation/Clearance

Site preparation/clearance works shall be carried out within defined perimeters and only when necessary. The maximum permissible time lapse between site clearing and initiation of construction operations shall be reduced to the barest minimum necessary to permit safe operations. Areas cleared in excess of operational requirements shall be reinstated with indigenous topsoil and vegetation. During construction the portion of land not used for project activities shall be cordoned off and left undisturbed. As an additional measure to mitigate reduction in biodiversity, approved clearing of land along the established perimeter fence shall not exceed 5m width from the fence to limit biodiversity loss and create corridor for fleeing wildlife

7.13.2 Health and Safety of Workers

Throughout the project development Hazards and Effects Management Process (HEMP) shall be applied and shall consist of identifying, assessing and controlling hazards, and putting in measures to recover from the consequences of hazards if the controls fail. Operations at all work sites shall be subject to government, industry and BMSL HSE policies and guidelines. All BMSL centre and Contractor staff shall be well informed and trained on the HSE policies and guidelines. All facilities shall also be designed to enhance safety planning and activities shall be executed within the confines of relevant legislation and stakeholders' interests. Contractors shall provide adequate health services as well as site first aid services for its workforce. The first aid services shall be extended to work related visiting personnel and employed casual workers. All construction activities shall be properly managed through careful planning and the application of relevant HSE policies including the following:

- Use of Permit to Work (PTW);
- Job Hazard Analysis and toolbox meetings;
- Use of PPE in designated hazard areas;
- Prohibition of alcohol during work hours and at work sites and facilities;
- Regular emergency drills;
- Prohibition of smoking in fire hazard areas.

7.13.3 Emergency Response

The following equipment shall be provided as minimum requirements for emergency response action.

- Safety showers at locations in the project site where accidental spillage of chemicals could occur. Supply shall be taken from the firewater system;
- Safety signs and notices shall be provided throughout the centre in accordance with FMEnv requirements and standards;
- A general alarm system shall be provided, capable of giving an audible alarm in all areas of the project facility and visual display in areas of high background noise;
- Emergency response procedures shall be put in place for snakebites, road traffic accidents, medevac/medial rescue and gas leaks.

During operations, firefighting and associated facilities shall be inspected and tested on a periodic basis to verify inventory and function. Also, BMSL through the administration department shall carry out programmes to educate the communities and local health facilities on what to do in case of a major incident of fire/accident. BMSL's emergency response guidelines relevant to this project shall be publicly displayed at strategic locations. In order to safe guard the lives of personnel and contractors during emergency situation, EPC contractor shall develop and implement an emergency response plan. Emergency training shall be conducted by the HSE Manager to enhance worker's preparedness to respond appropriately to emergencies. Emergency drill shall be conducted periodically and such drill shall include fire, abandonment as well as first aid emergencies. Response time and roll call shall be monitored and recorded by the HSE Manager, supervisor or fire warden as required, at each drill/training to ensure compliance.

All drills and training exercise shall be documented by the HSE Manager or the supervisor and copies sent to BMSL. In situations where evacuation of personnel is necessary as a result of fire or any other related accidents, BMSL shall follow the emergency medical evacuation procedure with responsible parties.

7.13.4 Waste Management Guidelines

Waste shall be managed in accordance with Federal Ministry of Environment guidelines and BMSL waste management procedures. The principle of waste reduction, recycling, recovery and reusing shall

be practiced. In addition to the regulations of FMEnv, the project will also comply with other national and international environmental standards that are binding on all staff and contractors involved in the proposed project with respect to the following:

- emission or release of pollutant, exhaust and/or fugitive gases;
- discharge or spill of effluent into surface water or land; and
- discharge of solid wastes (including domestic waste) into surface water, swamp or land;

The EPC contractor is also expected to develop and submit for approval to BMSL a comprehensive waste management plan to be used during the project. This waste management plan shall be in line with BMSL HSE Management System and shall comply with national and international waste management standards. The handling, storage and disposal of all wastes that will be generated during the life of the project shall be in accordance with BMSL approved waste management guidelines. These guidelines are binding on all staff and contractors involved in the proposed project with respect to:

- Emission or release of pollutants, exhaust and/or fugitive gases.
- Discharge or spill of effluent into surface water or land.
- Discharge of solid wastes (including domestic waste) into surface water or land.
- Generation of noise and vibration.

A detailed waste management plan shall be developed for the wastes generated during the decommissioning and abandonment of facilities. This waste management plan shall be subject to approval by the regulatory authorities prior to abandonment. In the design of this plan the focus shall be on optimal recycling and reuse of materials.

i) Waste Handling

For proper handling and disposal, wastes shall be well defined at source and the definition transmitted along with the waste to the final disposal points. Contractors and BMSL personnel shall define and document all wastes generated in the course of work. Basic information that must be provided, as a minimum, for adequate definition of wastes include:

- Waste type identification
- Proper waste categorization

- Waste segregation information
- Recommended Management practices.

ii) Waste Minimization

Waste minimization implies reduction to the greatest extent possible of the volume or toxicity of waste materials. The five principles of waste minimization process: recycle, reduce, reuse, repair and recover shall be adopted as applicable. Opportunities to achieve significant waste volume reductions during the proposed project are functions of activity level, age, depreciation and maintenance level of facilities and operating equipment. As much as possible, excavated materials shall be used for landscaping or other remedial works on site.

iii) Waste Segregation

For effective implementation of appropriate wastes disposal methods, it is important that wastes be segregated, preferably at source into clearly designated bins at strategic locations. It is the responsibility of the contractors, during their operations to provide enough clearly marked bins at strategic locations to ensure proper segregation.

Different colour codes are assigned to specific waste bins

Table 7.1: Waste bin Colour Code

Food/vegetation waste	**Green**
Glass waste	**Blue**
Plastic waste	**Brown**
General (non-useable)	**Black**
Medical waste (combustible)	**Yellow**
Toner/developer	**White**
Metal scraps	**Purple**

For medical wastes (hazardous & non-hazardous) segregation at source into colour coded bags would be as follows:

Table 7.2 Medical waste colour code

Hazardous medical waste	
Clinical combustibles	**Yellow or yellow tagged bags**
Sharps	**Cin bin**
No sharp/ non-combustible	**Black or black tagged bags**
Foul or infected linen	**Red or Pink bags**
Recyclable linen	**White or white tagged bag**
Cytotoxic waste	**Orange bin**
Non-hazardous	
Paper	Clear or clear tagged bag

iii) Wastes Inventory

An inventory of waste generated shall be maintained. Weighing scales or measuring devices shall be provided to measure quantities of waste generated/discharged. Records of waste generated, treated and sent for disposal shall be maintained on site. Wastes to be transferred to offsite facilities for treatment and disposal shall be done in accordance with the BMSL waste transfer process and in line with statutory requirements.

iv) Waste Disposal

All debris, spoil materials, rubbish and other waste, except excavated soil and rock, shall be cleared regularly from the site and sent to the disposal facilities. Instructions on material safety handling sheet shall be strictly adhered to and shall form the basis for the disposal of wastes related to such products. Wastes in transit shall be accompanied and tracked by consignment notes. All waste, shall be cleared regularly from the site/centre and disposed of at BMSL or Government designated areas and facilities. Wastes in transit must be accompanied and tracked by consignment notes.

Table 7.3: Management of waste streams

Waste Type	Management
Drums/Containers	• Bulk transport and storage for high volume consumption items • Refill and reuse containers • Where possible, non-refillable containers could be returned to vendor for re-use or sold to scrap vendors
Industrial wastes (electrode studs, scrap metals)	• Metal waste sent to scrap recycling plants • Non-reusable scraps stockpiled at Government designated waste dump via landfilling
Domestic waste (plastics paper, food, etc)	• Reduce packaging wastes (paper & plastics) by use of bulk handling • Paper wastes shredded at designated points • Food wastes to be composted
Used oil	• Transported to nearest blending plants where spent oil is a feed stock
Medical Waste (used needles & syringes, expired drugs, blood & blood products etc)	• Medical waste (hazardous & no-hazardous) shall be collected in colour coded bins and transported to a medical incinerator for incineration

The waste consignment notes shall contain the following information as a minimum:

- Date of dispatch;
- Description of waste;
- Waste quantity/container type;
- Type of waste
- Consignee/driver name and means of transportation; and
- Confirmation of actual disposal (time and date).

7.13.5 Pollution Control

i) Air Pollution

In operating equipment BMSL shall utilize all practical methods and devices available to control, prevent and otherwise minimize atmospheric emissions or the discharge of air contaminants. Good engine efficiency of equipment and vehicles shall be maintained. Indiscriminate burning of materials resulting from clearance of trees, bushes and combustible materials shall not be permitted.

ii) Water and Soil Pollution

a) Wastewaters: BMSL Pollution of surface water by project-related waste including jetty sweeping exercise and wastewater shall be prevented by proper management practices. Contaminated or potentially contaminated plant area run-offs shall be collected and treated to meet regulatory requirements before discharge.

b) Soil: BMSL shall ensure that all construction activities are performed by methods that will prevent pollution of the soil media by accidental spills of contaminants, debris, and other objectionable pollutants. In the event of a significant spill, relevant spill control measures shall be applied and contaminated soil shall be cleaned as appropriate. Regular checks shall be conducted on equipment to minimize minor lube oil and combustible leaks from engines.

iii) Noise Pollution

BMSL shall comply with all requirements for noise control and with regulatory standards. For example, BMSL shall ensure that contractor plans activities such that FMEnv, NESREA and LSMoE guidelines shall not be exceeded at the nearest communities especially at nights. All equipment shall be maintained at optimal working conditions and recommended work practices shall be employed to minimize noise. Night operations shall be avoided except when absolutely necessary. In such instances, adequate measures shall be taken to reduce the noise involved and keep working hours to a minimum. Earmuffs shall be provided for all workers and any visitor within the vicinity of high noise generating equipment or operations. If noise levels at any time give rise to public complaint, the issue shall be treated as public nuisance and BMSL will take appropriate measures to resolve the problem with the appropriate authorities. In any case, communities shall be consulted prior to periods of expected peak noise levels.

Safe separation distances and buffer zones shall be established between facilities, work sites and host communities to reduce the impact of high noise levels from the facilities. Also, noise mapping of the facility shall be done and a map produced and visibly displayed. The possibility of encroachment up to the fence line is taken into account in the design of noise reduction measures.

7.14 Site Inspection Procedures

Throughout the projects life, The Environmental Management Team and representatives of regulatory bodies shall carry out regular inspection of sites and facilities. The main objective of such inspections shall be to assess compliance level with mitigation measures and recommendations of the EIA. When the HSE and Security Team Leader request such inspection, the site shall therefore be made accessible to such inspectors upon authentication of identity to:

- Examine and inspect all equipment that could cause pollution;
- Collect samples of any atmospheric emissions, effluent discharges or solid waste deposition for analyses and interpretation;
- Examine all construction and operation logbooks for environmentally related issues.

After each inspection, the Team shall compile a site inspection report detailing the:

- Specific facilities or areas inspected,
- Details of project activities, and
- Highlights of any observed non-compliance/persistent negligence.

In case of non-compliance the Contractor shall be requested to take appropriate measures. The inspection procedure shall be repeated after implementation.

7.15 Audit Programme

FMEnv directed Environmental audit shall be conducted at the project site three (3) years after closeout of impact mitigation monitoring (IMM). BMSL works director on the advice of the HSE and Security Team Leader shall provide authorization. The audit process shall be used to confirm that mitigation measures listed in the EMP of the EIA have been followed and complied with as well as to assess the environmental performance of project management during the all phases of the project. This

will ensure that environmental protection and management procedures are being enforced. In implementing the audit programme, facilities on the Port facility and other facilities perceived as having high environmental risks shall be thoroughly investigated. The audit programme shall:

- Examine compliance with regulatory requirements;
- Examine line management systems, plant operations, monitoring practices etc.;
- Identify current and potential environmental problems especially during the various phases of the project.
- Assure implementation of recommended practices and procedures; and
- Make recommendation for the improvement of the management system of the operations in the proposed port facility.

After every audit exercise, the environmental auditor shall produce an Environmental Audit Report that shall be submitted to BMSL HSE. Audits of the facility activities shall be conducted in order to ascertain extent of compliance with set guidelines, policies and requirements. The audits shall be carried out by certified auditors (both in-house and independent auditors) and in accordance with regulatory requirement and ISO 14001 guidelines. The scope of the audit shall include the following:

- compliance with all necessary codes, standards and procedures;
- examination of line management systems, operations, monitoring practices etc.;
- identification of current and potential environmental problems especially during the operational phase of the project;
- checking the predictions in EIA and assure implementations and application of recommended practices and procedures; and
- make recommendation for the improvement of the management system of the operation.

Also as part of audit and review this EMP shall be reviewed annually to determine its adequacy/suitability for continuous use.

7.15.1 Capacity Assessments

Capacity assessment and development process for those to be charged with managing the mitigation measures and grievance procedures is usually a cyclical process. Such a cycle will comprise several steps, from recognition of capacity deficiencies/efficiencies to the implementation of capacity development initiatives. Contract Agreement requirement is that the EPC submit the resume of key personnel, especially for those who would be directly responsible for the implementation, reporting, and monitoring of the EIA impacts mitigation and monitoring measures. Approval of personnel will depend on their proven experiences and capability to manage the recommended measures. Those whose capabilities are determined to meet the requirement will be approved for engagement in the project but those whose experiences and skill are determined to be insufficient will not be approved. The implication is that the EPC may retain and engage their services from temporary to permanent basis if it so wishes but they will not be engaged by BMSL for the operation of the Port facility. EPC deliverables will include engagement of sufficient and skilled personnel for key project areas especially in the HSE and socio-economic sections to ensure effective implementation of the project impacts mitigation and monitoring measures. The Project and EPC's Environmental Management Plan will specify the roles and responsibilities of those charged with HSE duties especially for those responsible for implementing the mitigation and monitoring measures. The EMP will also include training programs for such personnel in order to enhance their capabilities and performance. The project specific plans to be developed by the EPC such as the Environmental Management Plan, Waste Management Plan, Regulatory Compliance Plan, Socioeconomic/Community Relations and Engagement Plan, and Spill Response Plan will be submitted to BMSL project management team for review and approval prior to implementation. This will ensure that the key elements are captured in the plans. It will also ensure well-coordinated execution of project activities as well as confirm harmonized implementation of EPC's documented strategies in accordance with the terms and conditions of the approved project EIA. BMSL Governmental Department shall be responsible for capacity assessment of EPC personnel responsible for the management and monitoring of impacts mitigation measures as documented in this EMP and as regularly updated to cover for the project life span. Capacity assessments and other trainings as well as competency certification and validations of personnel shall progress from before the commencement of the project, through construction and operation phases.

Assessment shall also form part of the auditing/training program to be developed for the project. In addition to overseeing the implementation of the mitigation and monitoring measures, BMSL HSE will also be responsible for operation of the grievance procedures. In order to assure the competency of BMSL personnel charged with the above responsibilities, experienced personnel will be engaged for the execution of the project. Capacities of personnel assigned to the project will be assessed prior to their involvement in the project and appropriate trainings provided to cover identified capacity gaps. BMSL shall engage reputable consultancy firms to provide such capacity enhancement trainings and certifications. Federal Ministry of Environment (FMEnv) will be responsible for the regulatory monitoring of the implementation of the project EIA approved mitigation and monitoring measures. The Ministry assigns personnel with proven competencies to such tasks.

Table 7.4: Impact Management and Monitoring Plan – Pre-construction

Project Activity	Impact (positive or negative	Mitigation/ Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
Movement of goods, equipment and personnel	Potential increase in road traffic volume	As much as possible, large and slow moving vehicles should be scheduled during off peak periods	BMSL HSE Policy	Journey management record; IVMS record, night driving permit and statistics	Weekly	Monthly	Contractor HSE adviser	50,000
		Ensure maintenance of the any damage portion of secondary road as a result of project heavy duty vehicles	None	Road maintenance	Monthly	Six monthly	BMSL Contractor	Included in contractor Management Cost
		Raise community awareness of unusual activity through the SD team	BMSL HSE Policy and business ethics	Record of awareness sessions	Monthly	Six monthly	BMSL SHE Contractor Consultant	50,000
	Potential increase in road traffic incidents	Pre-mobilization of all vehicles	BMSL contract agreement	Pre-mob certificate and statistics	Weekly	Monthly	BMSL Contract Holder	Included in contractor Management Cost
		Visible warning signs on roads and vehicles	Federal traffic regulation	Number and adequacy of signs and speed breakers	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		Speed breakers at sections transversing communities	BMSL HSE Policy	Number of speed breakers	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		Defensive driving course for BMSL and contractor drivers	BMSL HSE Policy	Driving permit and statistics	Weekly	Monthly	BMSL Contract holder	Included in contractor Management Cost
		Vehicle monitoring device/BMSL journey management policy/ night driving and alcohol policy shall be enforced	BMSL alcohol and drug and HSE Policy	Journey management record; IVMS record, night driving permit and statistics	Weekly	Monthly	BMSL	Included in contractor Management Cost

		First aid training of workforce and provision of first aid boxes in operational vehicles	BMSL standards	Number of first aid certificates issued and records of vehicle first aid boxes audit	Weekly	Monthly	BMSL Contractor Consultant	50,000

Table 7.4: Impact Management and Monitoring Plan – Pre-construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
	Increase in noise levels	Enforce night driving policy (no night driving except when unavoidable)	BMSL HSE Policy	Night Driving permit and statistics	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that all vehicles and equipment conform to World Bank limits for noise	World Bank guidelines	Vehicle maintenance records	Monthly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Reduction in air quality (dust, exhaust fumes)	BMSL shall ensure that only vehicles with pre-mobilization certificates are used to reduce emissions from vehicle exhaust	FMEnv Standards	Pre-mob certificates and statistics	Weekly	Monthly	BMSL Contractor Consultant	100,000

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implement ation (Naira)
		BMSL shall abide by all MOUs signed with the host communities	BMSL Policy	Records of compliance with MOU items	Monthly	Quarterly	BMSL Contractor	BMSL Management Cost
	Stress on existing security structures	BMSL shall ensure that both contractor and BMSL personnel develop a high level of security consciousness both within and outside the work area	None	Statistics of security breaches	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		Security reports shall reviewed by the BMSL Project Manager	BMSL Policy	Security reports	Weekly	Monthly	BMSL Contractor	BMSL Management Cost
		If required, special security force shall be established and deployed for the project.	BMSL Policy	Number of special security personnel on site	Weekly	Monthly	BMSL Contractor	BMSL Management Cost
		BMSL shall ensure that a liaison to foster partnership with the community so as to guarantee security for the project is established and sustained	BMSL Policy	BMSL- community meetings	Monthly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized	BMSL Policy	Records of security workshops	Monthly	Quarterly	BMSL Consultant	520,000

Table 7.4: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
	Increase in dust and noise	BMSL shall ensure that nose masks and earmuffs are worn by site workers during excavation	BMSL HSE Policy	SPM, records of respiratory diseases and noise levels	Monthly	Monthly	BMSL Contractor	Included in contractor Management Cost
		Water shall be sprayed on construction sites to reduce dust levels especially during dry season	AFD / World Bank Standards	Records on compliance, SPM at selected sites within 100m band	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Threat to health of workers (snake bites, insect stings, injuries etc)	BMSL shall provide and ensure usage of PPE by field workers	BMSL Policy	Compliance records	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that an adequate numbers of trained first aiders are available at work sites	BMSL Policy	First aid training records and statistics	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that anti-venom/anti-histamine is provided on site to mitigate snake bites and insect stings	BMSL Policy	Records of anti-venom/anti-histamine at site clinic	Monthly	2-monthly	BMSL Contractor	Included in contractor Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL shall ensure that awareness is created among site workers on the likelihood of exposure to poisonous wildlife and plants	BMSL Policy	Awareness records	Monthly	Monthly	BMSL Contractor	Included in contractor Management Cost
Influx of Labour and followers (dependents, bounty seekers, CSWs etc)	Changes in local population	BMSL will look into the development of off-site job by EPC Contractor to discourage influx of people.	None	Documentary evidence of implementation	3-months	6-monthly	BMSL Contractor	Included in contractor Management Cost
		Movement of unauthorized persons into construction camps shall be strictly restricted	BMSL Policy	Records of access control	monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
	Increase in morbidity (including STIs) and mortality	Health awareness on the mode of transmission of STIs (including HIV/AIDS)	None	Statistics of health awareness lectures	Intensive phase one to two months prior to mobilization and quarterly there after	Quarterly	BMSL SD Consultant	650,000
		As much as possible, psychological support shall be provided to persons living with the HIV virus	Government Policy	Records of HIV support programs	Quarterly	6-monthly	BMSL SD Contractor	Included in contractor Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		Immunization of workforce as appropriate	None	Records and statistics of immunization	During mobilization	Quarterly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall enforce Expatriate malaria policy	BMSL Policy	Compliance	Monthly	Annually	BMSL Contractor	Included in contractor Management Cost
		Vector control to reduce incidence of malaria such as regular spraying of site and provision of Insecticide Treated Nets (ITN)	BMSL	Records and statistics of ITN distribution	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
		Awareness campaign shall be carried out to enlighten the communities/field workers on the common communicable diseases and the health implications of drug and alcohol abuse, unprotected sex, prostitution and the need to sustain cultural values	None	Statistics of health awareness lectures	Monthly	Quarterly	BMSL Consultant	200,000
		Alcohol and drug policy shall be implemented to encourage healthy lifestyle for workers	BMSL Policy	Records of violations	Monthly	6-monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall support the activities of the state action committee on STIs/HIV/AIDS within the local communities	None	Records of supportive action	Monthly	Quarterly	BMSL	BMSL Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL shall provide site clinic to take care of minor illnesses for all workers	BMSL Policy	Statistics of attendance, morbidity and mortality	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall provide condoms for construction workers	BMSL Policy	Condoms availability to workers	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
	Increase in social vices	Intensive enlightenment campaign and health education for the abatement of abuse of drugs, alcohol in the communities and among workers throughout the life of the project	Law against smoking in public places and NDLEA Act	Enlightenment campaign/health education statistics; records of cases of abuse in the workforce	At least 3 months before commencement of construction activities then 6-monthly thereafter	Annually	BMSL Contractor Consultant	475,000
		BMSL shall ensure that contractor enforces the alcohol and drug policy for staff	BMSL Policy	Records of violation	6-monthly	Annually	BMSL Contractor	Included in contractor Management Cost
		BMSL shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS	None	Statistics of health awareness lectures	1 to 3 months before mobilization and then quarterly thereafter	Quarterly	BMSL	BMSL Management Cost
		BMSL shall support local security systems	None	Record of BMSL support	Quarterly	6-monthly	BMSL Contractor	BMSL Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL shall ensure that contractor implements social and health awareness programs for all workers at induction and on a continuous basis throughout the life of the project	BMSL Policy	Statistics of social and health awareness programmes	At induction and quarterly thereafter	Annually	BMSL Contractor	Included in contractor Management Cost
	Pressure on existing infrastructures and utilities	BMSL shall make adequate accommodation arrangement prior to mobilization of workforce to reduce pressure on local housing	Public Health Law (CAP 103); Building regulations code	Accommodation plan	3 months prior to mobilization	1 month to mobilization	BMSL EPC Contractor	Included in contractor Management Cost
		BMSL shall provide basic recreational facilities for workers within their camps	None	Number and types of facilities	Quarterly	6-monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall extend water supply from camps/worksites to communities at strategic points	None	Number of water stand points outside the camps	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
	Increase in inflation level	BMSL shall support skill development and enhancement of the local communities through training	None	Number of beneficiaries of skill acquisition	6-monthly	Annually	BMSL SD team	BMSL Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
	Changes in culture, lifestyle and habits	BMSL shall carry out enlightenment campaigns to encourage positive influences on cultural values and healthy lifestyles (e.g. breast feeding habits, alcohol and drug use, exercise, monogamy, high moral values with regard to sexuality etc) and discourage adverse influences (e.g. prostitution, drug abuse, alcoholism etc)	None	Records of enlightenment sessions	6-monthly	Annually	BMSL Consultant	750,000
Construction of Port facilities including Jetty	Increase in dust, noise and vibration	BMSL shall ensure that all construction equipment shall be in proper operating condition and fitted with factory standard silencing features if appropriate	None	Number of equipment fitted with such facilities; maintenance records	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall provide and enforce the use of PPE (e.g. nose masks and earmuffs)	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		Water shall be sprayed on construction sites to reduce dust levels especially during dry season	None	Records of compliance	Daily	Weekly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall construct sound proofing walls around stationary power generating sources at camps	BMSL Policy	Compliance	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
	Soil degradation	BMSL shall provide containment for chemicals and liquid discharges	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL waste management policy shall be enforced	FMENV and BMSL Policy	Waste collection records	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that a controlled fuelling, maintenance and servicing protocol for construction machinery at worksite is established and followed to minimise leaks and spills	BMSL Policy	Fuelling, maintenance and servicing record	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Injury to workers	BMSL shall carry out first aid training for workers	BMSL Policy	Training records	Monthly	Annually	BMSL Consultants	400,000
		BMSL shall provide and enforce appropriate use of PPEs (e.g. hard hats, eye goggles)	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure toolbox talks are held, prior to work activities	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Loss of biodiversity	BMSL shall limit cleared area to what is required	BMSL Policy	Compliance	Once during construction	Once during construction	BMSL Contractor	Included in contractor Management Cost

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL shall ensure that site clearing is commenced from developed (e.g. roads) to undeveloped areas to provide escape routes for wildlife	BMSL Policy	Compliance	Once during construction	Once during construction	BMSL Contractor	Included in contractor Management Cost

Table 7.5: Impact Management and Monitoring Plan – Construction

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL shall undertake to educate construction workers on the sensitive nature of the biodiversity of the area and the need for conservation	BMSL Policy	Records of enlightenment sessions	Monthly	Annually	BMSL	BMSL Management Cost
		BMSL shall ensure that hunting by employees of the contractors shall be prohibited	BMSL Policy	Plans for enforcement and records of violations	6-monthly	Annually	BMSL Contractor	Included in contractor Management Cost
	Reduction in air quality	BMSL shall ensure that all mobile and stationary internal combustion engines are properly maintained	FMEnv Standards	Maintenance records Compliance monitoring	Monthly	Annually	BMSL Contractor	Included in contractor Management Cost
Waste generation and disposal	Increase in breeding ground for disease vectors and other agents of diseases	BMSL waste management policy shall be enforced	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Increase in Nuisance effect	BMSL shall enforce adequate waste management on site	Public Health Law (CAP 103), BMSL Policy	Compliance	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
	Blockage of natural drainages	BMSL shall ensure that wastes are disposed of at appropriate locations provided for waste disposal and collected as quickly as possible	Public Health Law (CAP 103), BMSL Policy	Compliance	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
	Pressure on existing waste management system	BMSL shall explore ways to assist the communities in managing wastes	Public Health Law (CAP 103); BMSL Standard	Records of supportive action	Quarterly	Annually	BMSL SCD team	BMSL Management Cost

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
	Loss of flora and fauna	Hunting by the workforce shall be prohibited	BMSL Policy	Compliance records	Weekly	Monthly	BMSL Contractor	NA
		BMSL shall educate construction workers and host communities on the sensitive nature of the biodiversity of the area and the need for conservation	BMSL Policy	Records of HSE meetings and community enlightenment sessions	Weekly	Monthly	BMSL Consultant	450,000
	Community unrest	BMSL shall ensure that all host communities are represented in the employment of locals during land clearing and excavation to avert any conflict that could arise from perceptions of unfairness	BMSL Policy	Employment records for locals	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that land clearing and excavation jobs are reserved exclusively for the host communities	Government Policy	Employment records for locals	Weekly	Monthly	BMSL Contractor	NA

Table 7.6: Impact Management and Monitoring Plan – Operation and Maintenance

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspection/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
Operation and Maintenance	Increase in noise levels	BMSL shall encourage Community members not to settle near the Port facility fence	BMSL Policy	Visual monitoring of the level of encroachment	3-monthly	6-monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall maintain sound barriers around noisy equipment	BMSL Policy	Visual monitoring of compliance	3-monthly	6-monthly	BMSL Contractor	Included in contractor Management Cost
	Potential for erosion around the Jetty or Facility	BMSL shall utilize onsite drainage system to collect runoff from all impervious onsite location	BMSL Policy	Compliance	6-monthly	Annually	BMSL Contractor	Included in contractor Management Cost
	Reduction in air quality	BMSL shall ensure that appropriate maintenance programs are in place for all equipment	BMSL Policy	Maintenance Records	6-monthly	Annually	BMSL Contractor	Included in contractor Management Cost
	Degradation of soil and surface water from spills and leaks	BMSL shall provide containment for chemicals and liquid discharges	BMSL Policy	Compliance	Quarterly	6-monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that Chemicals/fuel are stored in lined bounded areas in sealed containers with rain protection	BMSL Policy	Compliance	Quarterly	6-monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that a controlled fuelling, maintenance and servicing protocol for operation machinery at worksite is established and followed to minimise leaks and spills	BMSL Policy	Compliance	Quarterly	6-monthly	BMSL Contractor	Included in contractor Management Cost

Table 7.4: Impact Management and Monitoring Plan – Operation and Maintenance

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
		BMSL waste management policy shall be enforced	BMSL Policy	Compliance(waste consignment notes)	Quarterly	6-monthly	BMSL Contractor	Included in contractor Management Cost
	Relative drop in economic activities	BMSL shall support skill development and enhancement of the local communities through training as agreed in the SCD plan	BMSL Policy	Compliance with MOU/SCD plan	Quarterly	Annually	BMSL SCD team	BMSL Management Cost
Port facility	Degradation of soil and surface water from spills, leaks and fire	BMSL shall maintain clean-up equipment at site	BMSL Policy	Audit/ inspection reports	6-monthly	Annually	BMSL Contractor	Included in contractor Management Cost
		Emergency response shall be activated when necessary	BMSL Policy	Emergency drills statistics	6-monthly	Annually	BMSL Contractor	Included in contractor Management Cost
	Threat to health of workers(snake bites, insect stings, injuries etc)	BMSL shall ensure that fully equipped first aid boxes and trained first aiders are available on site at all times in addition to a functional site clinic	BMSL Policy	Records of inventories of first aid boxes, and health records from site clinic	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall enforce appropriate use of personal protection equipment (PPE)	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost

Table 7-7: Impact Management and Monitoring Plan – Decommissioning and Abandonment

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party	Budget for implementation (Naira)
Building and equipment dismantling, Excavation, Removal and Disposal of concrete works and steel	Increase in dust generation	BMSL shall ensure proper use of appropriate PPE	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure that water is sprayed to reduce dust levels	None	Records of Compliance	Daily	Weekly	BMSL Contractor	Included in contractor Management Cost
	Increase in noise levels	BMSL shall inform communities in advance of likely increase in noise level during decommissioning	FMEnv Standard	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall ensure proper use of PPE (ear muffs)	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Increase in respiratory tract diseases	BMSL shall ensure that all personnel are medically certified for the operation prior to engagement	BMSL Policy	Compliance	Monthly	Annually	BMSL Contractor	Included in contractor Management Cost
		BMSL shall enforce appropriate use of PPE (nose mask)	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall use barriers to minimise the spread of dust	None	Compliance Record	Monthly	Quarterly	BMSL Contractor	Included in contractor Management Cost
	Increase in waste generation	BMSL shall ensure that Scraps are disposed of in accordance with her waste management plan for this project	BMSL Policy	Compliance	Weekly	Monthly	BMSL Contractor	Included in contractor Management Cost
	Potential for community unrest (from employment, pollution and resistance to dismantling of equipment)	BMSL shall ensure fair community representation in the employment of local labour	None	Employment Records	Quarterly	Six – monthly	BMSL Contractor	Included in contractor Management Cost
		BMSL shall abide by the MOUs signed with the communities for this project	Contractual	Compliance with MOU items	Yearly	Once during de-commissioning	BMSL Contractor	Included in contractor Management Cost

7.16 Managing Stakeholder Perceptions

Public interest in this project is expected to be high. The project will have impacts on the surrounding communities especially during construction and operation (e.g. noise, traffic, dust, emissions etc) and from the influx of workforce. Effective and realistic measures to mitigate/enhance these impacts have been proposed. Nevertheless, stakeholder perceptions are bound to persist, so a social action/stakeholder following actions amongst other others.

- BMSL shall ensure that the communities are involved in the environmental monitoring and management plan for this project.
- BMSL will identify primary and secondary stakeholders
- Use available records on community development and other community-based activities as evidence of a good corporate neighbor.
- Nominate Community Relation units to receive complaints
- Develop grievance solution mechanism.

7.17 Environmental Monitoring

Environmental monitoring programs for this sector shall be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities shall be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the proposed Port facility project. Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored. Monitoring shall be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data shall be analysed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. The overall objective of (performance) monitoring shall be to identify any unanticipated changes to the biophysical, health and social environment brought about by the proposed Transmission Line and associated facilities Project. Baseline information against which development and post development impacts and mitigation measures can be measured and compared

has been established. BMSL shall ensure that deviations from the baseline beyond reasonable limits shall trigger corrective actions so that monitoring becomes a dynamic activity as opposed to passive collection of data. This Environmental Monitoring Plan has been formulated with the aim of ensuring that all the identified significant impacts from the project are mitigated to as low as reasonably possible and that key performance indicators are monitored periodically to track how effectively mitigation measures are implemented. It specifies the mitigation measures, monitoring requirements, duration and frequency of the monitoring, and the action parties to manage the biophysical, social and health environment at the various phases of the project. Tables 7.4 present the impact management and mitigation plan at the various stages of the project. In formulating this plan, care has been taken to ensure that BMSL complies fully with FMEnv regulatory control measures; international best practice and self-imposed standards. In addition, the plan also provides for measures to mitigate indirect impacts of the project that may result from influx of people into the project area as well as practical proposals for the enhancement of significant positive impacts. The national regulatory agencies in conjunction with the relevant states and local government authorities shall conduct routine impact mitigation monitoring visits as and at when due. It is recognized that many of the host communities lack basic infrastructure and have needs that though unrelated to the project, have generated concerns from stakeholders. These and related issues have been considered in a separate section on Community Development. Once this proposed Environmental Monitoring Plan has been reviewed, it shall be prepared as a stand-alone document and signed by the asset manager. This is to ensure ownership and implementation of the EMP and shall be updated as results of monitoring.

Table 7.8: Key Monitoring Parameters

Environmental component	Description of Impact	Parameters to Monitor	Monitoring Frequency	Detection Limit (if applicable)	Responsibility / Action Party	Supervision
Air quality/Noise	Impairment of air quality	CO, VOCs, NO, CO_2, SOx, H_2S and SPM	Quarterly	FMEnv limits	BMSL & Consultant	FMEnv
Aqueous Effluent	Surface water pollution	Salinity, DO, TSS, TDS, pH, Turbidity, BOD, COD, Heavy metals, Oil & Grease	Monthly	FMEnv, limits	BMSL & Consultant	FMEnv
Groundwater quality	Seepage /percolation	Ground water physicochemical properties (pH, turbidity, EC, TDS, Salinity, Na, Ca, Mg) and heavy metals (Pb, Fe and Ni)	Quarterly	FMEnv, limits	BMSL & Consultant	FMEnv
Waste	Facility pollution	Segregation, collection, removal, disposal, (Heavy metals, Oil & Grease)	Daily/ Quarterly	FMEnv, limits	BMSL & Consultant	FMEnv
Welfare	Occupational health	PPE, Health	daily	International standards	BMSL & Consultant	FMEnv

CHAPTER EIGHT
CONCLUSION AND RECOMMENDATION

This EIA study was conducted to assess the potential impacts of the activities of the proposed Bestaf Marine Services Limited Port Facility Project on the biophysical, social and health components of the environment. This study was carried out in accordance with relevant local and international regulations based on FMEnv approved terms of reference. The methodology applied for the study involved desktop studies, reviews of existing data and fieldwork including community consultations. To achieve this objective, a multi-disciplinary approach was adopted in the assessment of the environmental status and sensitivities of the various ecological components of the project area using extensive literature, one season field sampling, measurements/testing as well as quantitative and qualitative analysis.

The biophysical characterization of soil, surface water and sediment around the project area showed that the soil, surface water and surficial sediment were consistent across sampling stations and compared well with values recorded in previous studies around similar environments in Port regions of Lagos State, Nigeria. The EIA of the project shows that it would have a significant beneficial impact on both local and national economy. The identified adverse impacts were generally short-term and can be prevented, reduced, ameliorated, or controlled if the recommended mitigation measures are implemented. Further, an Environmental Management Plan (EMP) has been developed to ensure effective implementation of prescribed mitigation measures and for proactive environmental management throughout the life of the project. The EMP should therefore form the basis for the actual project implementation and future monitoring of environmental components. It is concluded that the execution of the activities of the proposed Project will not cause damage to the environment if the EMP is implemented. The approval of this EIA report for the execution of the proposed project is hereby recommended.

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