NIGERIA CONTENT DEVELOPMENT AND MONITORING BOARD

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT FOR THE PROPOSED BRASS ISLAND SHIPYARD AT BRASS ISLAND, BRASS LOCAL GOVERNMENT AREA, BAYELSA STATE.

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SUBMITTED TO

FEDERAL MINISTRY OF ENVIRONMENT, ABUJA

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ABUJA NIGERIA

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LIST OF ABBREVIATIONS, SYMBOLS AND ACRONYMS

%	Percentage
AAS	Atomic Absorption Spectrophotometer
AGO	Automotive Gas Oil
ALARP	As Low As Reasonably Practicable
ANSI	American National Standard Institute
APHA	American Public Health Association
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ATK	Aviation Turbine Kerosene
BAT	Best Available Technology
BOD	Biological Oxygen Demand
BOD	Basis of Design
BRV	Bulk Road Vehicles
BS	British Standards
BYS	Bayelsa
Ca^{2+}	Calcium ion
CDC	Community Development Committees
CFR	Code of Federal Regulation
CG	CORE global services limited
CITES	Convention on International Trade in Endangered Species

Cl^-	Chloride ion
cm	centimeter
CO	Carbon Monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
CO_X	Oxides of Carbon
Cr	Chromium
CSR	Concept Selection Report
Cu	Copper
DBA	Decibel unit (a weighted factor)
DO	Dissolved Oxygen
DPK	Dual Purpose Kerosene
DPR	Department of Petroleum Resources
EC	Electrical Conductivity
EGASPIN	Environmental Guidelines and Standard for Petroleum Industry in Nigeria
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	European Standard
ESIA	Environmental and Social Impact Assessment
Fe	Iron
FEPA	Federal Environmental Protection Agency

FMA	Federal Ministry of Aviation
FMENV	Federal Ministry of Environment
ft	feet
g	gramme
GPS	Global Positioning System
Hg	Mercury
HSSSE	Health Safety Security Social and Environment
HUBC	Hydrocarbon Utilising Bacteria Count
HUF	Hydrocarbon Utilising Fungal
HUFC	Hydrocarbon Utilising Fungal Count
Irre	Irreversible
ISO	International Organization for Standardization
ITD	Inter- Tropical Discontinuity
IUCN	International Union for Conservation of Nature
K^+	Potassium ion
KCl	Potassium Chloride
KH_2PO_4	Potassium Hydrogen Phosphate
m	metre
m^2	Square metre
mg/l	milligram per liter
Mg^{2+}	Magnesium ion

ml	milliliter
NCDMB	Nigerian Content Development and Monitoring Board
Ni	Nickel
NIMET	Nigerian Meteorological Agency
NOx	Oxides of Nitrogen
NTU	Nephelometric Turbidity Units
OSHA	Occupational Safety and Health Administration
Pb	Lead
pH	Hydrogen ion concentration
PMS	Premium Motor Spirit
PMT	Project Management
PO_4^{3-}	Phosphate ion
ppm	parts per million
QHSE	Quality Health Safety and Environment
Rev	Reversible
ROW	Right of Way
µS/cm	Micro Siemens per centimeter
SO_4^{2-}	Sulphate ion
SON	Standards Organisation of Nigeria
SONCAP	Standards Organisation of Nigeria Conformity Assessment Program
SOW	Scope of Work

SOx	Oxides of Sulphur
SPM	Suspended Particulate Matter
STN	Station
SWL	Safe Working Load
TDS	Total Dissolved Solids
TFC	Total Fungal Count
THBC	Total Hetrotrophic Bacteria Count
THC	Total Hydrocarbons
THF	Total Hetrotrophic Fungi
TOC	Total Organic Carbon
TOR	Terms of Reference
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
V	Vanadium
VOC	Volatile organic carbon
WHO	World Health Organization
Zn	Zinc

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EXECUTIVE SUMMARY

The Proponent

The Nigerian Content Development and Monitoring Board (NCDMB) was established in 2010 by the Nigerian Oil and Gas Industry Content Development (NOGICD) Act. NCDMB is vested with the mandate to make procedures that will guide, monitor, coordinate and implement the provisions of the NOGICD Act signed into law on April 22, 2010. One of the key functions of NCDMB is to engage in targeted capacity building interventions that would deepen indigenous capabilities-Human Capital Development, Infrastructure and Facilities, and Manufactured Materials and Local Supplier Development. The NCDMB headquarters is located at Nigerian Content Tower, Oxbow Lake Road, Swali, Yenagoa, Bayelsa State.

Project Overview

The proponent intends to establish a shipyard at Brass Island, Brass Local Government Area of Bayelsa State, Nigeria. The sole aim is to provide maintenance and repair services for cargo vessels, oil tankers, and Liquefied Natural Gas (LNG) carriers which are highly expected to increase with the completion of the implementation of the Nigeria LNG's Train 7 project. The Nigeria LNG's Train 7 project is expected to increase the company's Liquefied Natural Gas capacity from 22MTPA to 30MTPA and induce the acquisition of additional LNG carriers to the existing ones, all of which would need maintenance and servicing. The proposed Shipyard project shall principal amongst other things serve as a mooring and ducking facility and it is envisaged to boost economic activities within the subregion. The Brass shipyard project would further develop and harness the nation's position in the oil and gas value chain and linkage to other sectors of the economy.

Objectives of the Study

The objectives of the study include:

- to establish the baseline ecological conditions of the proposed Shipyard project area at Brass Island, Brass local Governement Area of Bayelsa State;
- to use the baseline data to describe and characterize the study area;
- to establish the environmental sensitivities prevalent in the area;
- to identify, quantify, and assess the likely negative and positive environmental impacts of the project as presently designed;
- to identify, evaluate, and predict the impact of the proposed Shipyard project on the ecological and socio-economic settings with adequate interfacing and project interaction;
- to identify existing and expected environmental regulations that will affect the operations and advise on standards, concepts and targets;
- to identify any environmental issues and concerns that may, in the future, affect the successful operation of the project;
- to develop control strategies with a view to mitigating and ameliorating significant impacts that the proposed Shipyard projects would have on the totality of measurable environmental characteristics;
- to develop an effective Environmental Management Plan (EMP) to last the life-span of the project including compliance, monitoring, auditing and contingency planning.

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Legal and Regulatory Framework for EIA in Nigeria

The legal and regulatory framework within which the proposed Shipyard project by NCDMB at Brass Island, Brass Local Government, Bayelsa State shall be executed is entrenched in the broader framework of international, national and local laws and statutes applicable to infrastructures and environment in Nigeria. These include:

- All applicable International Agreements and conventions to which Nigeria is a signatory.

- The regulations, standards, codes and recommended practices of the Federal Ministry of Environment (FMENV).
- The regulations, standards, codes and recommended practices of Bayelsa State Ministry of Environment.
- NCDMB HSSSE Policy

Need for the Project

The proposed project is an initiatives to promote participation and increase capacity of local shipyards to build, service and maintain marine vessels of various sizes and not excluding manufacturing of vessels components and consumables in-country.

Project Benefits

On completion, the benefits of the proposed Project are numerous and cannot be over-emphasized. Some of the benefits of the project include:

- Provision of huge opportunity to retain substantial value in-country through the provision of dry-dock services.
- It will develop and harness the nation’s position in the oil and gas value chain and linkage to other sectors of the economy.
- Improve the standard of living of Nigerians and therefore enhance socio-economic development of Nigeria.
- Ensure gainful employment of Nigerian/host-community

Project Description

The proposed Shipyard project is to establish a commercially viable ship repair/ship building yard with graving and floating dock capabilities to dry dock LNG carriers, Tanker vessels and container ships of up to 300 meters L.O.A. The project site covers about 10 hectares. The Brass Shipyard will serve as hub for ship-building and repairs. The project includes using components that are constructed both off and on-site. The onsite work will involve specialized areas and equipment. The off-site work involves pre-fabrication such as assembling components of a structure in a manufacturing site and then transporting those parts to the construction or building site. The construction scope mainly consist of fitting out quay, tug berth, revetement, graving dock, ship-repairing area, buildings and other supporting facilities.

Project schedule

The construction phase of the proposed Brass Shipyard project is schedule driven with the target completion date set at first (1st) quarter of 2023, following the receipt of all necessary approvals and permits from the government. The schedule will be revised if the need arises.

Baseline Conditions

Data Acquisition Methods

Prior to the commencement of the field data gathering process for the ecological baseline data acquisition, a reconnaissance visit was carried out to project area and host communities by the study team lead to firm up sampling strategies, identifies representatives of the host communities that will join the team as local labour and identify options for logistic planning in order to have a hitch-free field campaign. The consultation process that has started at this reconnaissance visit will be maintained throughout the various phases of the study and project execution. The field data gathering activities was carried out between 20th and 21st September, 2021 for wet season while dry season data was gotten from Okpoama Tank farm EIA project executed by Lympson Leosentino Limited, January, 2021

Summary of Sample Type and Field Method of Collection

SAMPLE TYPE	METHOD OF COLLECTION
Soil Samples/Land use	Dutch Stainless steel hand auger, Shovel, Core Samplers, Interviews, and Direct Observation
Air Quality and Noise	Electronic air quality monitor, Aeroqul air quality kit, Noise meter
Meteorology	Literature Survey, Field Studies with Rain Gauge, Thermograph, Wind Vane
Vegetation	Transects, key Informant Interviews, Direct Observation and sample collection
Wildlife	Direct Observation, Key Informant Interviews and indirect count method
Sediment	Sediment Grab sampler
Surface Water	Water Samplers
Hydrobiology/Fisheries	Collection with Plankton Net, observation of fish landing
Geology/Hydrogeology	Ground water sampling using Teflon water sampler

All field data gathering methods and laboratory analytical procedures for all the environmental parameters are as stipulated by the Federal Ministry of Environment. Also, adequate measures put in place to ensure quality assurance and control of samples collection, handling/preservation, and analytical procedures. All personnel involved in the study were given daily safety briefings, and kitted in appropriate working gear to forestall any near misses.

Existing Baseline Conditions

Climate and Meteorology

The climatic factors considered include temperature, rainfall, relative humidity, wind speed and direction. The study area is located completely in the semi-hot equatorial zone. The climate here reflects conditions of the equatorial rain forest where the temperature and humidity are high all the year round. Also, high and persistent is the amount of rainfall that even in the dry months characterizes the proposed project area. In addition to meteorological data obtained from literature, meteorological parameters such as, wind speed, wind direction, humidity, atmospheric pressure, and temperature were observed during the fieldwork. The measurements reveal low wind speed (0.4-2.4m/s) and predominance SW and NE wind directions with high relative humidity.

Air Quality and Noise Levels

The observed air quality data of the study area was within permissible limits recommended by The Department of Petroluem Resources (DPR) and Federal Ministry of Environment (FMEnv). CH_4, NO_2, SO_2, O_3, H_2S and CO measured during the dry season were less than 0.01ppm in most sampling station while SPM ($PM_{2.5}$ and PM_{10}) ranged from 17.8µg/m^3 to 53.4µg/m^3 which were relatively above standards except for point AQ 7. The wet season data were relatively low with the highest value of 20 µg/m3 obtained at control point 1 at Okpoama community and the lowest value of 10 µg/m3 obtained at Point 7, in the project site. The wet season data showed less emission of particulate matter compared to dry season data. The mean data obtained during the dry season for VOCs within the study area were 4.5ppm highest value and <0.01ppm lowest values at five locations (AQ4, AQ5, AQ6, AQ C1 and AQ C2), inclusive of the two control locations which are also similar to the results obtained for wet season studies. The wet season mean VOC data were relatively lower at all points ranging from 0.2ppm to 2.4ppm less than the FMEnv, NESREA, and EGAPSIN 2018 standards. The noise levels recorded in the dry season study (45.4-57.8 dB(A)) while that of wet season were ranging from 39.4-52.9dB(A)are within national regulatory limits.

Surface Water

The main water body in the the study area is Okpoama River from which surface water samples were collected for analysis. The water body in the proposed study area is tidal and fresh. During the dry season, the sampled surface water had pH in the range 6.94-7.12 thus being slightly acidic in some stations and slightly basic in others. While the wet season values for pH ranged from 7.6 to 8.6 which is more alkaline compared to the dry season study.

However, the recorded pH range is suitable for the survival of freshwater fish and bottom dwelling invertebrates. The recorded electrical conductivity values for dry season were in the range of 30440-34360 µS/cm while it ranged from 6500-11700µS/cm for wet season. TDS for dry season study ranged from 16742-18898mg/L while for wet season ranged from 3200 to 5900mg/L revealing the salt water intrusion. DO and BOD values for dry season ranged from 6.9-7.3mg/L, and 1.8-2.4mg/L respectively while that of wet season ranged from 3.6 to 6.5mg/L and 1.6 to 2.4mg/L respectively. Turbidity values for dry season ranged from 81.5-339NTU and 135.1-191.7NTU for wet season. Also, total hydrocarbon levels, PAH and BTEX were below detection limit for both dry and wet season studies.

Heavy metals contents were low in the sampled waters. The results for heavy metals in the surface water are: Fe ranged 0.74-2.16mg/l (dry season) and below detection limit for wet season. While Zn ranged 0.12-0.18mg/l (dry season) and 0.019 to 0.045mg/l (wet season). However the concentration of barium, arsenic, lead, chromium, vanadium, and mercury were below equipment detection limits of 0.001mg/l for both dry and wet season. The dry season values for nickel, copper, and cadmium ranged between 1.49-1.77mg/L, 0.03-0.05mg/L and 0.12-0.14mg/L respectively while the values for wet season for nickel and cadmium were below equipment detection limits. Copper was not measured during the wet season.

Analysis result of surface water samples collected in the proposed project area for dry season indicated that the total heterotrophic bacteria (THB) count in the surface water samples ranged between $1.4 \times 10^4 – 4.8 \times 10^4$ cfu/ml and $5.11 \times 10^8 – 7.83 \times 10^8$ cfu/ml for wet season. The predominant bacterial species were Staphylococcus spp., Pseudomonas spp., Streptococcus spp., and Escherichia spp. The microbial load of HUB in the surface water body was not detected for both dry and wet season studies.

Analysis result of surface water samples collected during the dry season from the sampling stations in the study area indicated that the total heterotrophic fungi (THF) count in the surface water samples ranged between 1.0×10^2 - 3.5×10^2 cfu/ml while that of wet season ranged from from 0.01×10^2 to 1.52×10^2 cfu/ml. The microbial load of HUF in the surface water body was not detected in during the dry season study while that of wet season ranged from 2.18×10^5 to 3.27×10^5 cfu/ml.

Sediments

The analysis shows that for dry season, the value for pH were slight acidic and ranged from neutral 5.68-6.29 which is within DPR permissible limits of 6.6-9.5 unlike the values for wet season which ranged from 6.3-7.4. Also, the electrical conductivity, ranged from 49920 to 58800 µs/cm (dry season) and 4.68 to 11.12 µs/cm during the wet season study.

The concentrations of heavy metals in the sediment samples for dry seasons: Fe (297.5-768.75mg/kg); V (0.1 – 0.4mg/kg); Cu (04.86-8.50mg/kg), Ni (1.85-6.15mg/kg) and Zn (30.73-39.75mg/kg). In wet season, the results of analysis ranges as follows: Fe (5628.72-7603.76 mg/kg); V (<0.001mg/kg); Cu (0.157-0.571mg/kg), Ni (0.053-0.172mg/kg) and Zn (21.762-31.524mg/kg) which were above the DPR threshold limits except for Vanadium (V) was below detection limits for both dry and wet season studies.

Hydrobiology

Phytoplankton

A total of 58 taxa comprising of 311860 individuals were recorded. The overall abundance of phytoplankton among the stations shows that station 1 had the lowest abundance and the highest was recorded in station 4.

Bacillariophyta dominated the collection with 31.03% of the total taxa and 66.33% of the total number of individuals. The rest of the taxa were composed of the Chlorophyta, Euglenophyta, Cyanophyta and Dinophyta. Euglenophyta was ranking next to Chlorophyta, found throughout the stations except in control stations 2.

Zooplankton

The zooplankton population comprises of about 1.4% and 11.5% of the plankton population in Brass and Okpoama River area. Copepods dominated the Zooplankton collection with 16.67% of the total taxa and 46.22% of the total number of individuals. The rest of the taxa were composed of the Cladocera and Rotifera. Rotifera has least abundance only found in control station 1, ranking next to Cladocera in same control station and station 1, but copepods have representatives in all the stations

Soil Studies

The particle size analysis, expressed as fractions (Sand, Silt and clay) of the dried mineral matter based on PSD analysis of the soil samples showed that sandy soil predominates the study area. The values of surface soil reaction (pH) ranged from strongly acidic (pH 2.97) to acidic (pH 5.31) across the study areas. The studied soils are, therefore, predominantly acid soils. While that of the bottom soil ranged from 2.97-5.31. While during the wet season, the soils were slightly acidic to neutral (with values that range from 5.2-7.4 for top soils and from 5.4-7.8 for the sub-surface. The values of total nitrogen contents during the dry season study across the soils were low (0.17-0.44%) for topsoil while 0.08-0.37% for bottom soil. While for wet season, total nitrogen contents was measured. The exchangeable cations of sampled soils across the established transects indicated that the exchange complex is dominated by Na^{+}, followed by Ca^{2+}, Mg^{2+}, and K^{+}, in that order for dry season which was not measured for wet season.

Extreme values of electrical conductivity for dry season study, across soil samples, ranged from 142-15295µS/cm and 145-13755µS/cm for top and bottom soil respectively while that of wet season ranged from .09-1.69µS/cm for top soil and 0.13-3.62µS/cm for bottom soil. The heavy metal profile of soil samples across all sampled soils of the study area indicated the dominance of Mn, Zn and Fe. However, the results indicated low values when compared to corresponding naturally occurring soil concentrations reported by Allen, *et al* (1974).

Geology/Hydrogeology

The study area (NCDMB Proposed Shipyard at Brass Island), Brass Island lies on Quaternary-Recent sediments known as the Mangrove swamp deposits which are marked by superficial dark organic, greyish brown, peaty clays and sandy silts (Ekundayo, 2006) which are underlain by fine to medium grained sands. The deposits overlie the major subsurface lithostratigraphic units of the Niger Delta which from bottom to top are the Akata, Agbada and Benin Formations.

The geomorphology of the area is characterized by low, flat lands which are bordered by the Brass River.

The groundwater is pH values ranging from 6.64-6.87at an average temperature of 31.7°C during the dry season while it ranges from 6.9 to 7.7 with an average temperature of 27.93 °C duing the wet season. TDS values ranged from 1291-1887mg/L (dry season) and 3100 to 16600mg/L (wet season). Total suspended Solids concentrations range from 18.31mg/L-21.15mg/L (dry season) and 60 to 120mg/L (wet season). The heavy metals concentration revealed that Pb, Cd, Cr, Ba, V, and Hg were not detected in the groundwater samples for dry season while for wet season, Ni, V, Pb, Ba, and Hg were not detected in the groundwater samples. However, the level of Zn ranged between 0.01 and 0.04 mg/l (dry season) and 0.017-0.071mg/l (wet season) while that of Iron ranged from 0.47mg/l to 0.71mg/l (dry season) and 0.009-0.821mg/l (wet season).

The study area also indicated that the total heterotrophic bacteria (THB) count in the ground water samples ranged between 1.3 x 10^4 – 2.0 x 10^4 cfu/ml (dry season) and 2.54 x 10^8 to 3.06 x 10^8 cfu/ml (wet season). The microbial load of HUB in the ground water samples was not detected during the dry season but for wet season, the HUB ranged from 1.42 x 10^5 to 1.92 x 10^5 cfu/ml. The predominant total heterotrophic fungal (THF) species in the ground water samples of the area were *Penicillium spp.*, and *Aspergillus spp.*, with counts that ranged between 1.0x10^2 – 2.1 x 10^2 cfu/ml (dry season) and .4 x10^3 to 0.9 x 10^3 cfu/ml (wet season). The microbial load of HUF in the ground water samples was not detected during the dry and wet season studies.

Vegetation and Wildlife Studies

The vegetation mainlyconsist of three (3) layers of vegetation. The densest being the middle/canopy with trees between 14 -26 meters in height forming a closed canopy and allowing little sunlight penetration to the forest floor. This layer also hosts a rich community of epiphytes and lianas. The emergent layer consists of fewer sparsely distributed giant trees towering above the canopy layer reaching between 32-43meters in height, with trunk girths of 3 meters and above. Some of the plant species in this area include: *Avicennia germinans* (Black mangroves), and *Avicennia marina* of the Family Avicenniaceae; *Laguncularia racemosa* (White mangrove) of the family Family Combrataceae; *Rhizophora mangle* (Red mangroves); *Rhizophora racemose, Rhizophora Africana, Rhizophora mucronata* (Loop-root mangrove), *Rhizophora stylosa* (Stilted mangrove), *Ceriops tagal*, *Avicennia germinans* (Black mangrove), *Calamus sp* (Rattan palm), *Elaeis guineensis* (oil palm), and *Cocos nucifera* (coconut palm), *Acrostichum speciosum* (Mangrove fern), *Acrostichum aureum* (Golden leather fern) and so on.

The wildlife inventory for the study area was carried out by the use of pitfall traps, examining the animal footprints, droppings, interview with local hunters, etc. The studies revealed the presence of some mammalian, avian, amphibians, mollusks and reptile species. Significant among the species include: insects, Antelopes, Sunbirds, Weaverbird (*Pleisisositaara spp*), kites, Cattle egrets (*Ardeola ibis*), Doves, Fruit pigeon, Parrot, etc.

Land Use

In the study area, Land in the proposed NCDMB Brass Shipyard stakeholder community is an invaluable resource. Traditionally, these have been used over the years for housing, and in more recent times there have been additional uses for infrastructural development and industrial purposes. However, the main land use structure at the proposed site are; agricultural 0.0%; Industrial 5.0%; Housing Development 70.0%; Institutional (Infrastructure) 5.0%; Loss from natural factors 20.0%.

Socio-Economic Studies

The identified stakeholder's community in the proposed NCDMB Brass Shipyard are Okpoama and Twon-Brass. The communities are of Ijaw ethnic nationality. Okpoama and Twon-Brass is a Kingdom on their own with other constituent villages and fishing camps that make-up the Kingdoms. Okpoama and Twon-Brass town is under the local government jurisdiction of Brass Local Government Area of Bayelsa State. The communities are predominantly inhabited by the Ijaw ethnic group of Bayelsa State with other ethnic nationalities living with them; like Ilajes, Efiks, and Hausas etc. Brass Local Government headquarters is in Twon-Brass town with an area of 1,342km², a Density of 183.4/km^2 and a population of 184,127 based on the 2006 National Population Census figures, projected at 246,100 in 2016 and current year 2021 projected at 288,076 using 3.2% annual growth rate.

Returned responses from administered questionnaires of the surveyed community revealed on average some 34.7% to be of single marital status while over one half (52.5%) were married persons**.** The percentage of respondents divorced, separated from their spouses and those widowed amounted to some 12.8%, implying that the vulnerable proportion is comparatively low.

The household structure in the proposed NCDMB Brass Shipyard project stakeholder's community' parallels the patriarchal leadership structure of most Nigerian ethnic groups. The majority (82%) of households in Nigeria are headed by men, with only 18% headed by women. The age distribution of respondent is dominated by youth ranging between 20–49years (60.4%). About 30.3% were found to fall within the age bracket of 50–69 year while above 70 years accounted for only 6.7% and respondents less than 20years account for 2.6%.

Women have an average of 5 children and average household size approximates to 5.3. If other dependants living in the households are added, (a minimum of 2 and maximum of 5 was reported within the community), household size now comes to 10. This trend of large household sizes can be attributed to several reasons in the study community in particular and the South-South (Niger Delta) region as a whole. For instance, people marry at a relatively early age thereby extending their period of child bearing. On the other hand, the men marry more than one wife (i.e polygamy) as well as keep other concubines. On the average, about 55.7% of the sampled respondents are married while about 26.7% are single. Widows' people account for about 9.2%, Divorced 3.9% and Separated 3.9%. This is in conformity with the Bayelsa State marital status where the married and single are higher with 27.8% and 63.6% respectively as depicted

The age and sex demographic classification variables shows that children aged 0-4 years (infants) is about 12.1% of the household members and children aged 5-12 years (primary school age) makes-up about 12.1% of the population. The age range of 13-18 years (Secondary school age) is about 15.8% while 19-25years (Tertiary education) made up of

18.4%. Also 25.6% make up 26-59 years (active working proportion) and the aged (60 years and above) make up 16% of the household composition. The socio-economic data also indicates that most of those surveyed are adults of at least 20 years old (2.6%). On the average, about 22.4% and 66.4% of the communities' respondents were respectively in the 20-39- and 40-59-years age brackets, 36.5% were aged 40-49; 29.9% (50-59) while 11.2% were aged 60+ years and above.

The educational status of Okpoama community depicts that some of the population has formal education indicating a literate society. The common classes of educational attainment among the sampled population are the tertiary, post primary and primary education. On the average, 8.4% of the respondents had tertiary education training. Those with post primary (secondary) and primary education accounted for 47.6% and 20.9% respectively. The possession of vocational/technical education among the sampled population is quite high (14.3%) and this is good on occupational skill needed for prospective employment positions that may be offered to members of the communities. Those of NFE constitute 6.5% and 2.3% others. The educational attainment of the studied community is in conformity with the Bayelsa State educational attainment where the bulk of attainment is in secondary educational level.

The livelihood of the community in the study area depends much on their natural resource-based traditional occupations. Fishing is obviously the major occupation practiced, supplemented with other agriculture-based enterprises such as fish farming and fish smoking. Most of these activities are carried out at subsistence level. Apart from the traditional occupation, other income generating activities identified include petty trading, contracting, boat transportation/driving, and technical and artisan works (tailoring, welding, electrical works, and carpentry). In addition, there are few company workers and civil servants as well as teachers in local schools in the area. All of these other economic engagements have affected traditional fishing. As a consequence, contrary to expectations, the percentage of people currently depending on fishing appears to be dwindling as the years pass on.

Responses from administered questionnaires revealed the mean monthly incomes within Okpoama Kingdom is ₦34, 224.14 and Twon-Brass ₦34,207.32. The modal income bracket across the community is ₦30, 000.00 - ₦35, 000.00. Given the mean income values and assuming naira to United States of America dollar (USD) conversion rate of ₦480: 1USD and 30 days in a month, the daily individual incomes will be ₦1,140.80 or 2.40USD in Okpoama Kingdom and ₦1,140.24 or 2.40USD. Using the midpoint of the modal income range (i.e., ₦32, 500) individual daily incomes in the communities will be N1, 083.33 or 2.25USD. Daily incomes in the communities are higher than the World Bank extreme poverty income of 1.9USD.

Household expenditure and consumption pattern gleaned from FGDs ranked in order of concern food as the most important spending priority, with entertainment ranked the least in priority in the households.

Lands in the community are primarily owned by extended families, compounds and the community. In the community, families and compounds own lands. Ownership rights over lands are handed down from one generation to another within the extended family, compound and community. Such inherited land is put to any use as desired by the owners. These are the lands on which family, compound and community members build their houses. They are also allocated to members for use as farm lands and for other economic purposes. These lands revert back to the families and compounds at the end of its use. Lands can be leased by non-family and compound members. Such lands similarly revert back to the owners after the period of lease. Lands are managed by males within the extended families and compounds. The study also revealed that 82.8% of lands are owned through family inheritance, 6.5% bought it, 9.3% rented/lease it, while 0% sharecropping and 1.4% others.

The host community has public primary and secondary schools within its immediate domain. The proposed NCDMB Brass Shipyard project study environment has physical conditions and constraints to road construction since it is riverine communities. The communities can only be accessed by water. Access to Okpoama Kingdom and Twon-Brass is either through Nembe jetty or Yenagoa jetty through Twon Brass.

Access to public communication facilities like the telephone in the study communities was also found to be greatly enhanced. In fact, the new mode of telephony, the GSM has made telecommunications quite easy in the area; there is hardly any part within the area where the population does not have access to one of the networks, as base stations and masts are located in the communities.

These are facilites for recreational activities, meetings and dancing sports for members in the project communities. These include town halls/auditoriums, swimming pools and club/ rest houses.

The proposed NCDMB Brass Shipyard project stakeholder's communities owned public primary and two secondary schools within their immediate domains. Okpoama own two primary school with two secondary school while Twon-Brass own 4 primary school and 2 secondary schools. There are also private school, however, notably is the Kingdom Heritage own and managed by Winners Chapel. The schools on ground had relatively adequate capacities in terms of structures (some need rehabilitation/renovation) and pupils/students enrolments were adequate but the number of teachers in the schools was a cause

Traditionally, the proposed NCDMB Brass Shipyard project stakeholder's communities have kings that rules over the land. He is known as the 'Amanyanabo'. The Amanyanabo as paramount ruler has members of his traditional ruler's council. The leadership structure is as follows: Amanyanabo (His Royal Majesty), Alepu (the Council of Chiefs), Elders (Traditional ruler in Council), Youth group/leader and Women group/leader respectively constitute the local and traditional administrative structures of the proposed NCDMB Brass Shipyard stakeholder's communities.

Method of Impact Identification and Evaluation

The guidelines of ISO 14001 were used for impact prediction and evaluation. This allows for interactive and descriptive analysis of relationships between the proposed project activities and the various environmental components (biophysical, health and social).

The impact evaluation which was based on clearly defined criteria (legal / regulatory requirement, risk, frequency of occurrence, importance and public Interest / concern) was used to determine the significance or otherwise of the impacts.

Impact Discussion from Proposed Project Activities

The likely impacts of the proposed project on the biophysical and socio-cultural components in the study area are as follows:

Land use: Land aquisation for the proposed are some of the activities that will impact on land use.

Vegetation: Trees, shrubs and herbs will be permanently removed. Stands of more obvious and viable economic species such as *The Rhizophora mangle (Red mangroves), Rhizophora Africana and Laguncularia racemosa (White mangrove)* will be lost. The habitats of these species and homes of animal wildlife will also be lost.

Biodiversity**:** The impact on plant biodiversity will be direct and adverse as species will be lost permanently as a result of site clearing. The impact will also be limited to the acquired area. The impact would be direct and of long-term duration.

Soil: Soil will be exposed to direct sunlight rays due to removal of vegetation. This may elicit erosion, high temperature and changes in soil moistures regimes. This will lead to changes in soil physical and chemical characteristics and subsequent death of soil organisms; promotion of run-off and may impact nearby water body. These impacts will be direct and long term but localized.

Air Quality: Project activities like vegetation clearing, etc. will impact the on the air quality due to generation of dust and gaseous emission as a result of movement of heavy machineries. The particulate matters that would be released into the air could reduce visibility.

Socio-Economics: The likely effects of the planned project and related activities on the communities and its total environment are enumerated below:

- **Demographic Changes**

  The proposed project activities, which will involve movement of job seekers, could lead to a temporary net increase in population and moderately affect the demographic pattern. This impact is expected to be direct and indirect, reversible, of short-term duration and rated low.

- ***Increase in social vices***

  The job opportunities created by the project activities and the expected monetary gains could encourage some social vices such as drunkenness, violence and drug abuse. It could also attract commercial sex workers (CSW) and teenage girls to the area. The influx of these categories of people to the area has the potential to increase teenage pregnancies. The impact would be direct, irreversible/reversible, long-term, and rated high.

- ***Pressure on existing infrastructure***

  The relatively large labour force required for project activities could lead to an increase in overall population of the communities. Population increase due to the labour force and migrants could lead to overcrowding and its consequent pressure on existing housing, educational and recreational facilities. The impact would be direct, reversible, short-term, and rated medium.

- ***Community Agitation***

  Land acquisition, destruction of farmlands and other areas of interest and supply of labour could attract third party agitation involving inter- and intra-communal conflicts and human rights issues. The impact would be direct, reversible, short-term, and rated high.

- ***Increase in cost of living/inflation***

  The increase in population which is likely to occur as a result of the movement of people to the project site could overstretch available food supplies, healthcare and other social facilities such as housing, water and power supply. The shortage of these goods and services could result in increase in cost of living and attendant inflation. This impact would be direct, reversible, short-term, and rated medium.

- ***Emergence of new communicable diseases***

  The movement of a large number of people (workers and job) into the hitherto isolated, discrete communities could introduce new diseases in the communities if good hygiene is not ensured. This impact would be direct, reversible, of short-term duration and rated medium.

- ***Sexually transmitted infections (STIs), skin and respiratory diseases***

There could be an increase in STIs (including HIV/AIDS), due to anticipated movement of commercial sex workers and increase in sexual risk behaviours. Skin and respiratory diseases could also occur from overcrowding and poor ventilation (poor housing conditions) due to anticipated marginal increase in population. This impact would be direct, irreversible, of long-term duration and rated high.

- ***Soft tissue injury and poisoning***

There could be an increase in soft tissue injuries and poisoning from exposure of field workers and community members to poisonous plants and dangerous animals (snakes, bees, etc.) that have been displaced from their habitats. This impact would be direct, reversible, of short-term duration and rated medium.

- ***Trauma and deaths***

This could result from work-related accidents involving field workers. This impact would be direct, irreversible, of long-term duration and rated high.

- ***Respiratory disorders***

Gaseous discharges and dust particles from vegetation clearing, excavation and heavy machinery/vehicles used during construction, could impair lung functions could lead to or aggravate respiratory disorders such as bronchitis and asthma. This impact would be direct, irreversible, of long-term duration and rated high.

- ***Improvement in Local Economy***

Positively, the proposed project is expected to benefit the local economy of the host community employment opportunities, the opportunities for contract works and welfare improvements in the host community. All these are capable of having a beneficial multiplier effect on the local economy.

Mitigation Measures

Acquisition of land for the project shall involve CDC of the project affected communities and individual families.

Adequate compensation shall be paid to owners of buildings on the proposed project right of way.

Clearing of site shall be restricted to right of way in order to reduce ecological damage. Equipment shall be routinely maintained to reduce the introduction of noxious gases into the project area.

Adequate waste disposal strategies shall be put in place during after construction. Also, workers shall be trained on basic waste management strategies.

Procurement methods shall be skewed in favour of host communities and project affected communities shall be treated fairly and without discrimination.

Construction workers shall be educated on the need to respect the custom and tradition of project affected communities. Temporary camp that would provide basic necessities of workers shall be provided at the already acquired plant site.

The CDC shall be engaged to guide matters concerning the project including employment of locals and engagement of local contractors.

Environmental Management Plan

Environmental Management Plan (EMP) is a management tool that presents strategies and procedures for managing potential environmental impacts associated with a proposed project. It provides confidence on the part of project proponent that a reliable scheme has been put in place to deal with any contingency that may arise during the life period of the shore protection project, including construction stages. The details of the EMP including the mitigation measures for identified significant impacts are provided in the report.

The EMP is designed to:

- ensure that all mitigation measures prescribed in the ESIA document for eliminating, minimizing, and enhancing the project adverse and 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 activities.

This has been developed to manage negative impacts/effects, enhance benefits and ensure good standards of practice are used throughout the project. These objectives shall be achieved by:

- ensuring compliance with all stipulated legislation on protection of the biophysical and socio-economic environment and NCDMB HSSSE policy;
- integrating environmental and socio-economic issues fully into the project development and operational philosophies;
- promoting awareness on the management of the biophysical and socio-economic environment among workers;
- rationalizing and streamlining existing environmental activities to add value to efficiency and effectiveness;
- ensuring that only environmentally and socially sound procedures are employed during the project implementation; and
- continuous consultations with the relevant regulatory bodies, community leaders (local heads/chiefs, clan heads, landlords, etc), youth leaders, community-based organizations (CBOs), and other stakeholders throughout the project lifecycle.

In line with the objectives summarized above, the main elements of this EMP stated below are addressed in the main report:

- Overall project organizational chart (including HSSSE) organogram;
- Preliminary EMP guidelines;
- Guidelines for waste management;
- Guideline for Consultation;

- Noise Minimization Guideline;
- Overall safety philosophy/guidelines;
- Emergency/Contingency plan;
- Communication plan;
- Security plan;
- Plan for Training and Awareness;
- Environmental monitoring plan;
- Guidelines for audit and review;
- Application of Equator rinciples;
- Development and Implementation of Resettlement Paln;
- Guidelines on maintenance and facility management; and
- Guidelines for decommissioning and abandonment

Conclusion

The existing biophysical environment does not seem to pose any environmental threat to the project host communities. However, existing health status in terms of health infrastructures is a far cry from minimum expectation. Socio-economic indices prevalent in the project area are fairly good. The communities are peaceful and peace loving blessed with agricultural products. Fishing and subsistence farming among others are the predominant occupation of the people.

The impacts assessment of the proposed development project shows that it will impact positively on the national economy as well as the revenue base of the project proponent and its joint venture partner contribute to socio-economic development within the host communities and result in economic empowerment for the indigenes and residents as well as other professionals. These would be by way of increased gas production, power generation, skilled and semi-skilled employment opportunities, award of contracts for supplies and services among others.

The adverse impact of the proposed projects on water, land use, vegetation wildlife air, socio-economics and health are localized and can be controlled and ameliorated if the recommended measures are strictly followed.

CHAPTER ONE
INTRODUCTION

1.1 General

There has been convincing ship movements into Nigeria via the various sea ports. In pursuit of the need to drastically reduce economic flights to other countries from Nigeria, the Federal Government of Nigeria, through the Nigerian Content Development and Monitoring Board (NCDMB) is establishing a Shipyard at location within Brass Island in Brass Local Government Area of Bayelsa State

The shipyard is mainly meant to provide maintenance and repair services for cargo vessels, oil tankers, and Liquefied Natural Gas (LNG) carriers which are highly expected to increase with the completion of the implementation of the Nigeria LNG's Train 7 project. The Nigeria LNG's Train 7 project is expected to increase the company's Liquefied Natural Gas capacity from 22MTPA to 30MTPA and induce the acquisition of additional LNG carriers to the existing ones, all of which would need maintenance and servicing. The proposed Shipyard project shall principal amongst other things serve as a mooring and ducking facility and it is envisaged to boost economic activities within the subregion. The Brass shipyard project would further develop and harness the nation's position in the oil and gas value chain and linkage to other sectors of the economy.

The major component of the proposed project includes the following facilities: mooring facility, Loading/ offloading area, ducking and maintenance facility, offices, workshop and lodging facilities. The proposed site covers about 10 hectares of land most of which lies in low lying sand shoreline terrain that may require some form of sand filling and shore protection to avert coaster erosion. The proposed project shall utilize sand obtained within and around the Brass Island for construction activities. However, adequate logistic planning shall be required to bring in granite, cements, steel/ iron bars and other construction materials from Yenagoa and Port Harcourt.

Therefore, in compliance with the mandate of the EIA Act CAP E12 LFN 2004, NCDMB commissioned Lympson Leosentino Limited was to conduct Environmental Impact Assessment (ElA) studies on the proposed site. The Environmental Impact Assessment (EIA) was undertaken in line with the submitted terms of reference stated here-under, to, in this particular case, identify, predict, mitigate and evaluate potential impact on ecological factors within a sphere of influence of 2km radius, arising from the proposed development of Brass Island Shipyard.

1.2 Project Location

The proposed located at Shipyard is located in Brass Island, Brass Local Government Area of Bayelsa State. It is located between latitudes 4°19’48.11” and 4°20’04.1” and between longitudes 6°15’01.11” and 6°15’30.6” in Brass Island, Brass Local government area Bayelsa State (Figure 1.1, Figure 1.2 & Figure 1.3). The project site is presently unoccupied and mainly covered with vegetation The project site covers about 10 hectares of land most of which lies in low lying sand shoreline terrain that may require some form of sand filling and shore protection to avert coaster erosion.

Bayelsa is a southern Nigeria state in the core Niger Delta region, which has riverine and estuarine setting. It is geographically located within latitudes 4°15' North and 5°23' South and longitudes 5°22' West and 6°45' East. The state is bounded by Delta State on the north, Rivers State on the east and the Atlantic Ocean on the western and southern parts. Many communities (and in some cases) completely surrounded by water, making them inaccessible by road. The state is home the Edumanom Forest Reverse. Its capital is Yenagoa, and it consists of eight local government areas, namely: Brass, Ekeremor, Kolokuma/Opokuma, Nembe, Ogbia, Sagbama, Sothern Ijaw and Yenagoa. Brass island in southern Bayelsa state in the Niger Delta comprising Twon- Brass, Ewoama, Okpoma, Kunupogu, Twonkubu etc communities and bordering the Brass River estuary to the west and the coast of Atlantic Ocean to the south. It is the site of Twon-Brass, the headquarters of Brass local government area. Ferries link the town with Port Harcourt and Yenagoa. Transportation to and from Brass Island is only by water or air through choppers, as there is no road connection. There are basically three routes, namely: Port Harcourt–Nembe–Brass route, Yenagoa–Nembe–Brass route and Yenagoa– Brass route. Means of transportation within the land areas of the Island is by Motorcycles on commercial bases and private cars, and boat and canoe within the coastal areas.

The Propose Shipyard is expected to serve for 50 years, however if properly managed and maintained it can last indefinitely and as such the project has an in determinant lifespan.

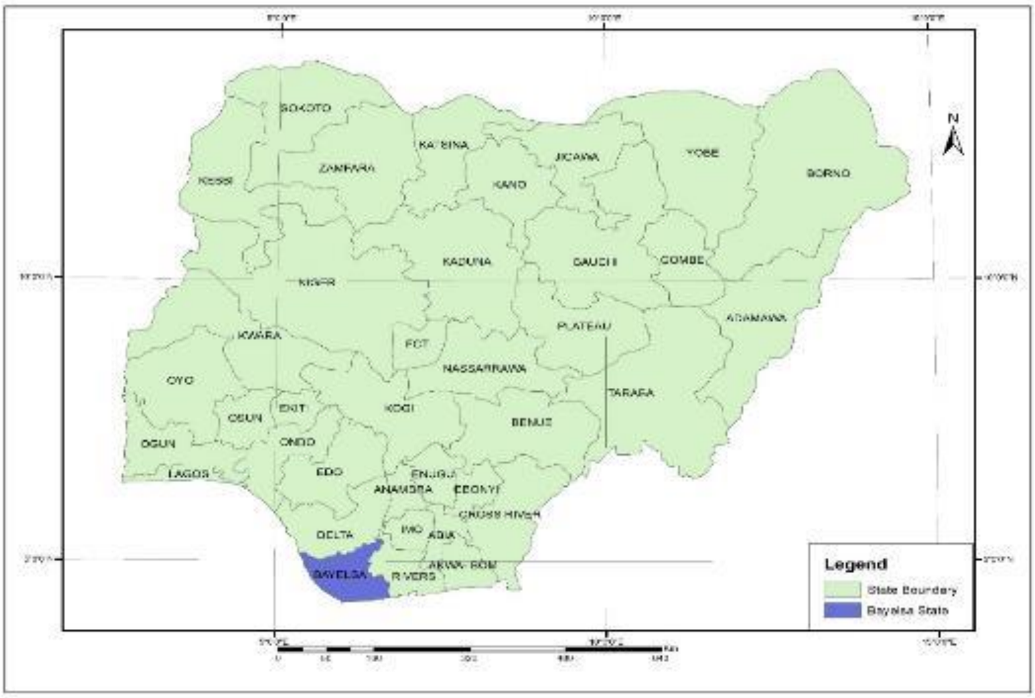


Figure 1.1: Map of Nigeria Showing the Location of Bayelsa State

Figure 1.2: Satellite Imagery of Subject Site.

Figure 1.3: Survey plan of the proposed Brass Shipyard

1.3 The Proponent

The Nigerian Content Development and Monitoring Board (NCDMB) was established in 2010 by the Nigerian Oil and Gas Industry Content Development (NOGICD) Act. NCDMB is vested with the mandate to make procedures that will guide, monitor, coordinate and implement the provisions of the NOGICD Act signed into law on April 22, 2010. One of the key function of NCDMB is to engage in targeted capacity building interventions that would deepen indigenous capabilities-Human Capital Development, Infrastructure and Facilities, and Manufactured Materials and Local Supplier Development. The NCDMB headquarters is located at Nigerian Content Tower, Oxbow Lake Road, Swali, Yenagoa, Bayelsa State.

1.4 EIA Objectives

The objectives of the study include:

- to establish the baseline ecological conditions of the proposed Shipyard project area at Brass, Brass Local Governement Area of Bayelsa State;
- to use the baseline data to describe and characterize the study area;
- to establish the environmental sensitivities prevalent in the area;
- to identify, quantify, and assess the likely negative and positive environmental impacts of the project as presently designed;
- to identify, evaluate, and predict the impact of the proposed Shipyard project on the ecological and socio-economic settings with adequate interfacing and project interaction;
- to identify existing and expected environmental regulations that will affect the operations and advise on standards, concepts and targets;
- to identify any environmental issues and concerns that may, in the future, affect the successful operation of the project;

- to develop control strategies with a view to mitigating and ameliorating significant impacts that the proposed projects would have on the totality of measurable environmental characteristics;
- to develop an effective Environmental Management Plan (EMP) to last the life-span of the project including compliance, monitoring, auditing and contingency planning.

1.5 EIA Work scope

EIAs include environmental, social, and consultation elements which are integrated into the planning and decision-making process to avoid, reduce, or mitigate adverse impacts and to maximise the benefits of a proposed project.

The emphasis of the EIA is to produce robust environmental and social management plans (EMPs) which are able to effectively implement the recommended mitigation measures identified in the EIA, during the life of the Project and at the time of project decommissioning.

The overall EIA process is shown schematically in Figure 1.3 and the following key steps are described in the subsequent sections.

- Review of relevant national and international environmental regulations guiding onshore gas pipeline installation and operations;
- Comprehensive literature review on the biogeophysical characteristics of the project area;
- Screening and scoping
- Baseline data collection
- Laboratory analysis of samples collected from field survey / sampling;
- Stakeholder consultation
- Impact assessment
- Management plans
- Reporting and disclosure

1.6 Legal and Administrative Framework for the EIA

Projects such as Tank Farm establishment are governed by regulatory legislations, guidelines and standards. Thus, the EIA of the proposed Okpoama Tank Farm project was carried out in accordance with regulations, guidelines and standards of the Department of Petroleum Resources, Federal Ministry of Environment, State legislations on the environment, and all other applicable National legislations, and International Agreement and Convention to which Nigeria is a signatory. The EIA is also in conformity with NCDMB HSSSE policy.

1.6.1 Legislations/body guiding Environmental management in Nigeria

The Mineral Oil (Safety) Act CAP 350 LFN 1990

Sections 37 and 40 of the Mineral Oil (Safety) Act CAP 350 LFN 1990 require provision of Personal Protective Equipment (PPE) and the safety measures for workers in drilling and production operation in accordance with international standards.

1.6.1.1 Federal Environmental Protection Agency (Now FMEnv) Act No. 58, 1988

This Act, which was issued in 1988 and amended by Act No. 59 of 1992, provides the setting up of the Federal Environmental Protection Agency, as the apex organization for the overall protection of the Environment and Conservation of Natural Resources. The act also makes environmental impact assessment (EIA) mandatory for all new major projects. In compliance with its mandate, FEPA issued the procedure, guidelines and standards for the execution of EIA with emphasis on the significance associated with current and potential impacts of such projects. The procedure also indicates the steps to be followed (in the EIA process) from project conception to commissioning in order to ensure that the project is executed with adequate consideration for the environment.

1.6.1.2 Petroleum (Drilling and Production) Regulations (1969)

The Petroleum (Drilling and Production) Regulations (1969), empowers the holder of an OPL to do practically anything in the area covered by the license {Section 15 (1)}, but Section 15(2) holds such a holder responsible for all the actions of his agents and contractors.

1.6.1.3 EIA Sectoral Guidelines for Oil and Gas Industry Projects, 1995

In compliance with its mandate, FEPA issued the EIA Sectoral Guidelines for Oil and Gas Industry Projects, 1995. Contained in the Procedural Guidelines (pg. 8) are Category I projects (mandatory study activities) and listed under item 15, sub-item (a) on page 10) (Petroleum) is Oil and Gas Fields Development, making an EIA mandatory for the proposed project. The Procedural Guidelines also indicate the steps to be followed (in the EIA process) from project conception to commissioning in order to ensure that the project is executed with adequate consideration for the environment. Annex C contains the EIA writing format as required by FMEnv. The guidelines are intended to assist in the proper and detailed execution of EIA studies of projects in consonance with the EIA Act.

1.6.1.4 National Environmental Protection Management of Solid and Hazardous Wastes Regulation (1991) (FMEnv)

This 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.

1.6.1.5 Environmental Impact Assessment Act CAP E12 LFN 2004

The Act sets out general principles, procedures and methods to enable the prior consideration of Environmental Impact Assessment on certain public or private projects. The objectives of the Act is to promote the implementation of appropriate policies consistent with all the laws and decision making processes through which the goal and objectives maybe realized. The Act also encourages the development of procedures for information exchange, notification and consultation between the organs and persons when proposed projects or activities are likely to have significant environmental effects on boundary or trans-state or on the environment of bordering towns and villages.

1.6.1.6 FEPA (Now FMEnv) National Policy on the Environment (1989)

This gave the policy goals, conceptual framework and strategies for implementation.

1.6.1.7 FEPA (Now FMEnv) Nigeria's National Agenda 21 (1999)

Nigeria's National Agenda 21 was developed to:

- Integrate environment into development planning at all levels of government and the private sector,
- Intensify the transition to sustainable development,
- Address sectoral priorities, plans, policies and strategies for the major sectors of the economy and,
- Simultaneously foster regional and global partnerships.

1.6.1.8 National Inland Waterways Authority Act No 13 of 1997

Established by the National Inland Waterways Authority Act No. 13 of 1977, it is the function of the Authority to

- Grant permit and licences for sand dredging, pipeline construction, dredging of slots and crossing of waterways, and;

- Subject to the provisions of the Environmental Impact Assessment Act No. 86 of 1992, carry out environmental impact assessment of navigation and other dredging activities within the inland water and its right-of-way.

Contained in Part VI of the Act are offences and penalties. It states that subject to the provisions of the Lands Act, 1993 and the Nigerian port Act 1993, any person who wilfully or negligently and without the consent of the Authority obstructs the waterways with rafts, nets, logs, cask of oil, dredgers, barges, pipelines, pylons, or bridges shall be liable upon conviction to a fine.

1.6.1.9 Endangered Species Act CAP E9 LFN 2004

This Act prohibits hunting, capture and trade of some *endangered species* like crocodile, alligator, turtles, Parrot, etc. The Endangered (Control of International Trade and Traffic) Decree (No. 11 of 1985) has been enacted by the Federal Republic of Nigeria specifically to implement CITES. It is broader than CITES in that it also covers domestic taking of listed species. Two schedules are included: Schedule I (Endangered Species – Animals in relation to which International Trade is absolutely Prohibited), and Schedule 2 (Animals in Relation to which International Trade may only be conducted under License). The decree prohibits taking of Schedule 1 species and requires that taking of Schedule 2 species be in accordance with a license issued under the decree.

1.6.1.10 Petroleum Act 1969

Section 9-(1) (b) (iii) of the Petroleum Act 1969 (Decree 51) states that the Minister of Petroleum Resources may make regulations on "the prevention of pollution of water courses and the atmosphere".

1.6.1.11 Petroleum Act CAP 350 LFN 1990

An Act to provide for the exploration of petroleum from the territorial waters and the continental shelf of Nigeria and to vest the ownership of, and all on-shore and off-shore revenue from petroleum resources derivable therefrom in the Federal Government and for all other matters incidental thereto.

1.6.1.12 Territorial Waters Act CAP 428 LFN 1990

The territorial waters of Nigeria shall for all purpose include every part of the open sea within twelve nautical miles of the coast of Nigeria (measured from low water mark) or of the seaward limits of inland waters. Any act or omission which -

(a) is committed within the territorial waters in Nigeria, whether by a citizen of Nigeria or a foreigner; and

(b) would, if committed in any part of Nigeria, constitute an offence under the law in force in that part, shall be an offence under that law and the person who committed it may, subject to section 3 of this Act, be arrested, tried and punished for it as if he had committed it in that part of Nigeria

1.6.1.13 Nigerian Oil and Gas Industry Content Development Act 2010

The Act provides for the development of Nigerian Content in the Nigerian Oil and Gas Industry, Nigerian Content Plan, Supervision, Coordination, Monitoring and Implementation of Nigerian content and for related matters. All regulatory authorities, operators, contractors, subcontractors, alliance partners and other entities involved in any project, operation, activity or transaction in the Nigerian oil and gas industry shall consider Nigerian content as an important element of their overall project development and management philosophy for project execution.

1.6.1.14 Employee's Compensation Act No. 13, 2010

The objectives of the Act are to— (a) provide for an open and fair system of guaranteed and adequate compensation for all employees or their dependants for any death, injury, disease or disability arising out of or in the course of employment; (b) provide rehabilitation to employees with work-related disabilities as provided in this Act; (c) establish and maintain a solvent compensation fund managed in the interest of employees and employers; (d) provide for fair and adequate assessments for employers; (e) provide an appeal procedure that is simple, fair and accessible, with minimal delays; and (f)combine efforts and resources of relevant stakeholders for the prevention of workplace disabilities, including the enforcement of occupational safety and health standards.

1.6.1.15 FEPA (Now FMEnv) National Guidelines for Spilled Oil Fingerprinting (Act 14 of 1999)

This provides guidelines for spilled oil fingerprinting applicable throughout Nigeria, in order to improve the quality of the environment and to free it from pollutants and other environmental and health hazards.

1.6.1.16 The Department of Petroleum Resources

The Department of Petroleum Resources (DPR) is under the Nigerian Ministry of Petroleum Resources. DPR is charged with the specific responsibilities of regulating activities in the Oil and Gas industry in order to ensure strict compliance with relevant regulations.

The DPR performs its regulatory functions under the mandate of the Petroleum Minister as provided for in the provisions of the Petroleum Act 1969, which empowers the Minister to make regulations for all petroleum operations including environmental matters. Under the Petroleum (Drilling and Production-Amendment) Regulations 1988, DPR is responsible for monitoring compliance with the Minister's regulations and approved control methods and practices. These requirements are detailed in DPR's "Environmental Guidelines and Standards for the Petroleum Industry in Nigeria" (EGASPIN Revised Edition 2018). The guidelines also provide for the establishment and management of Terminal operations (PART IV, section 1 to 6).

1.6.1.17 Abandonment Guideline

As far as abandonment of facilities is concerned, the applicable guidelines shall be as required by FMENV for oil and gas/infrastructural facilities and the DPR EGASPIN of 2002. The DPR EGASPIN stipulates that an operator, whose activity has been known to cause significant adverse environmental effect, should restore it as much as possible to its original state. This also deals mainly with oil spill sites. It is envisaged that more comprehensive guidelines and standards for abandonment of facilities will soon be enacted.

1.6.1.18 Oil Pipelines Act of 1956

Concerns construction, maintenance and operation of oil and gas pipelines. Section 11(2) of the Act provides for the definition of an oil pipeline as follows: "For the purposes of this Act an oil pipeline means a pipeline for the conveyance of mineral oils, natural gas and any of their derivatives or components, and also any substance (including steam and water) used or intended to be used in the production of refining or conveying of minerals oils, natural gas and any of their derivatives or components".

The Federal Republic of Nigeria Official Gazette of 2nd October, 1995 Vol. 82, No. 26 on Oil Pipelines Acts provides in detail all the regulations on pipelines, proposed routes, construction activities and the associated protection measures. Consideration for public safety shall be in accordance with the provision of API/RP 1102 or any other recognized equivalent standards

1.6.1.19 Criminal Code

Section 247 of the Nigerian Criminal Code makes it an offence, punishable with up to 6 months imprisonment for "Any person who: a) violates the atmosphere in any place, so as to make it noxious to the health of persons in general dwelling, or conducting business in the neighbourhood, or passing along a public way or; b) does any act which is, and which he knows or has reason to believe to be, likely to spread the infection of any disease dangerous to life, whether human or animal."

1.6.1.20 Land Use Act 1978

The Land-use Act of 1978 states that "...it is also in the public interest that the rights of all Nigerians to use and enjoy land in Nigeria and the natural fruits thereof in sufficient quality to enable them to provide for the sustenance of themselves and their families should be assured, protected and preserved". This implies that acts which could result in the pollution of the land, air and waters of Nigeria negates this decree, and are therefore, unacceptable.

1.6.1.21 National Environmental Standards Regulatory and Enforcement Agency (NESREA), 2007

The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established as a parastataI of the Federal Ministry of Environment. NESREA is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria.

1.6.1.22 Endangered Species (Control of International Trade and Traffic) Act 11 of 1985

This Act prohibits hunting, capture and trade of some *endangered species* like crocodile, alligator, turtles, Parrot, etc.

The Endangered (Control of International Trade and Traffic) Decree (No. 11 of 1985) has been enacted by the Federal Republic of Nigeria specifically to implement CITES. It is broader than CITES in that it also covers domestic taking of listed species. Two schedules are included: Schedule I (Endangered Species – Animals in relation to which International Trade is absolutely Prohibited), and Schedule 2 (Animals in Relation to which International Trade may only be conducted under License). The decree prohibits taking of Schedule 1 species and requires that taking of Schedule 2 species be in accordance with a license issued under the decree.

1.6.1.23 Bayelsa State Environment and Development Planning Authority

The Bayelsa State Environment and Development Planning Authority Edict of 1998 charges the Authority with the responsibility for the protection and development of the environment and biodiversity conservation and sustainable development of the State’s natural resources. The Authority shall also work with project developers who are required to conduct EIA for their new projects.

Part VII of the edict is on offences and penalties and states in section 33 that “No person shall discharge any form of oil, grease or spent oil produced in the course of any manufacturing operation or business into any public drain watercourse, stream, canal, pond highway or other land.

However, the Bayelsa State regulations guiding Environmental management includes but not limited to the following:

- Bayelsa State Environmental and Development Planning Authority Law 1998; • Bayelsa State Pollution Compensation Tax Law 1998;
- Bayelsa State Forestry Law 1998.
- Bayelsa State Land Use (Environmental Degradation/Protection) Charge Law 2005.

1.6.4 International Guidelines and Convention

1.6.4.1 International Laws and Regulations

Nigeria is signatory to several laws, treaties and regulations that govern the environment.

Among these are:

(a) United Nations Framework Convention on Climate Change (1992)

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

(c) Convention on the Migratory Species of Wild Animals (Bonn Convention)

(d) Convention of Biological Diversity

(e) Convention Concerning the Protection of the World Cultural and National Heritage Sites (World Heritage Convention)

(f) Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal and.

(g) World Bank Guidelines on Environmental Assessment {EA} (1991)

1.6.4.2 United Nations Framework Convention on Climate Change (1992)

In order to achieve sustainable social and economic development, energy consumption for 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 which make such an application economically and socially beneficial, determined to protect the climate system for present and future generations.

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

The IUCN in conjunction with the Oil Industry International Exploration and production Forum presented a set of guidelines for oil and gas exploration and production in mangrove areas. These guidelines are aimed at conservation of mangroves and enhancing the protection of marine ecosystems during E & P activities. The document also discusses the policy and principles for environmental management in mangrove areas as well as EIA procedures, Environmental Audit and Monitoring.

1.6.4.4 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

The Bonn Convention concerns the promotion of measures for the conservation and management of migratory species.

1.6.4.5 Convention on Biological Diversity

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.

1.6.4.6 Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (or World Heritage Convention)

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

1.6.4.7 Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal

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.

1.6.4.8 World Bank Guidelines on Environmental Assessment {EA} (1991)

The World Bank requires the execution of an EIA on a proposed industrial activity by a borrower as a pre-requisite for granting any financial assistance in form of loans. Details of World Bank's EIA procedures and guidelines are published in the Bank's EA Source Book vols. I - III of 1991. Potential issues considered for EA in the upstream oil and gas industry include the following:

- Biological Diversity
- Coastal and Marine Resources Management
- Cultural Properties
- Hazardous and Toxic Materials and
- International waterways.

1.6.4.9 National Oil Spill Detection and Response Agency (NOSDRA), 2006

The National Oil Spill Detection and Response Agency (NOSDRA) was established in 2006 as the lead Agency in ensuring timely, effective and appropriate response to oil spills, through clean-up and remediation of all impacted sites to all best practical extent.

1.6.5 NIGERIAN CONTENT DEVELOPMENT AND MONITORING BOARD (NCDMB) HSSSE Policy

NCDMB not only complies with relevant legislation, but also encourages other initiatives for protecting the health, safety and environment of those affected by its activities. The main focus of the policy is:

i. Has a systematic approach to HSSSE management designed to ensure compliance with the laws and to achieve continuous performance improvement,

ii. Sets targets for improvement and measures, appraises and reports performance,

iii. Requires contractors to manage HSSSE in line with this policy,

iv. Zero Harm to People/personnel, Zero Accidents and Zero damage to the Environment.

v. Getting HSSSE right is the responsibility of everyone, everywhere who works for NCDMB.

vi. Our highest priorities are the health and safety of those who come into contact with our operations, products and facilities, along with the impact we may have upon the environment.

vii. NCDMB encourages the vision to achieve 'Zero' in all employees, contractors and partners. This means that we will not be satisfied until we achieve zero incidents in our health, safety and environmental performance.

However, the management system in NCDMB will continually seek to conform to the highest level of HSSSE principles available. We resolve to implement, maintain and get certified in the occupational health and safety management system and the environmental management system. It will provide a broad-based set of expectations integrated into the following elements of accountability:

- Safety and accident prevention
- Plant and equipment integrity
- Pollution prevention
- Energy conservation
- Personal, occupational and environmental health
- Personal/physical security
- Product stewardship
- Sustainable development

1.7 Structure of the Report

The report is presented in eight chapters. Chapter one is an introduction stating the background information about the proponent and the project, and the legal/administrative framework for EIA in Nigeria and international guidelines/convention. The second chapter discusses the project justification and presents the need/value and the envisaged sustainability of the project as well as the project development options considered. Chapter three contains a concise description of the proposed project activities including project scope of work, facilities design data, engineering/detailed design, project management and operations philosophies and the project execution schedule. The fourth chapter describes the existing biophysical, community health and socio-economic baseline status of the project area.

Chapter five presents the potential and associated impacts of the proposed Shipyard project between Okpoama and Brass, while chapter six proffers mitigation and enhancement measures for adverse and beneficial impacts. Chapter seven describes the environmental management plan that NCDMB proposes to adopt during implementation of the proposed project. Chapter eight presents the conclusion of the report.

CHAPTER TWO

PROJECT JUSTIFICATION

2.1 Need for the Project

Nigeria has a long coastline of 853 kilometers and navigable inland waterways of 3,000 kilometers, which offer immense potential for maritime sector development, stressing that Brass coastline, was very close to the Atlantic Ocean.There are over 20,000 ships working for the oil and gas sector in Nigerian waters and the annual spend was over $600million in the upstream sector. The oil sector spent $3.047bn on marine vessels between year 2014-2018 and 73 percent of the total spend went to crew boats, security vessels, diving support vessels and fast supply intervention vessels. Other vessels in that category include mooring launch and shallow draft vessels, most vessels that operate in the oil industry are taken to Ghana, Equatorial Guinea, Cameroun and other countries for dry docking because our local dry docks were built many years ago and no longer provide the required services. The objectives of the shipyard are to include promotion of indigenous ownership, increase participation and increase capacity of local shipyards to build, service and maintain marine vessels of various sizes and manufacturing of vessel components and consumables in-country. The Brass Shipyard is expected to give first consideration to Nigerian built or owned vessels for contract award and job offers, discourage capital flight, generate employment and increase retention of Industry spends and stimulate value creation. The Brass shipyard project would further develop and harness the nation’s position in the oil and gas value chain and linkage to other sectors of the economy.

2.2 Envisaged Sustainability

Subsurface data acquired by NCDMB suggest that the risk shipyard activies is low when all safety measures are put in place. It is expected that the Brass Island Shipyard facility can be sustained for an average of 50 years depending solely on construction design, environment and social factor.

2.3 Economic sustainability

The economic sustainability of the proposed tank farm establishment has greater success potential than to fail as is not majorly involved with crude oil exploration processes. The project will increase the amount of crude-oil and its product within the proposed project sites. This will economically contribute to the revenue accruing to Nigeria and its partners.

2.4 Technical Sustainability

The proposed project is technically viable as it will rely on existing and well-established technologies, with proven oil and its product field experience and strong HSSSE awareness. The design and operation of the Tank Farm would be carried out in line with national and international codes and standards of practice. Innovative technologies that are economically viable and having minimal environmental, social and health impacts shall be utilized in the execution of the proposed project. In addition, personnel with experience in similar operations will be involved in the establishment and early operations.

2.5 Environmental Sustainability

The findings and recommendations of this EIA would be integrated into all phases of the proposed project lifecycle. Recommendations on the project process, waste management (handling, treatment and disposal) which were developed in line with the environmental regulations, guidelines and standards of the Federal Ministry of Environment and Department of Petroleum Resources as well as international best practices would ensure the environmental sustainability of the proposed project.

2.6: Value of the project

The project is expected to provide several job opportunities to the teeming youths in the project area and hence decrease social vices. This will have a rippling effect as it will positively affect the livelihoods of the employees as well as their defendants. The project will reduce the uncertainties on Hydrocarbon Initially in Place, rock and fluid properties

2.7: Project Options

The project development alternative considered was to "Do Nothing". The advantages and disadvantages of this alternative/ options are as listed below:

2.7.1. Advantages of the "Do Nothing" Option

- No serious negative impact of project on the environment

2.8.2. Disadvantages of the Do-Nothing Option

- Loss of an important revenue generating investment by the government
- Loss of job creation opportunities to the teeming youth of the project communities.

Persistence of social vices.

- No investment of interested stakeholders in the Oil and Gas sector of Bayelsa State.
- No community development programme.
- Loss of livelihood-enhancing opportunities.
- Loss of improved healthcare service and delivery in the community

CHAPTER THREE

PROPOSED PROJECT DESCRIPTION

3.1 General

This chapter presents the detailed technical description of the proposed Tank Farm at Okpoama, Bayelsa Local Government Area of Bayelsa State. The project work scope, proposed project design overview, operating philosophy as well as the overall implementation schedule for the proposed project are described in this chapter.

NCDMB shall be responsible for the overall project Engineering and Construction as well as Project Management, Pre-commissioning, Commissioning and decommissioning.

3.2 Project Overview

The objective of this project is to establish a commercially viable ship repair/ship building yard with graving and floating dock capabilities to dry dock LNG carriers, Tanker vessels and container ships of up to 300 meters L.O.A. The project site covers about 10 hectares. The Brass Shipyard will serve as hub for ship-building and repairs. The shipyard is to reduce 'capital flight', increase local content and boost employment opportunities in Nigeria. It is expected to help the NCDMB achieve the target of 70 per cent Nigerian Content by 2027. The shipyard project would further develop and harness the nation's position in the oil and gas value chain and linkage to other sectors of the economy. The project includes using components that are constructed both off and on-site. The onsite work will involve specialized areas and equipment. The off-site work involves pre-fabrication such as assembling components of a structure in a manufacturing site and then transporting those parts to the construction or building site.

The construction phase of the proposed Brass Shipyard project is schedule driven with the target completion date set at first (1st) quarter of 2023, following the receipt of all necessary approvals and permits from the government.

The construction scope mainly consists of fitting out quay, tug berth, revetement, graving dock, ship-repairing area, buildings and other supporting facilities. The natural conditions and external supporting facilities of the proposed project meets the needs of the project construction, the project belongs to NCDMB, with the strong support of Federal Ministry of

Petroleum Resources and Nigeria Federal Government, which provides a strong guarantee for the construction of the project. Besides, the main materials of the project can be transported to the site by water, sand can be dredged nearby, guaranteeing the supply of construction materials. The Project features a larger amount of construction quantity, multiple construction procedures and high requirement on construction technologies. But through detailed and scientific construction organization, strengthening the coordination between each process and pooling the wisdom and efforts of individuals, it is possible to complete the Project within planned construction period. The construction period of the Project would be 3.5 years.

3.3 Phases of Work for the Proposed Brass Shipyard

The proposed project shall utilize sand obtained within and around the Brass Island for construction activities.

The proposed project is scheduled for six (6) phases namely:

1. Conceptualization/ Design
2. Site preparation
3. Construction
4. Commissioning
5. Operation
6. Decommission/ abandonment

In Phase three, a dry dock of 310m×60m are to be built aiming at building container vessels up to 70,000DWT. Two 600t Goliath gantry crane will be installed above the dry dock to conduct the tasks of grand block and unit assembly and hull erection. The fitting out quay will be expanded to the final outfitting work of newly-built vessels.

The corresponding onshore ship building facilities such as steel stock yard, hull workshop, painting shop, block assembly and pre-outfitting yard, outfitting workshops will also be constructed. The ship building yard will be aimed at building three to four new, container ships per year and each ship will be of 30,000 to 70,000 DWT.

The fitting out quay of the project continues to extend to the right along the existing fitting out quay, followed by fitting out quay, graving dock (shipbuilding), and fitting out quay. The additional land area of the project is about 48ha, and the land layout follows the shipbuilding process and adopts a linear layout. The newly built fitting out quay is connected with the newly built land area by Approach Bridge. After the completion of the project, it can meet the requirements for 300m long ship construction.

3.4 Project Description

The Brass Island Shipyard is expected to generate in-country value by reducing flows of cash outbound while creating local job opportunities. The major component of the proposed project includes the following facilities: mooring facility, Loading/ offloading area, ducking and maintenance facility, offices, workshop and lodging facilities.

The design is based on employer's requirement; however, with the acquisition and collection of field data, we found some unreasonable or unclear requirement after in-depth research and discussion. Therefore, taking the employer's requirement as the framework, we've identified several major principles and revised the irrationalities in our design which is considered as the design premise.

3.5 Project Design

The design vessels of this project are considered only for ship repair. Besides, the ship repair design vessel is divided according to the dock repair ship (large ship) and slipway ship repair General Layout

There are no residential areas, industrial areas and corresponding supporting facilities and equipment in the area and it is mainly swamps and bushes. The usable land area is large and there is no land acquisition problem. Therefore, it is reasonable and feasible to consider a regular rectangular area for shipyard layout, which is convenient for shipbuilding and repairing process layout.

3.6 General Layout Option

The shipyard layout as shown in figure 3.1 shall consist of a fitting out quay with a length of 650m and a width of 50m, a tugboat berth with a length of 76m and a width of 16m is arranged along the shore. Considering the high intensity of sediment in the area where the project is located, in order to avoid large excavation resulting in large-scale sediment, the front line of the quay is set about 320m away from the existing shoreline, which has natural water depth of 6~7m, and it only needs to be dredged about 3m to reach the design bottom elevation. The land area of Phase 1 covers an area of about 25ha, which is divided into upper and lower areas by the access road. The upper area is a ship repair area, including a graving dock with a length of 310m and a width of 75m, which can meet the maintenance of two ships at the same time, and a slipway with a length of 244m accompanied by 5 dry berth, which can meet the daily maintenance work of 1000T-3000T small ships. Beside, the corresponding maintenance sites, workshops, warehouses, workshops, and water supply and power supply facilities are arranged in this area. The entire land area layout of upper area is set in sequence with ship repair process flow. The lower area is the auxiliary area, including administrative buildings, canteens, dormitories, parking, fire stations, and dangerous goods warehouses. The road outside the plant is connected to the road in the existing residential area.

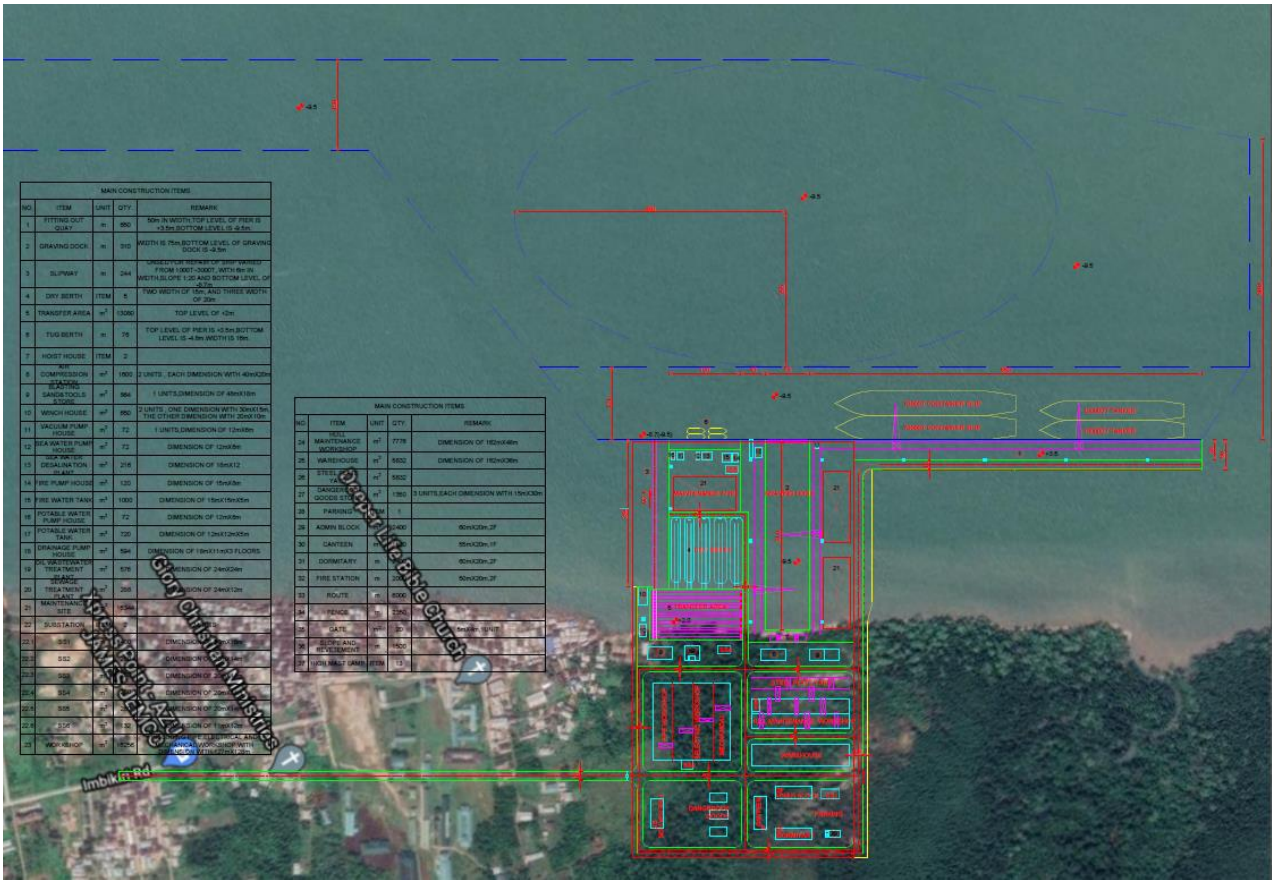


Figure 3.1: General Layout for the Proposed Brass Shipyard Project

Table 3.1 Main Technical Indexes for Construction

NO.	Item	UNIT	QTY.	Remark
1	Fitting Out Quay	m	650	50m inch Width, Top Level of Pier is +3.5m, Bottom Level is -9.5m.
2	Graving Dock	m	310	Width is 75m, Bottom Level Graving Dock Is
3	Slipway	m	244	Used For Repair of Ship Varied From 1000t~3000t, With 6m In Width, Slope 1:20 And Bottom Level of - 8.7m
4	Dry Berth	ITEM	5	Two Width of 15m, and Three Length Of 20m
5	Transfer Area	m2	13080	Top Level of +2m
6	Tug Berth	m	76	Top Level of Pier Is +3.5m, Bottom Level Is -4.8m. Width Is 16m.
7	Hoist House	Item	2	
8	Air Compression	m2	1600	2 Units, Each Dimension With 40mx20m
9	Blasting Sand&Tools Store	m2	864	1 Units, Dimension of 48mx18m

10	Winch House	m2	650	2 Units, One Dimension With 30mx15m, The Other Dimension With 20mx10m.
11	Vacuum Pump	m2	72	1 Units, Dimension Of 12mx6m
12	Sea Water Pump	m2	72	Dimension of 12mx6m
13	Sea Water Desalination Plant	m2	216	Dimension of 18mx12
14	Fire Pump House	m2	120	Dimension of 15mx8m
15	Fire Water Tank	m3	1000	Dimension of 15mx15mx5m
16	Potable Water Pump House	m2	72	Dimension of 12mx6m
17	Potable Water	m2	720	Dimension of 12mx12mx5m
18	Drainage Pump	m2	594	Dimension of 18mx11mx3 Floors
19	Oil Wastewater Treatment Plant	m2	576	Dimension of 24mx24m
20	Sewage Treatment	m2	288	Dimension of 24mx12m
21	Maintenance Site	m2	16344	
22	Substation	ITEM	2	2 Units
22.1	SS1	m2	480	Dimension of 30mx16m
22.2	SS2	m2	280	Dimension of 20mx14m
22.3	SS3	m2	280	Dimension of 20mx14m
22.4	SS4	m2	280	Dimension of 20mx14m
22.5	SS5	m2	280	Dimension of 20mx14m
22.6	SS6	m2	132	Dimension of 11mx12m
23	Workshop	m2	16256	Including Pipe, Electrical and Mechanical Workshop, With Dimension With 127mx128m
24	Hull Maintenance Workshop	m2	7776	Dimension of 162mx48m
25	Warehouse	m2	5832	Dimension of 162mx36m
26	Steel Plate Yayd	m2	5832	
27	Dangerous Goods	m2	1350	3 Units, Each Dimension With 15mx30m
28	Parking	ITEM	1	
29	Admin Block	m2	2400	60mx20m,2F
30	Canteen	m2	1100	55mx20m,1F
31	Dormitory	m	2400	60mx20m,2F
32	Fire Station	m	2000	50mx20m,2F
33	Route	m	6000	
34	Fence	m	2350	
35	Gate	m2	20	5mx4m, 1 Unit
36	Slope And	m	1500	
37	High Mast Lamp	ITEM	13	

3.5 Project Activities

The project activities can be divided into pre-construction, construction, commissioning, operation and decommissioning phase activities as highlighted below:

Pre-Construction/Construction

- Mobilization of personnel and materials to site
- Site preparation
- Civil works
- Electrical and Mechanical Equipment installation
- Land Scape works
- Demobilization of personnel and materials from site Commissioning
- Commissioning of the completed Master Piece Building and facilities Operation
- Hub for ship-building and repairs Decommissioning
- Evacuation of all Construction equipment from the project site

3.5.1 Ship Repair Process

The ship repair offshore facilities include a repair dry dock of 310m×75m for large vessels and launching facilities and dry berth for small vessels. Two 75t single jib level luffing cranes is installed along the dry dock for ship's repair. All the repair work except which must be done in dry condition can be conducted in the 650m fitting out quay. Two 40t single jib level luffing cranes are used to lift outfitting pieces and parts at the outfitting quay. Among many different kinds of launching facilities, an end-haul mechanical slipway with slope of 1:20 is adopted for launching vessels up to 3,000DWT and light vessel less than 1500t. A slope-frame cradle traveling on the slipway along with upper cradles will be used to carry vessels out of water. Through transfer area and corresponding facilities, vessels located on slope-frame cradle can be moved to repair dry berths. The ship repair onshore facilities comprise of dry berths, steel stock yard, hull maintenance workshop, pipe workshop, mechanical and electrical workshop and warehouse. Processing equipment and material handling equipment are allocated for repair works.

Ship's repair tasks can be divided into two kinds, scheduled repairs and unscheduled repairs.

3.5.2 Scheduled repairs

This is important for general routine maintenance but a key purpose for such work is to satisfy the ship's classification society, which produces class certificates for vessels. Whilst there are reported to be more than 50 ship classification organizations worldwide, the 13 major classification societies that claim to class over 90% of all commercial tonnage involved in international trade worldwide are members of the International Association of Classification Societies (IACS). ABS of USA, CCS of China, LR of Great Britain, BV of France, DNV of Norway, etc. are among the most famous IACS. Ship's periodical surveys are required by all IACS. Usually, ships are required to be examined in dry dock or dry berth at intervals not exceeding 30 months. At the dry-docking survey particular attention is paid to the shell plating, stern frame and rudder, external and through hull fittings, all parts of the hull particularly liable to corrosion and chafing, and any unfairness of bottom.

3.5.3 Unscheduled repairs

Unscheduled repairs are mostly caused by damage such as in-port damage, collisions, grounding and machinery failure. In order that the ship maintains its class, approval of the repairs undertaken must be obtained from the surveyors either at the time of the repair or at the earliest opportunity. The repair contents during unscheduled repairs are determined by the scale of the damage and the attitude of the ship owners or the insurers.

3. 6 Cost Estimate

The main construction content of this project is about 650 meters long fitting out quay, 310 meters long dry dock, step dock, slipway, dry berth and transfer area and other supporting facilities. The estimated investment includes dredging engineering, ground treatment, marine structure, process equipment purchases and installation, pavement, building structure, water supply and drainage, fire protection and environmental protection, power supply and lighting engineering, power engineering, communication, navigation and so on.

3.7 Waste Generation and Management

A project-specific Waste Management Plan (WMP) will be developed and implemented to manage the wastes streams associated with the project development phases i.e., pre-construction, construction, commissioning, operation, and decommissioning. Wastes will be recycled, reused or disposed of by contractors and accredited waste contractors.

3.8 Personnel Requirements

Local as well as expatriate employees and contractors will be hired in construction activities, start-up and operation and maintenance of the proposed project. Local employees will be recruited from the communities and regional area of the project site to meet required skill needs and trained to perform specific tasks necessary for all parts of the project operations and maintenance. The total number of labours that will be involved in the construction and operational phases of the project is yet to be finalized. It is envisaged, however, that more than 50 local people would be engaged during the construction phase of the project.

3.9 Emergency Response Plan

An Emergency Response Plan (ERP) will be developed for the project that caters for a variety of incidents, including construction hazards, mechanical and electrical failure, adverse weather, fires and explosion, illness/injury and environmental pollution. The objectives of the ERP are to:

- Anticipate possible emergency situations and plan for the most effective response;
- Establish specific company guidelines for responding to emergencies which may occur despite the measures to anticipate and prevent them;
- Consolidate in one location, key information required to respond effectively to an emergency; and
- Provide guidelines for follow up investigation and reporting emergency situations with a view to reducing the risk of a repeat of the emergency and to improve the company's response.

CHAPTER FOUR

Environmental Baseline Study of the Proposed Project Area

4.1 General

The present environmental condition physico-chemical, biological, socio-economic and health characteristics of the proposed project area are herein presented. The environmental characteristics are required to establish the existing environmental status of the proposed project area and also serve as a reference data for future studies and environmental monitoring. The data will also be used as a baseline for which the anticipated impacts of the proposed project would be determined for appropriate mitigation measures to be put in place.

4.2 Methodology of Study

A multi-disciplinary approach was employed in the acquisition of environmental conditions data of the proposed project area. The environmental condition for the proposed Shipyard area at Brass Islamd, Brass LGA for dry and wet season was obtained through desktop research (including Okpoama Tank farm EIA project executed by Lympson Leosentino Limited, January, 2021), field observations, sampling and measurements as well as laboratory analyses of biological, chemical and physical characteristics of sampled environmental components.

4.2.1 Desktop Research

Desktop research involved a detailed search of relevant textbooks, research publications, and articles. The demographic pattern and wildlife characteristics were also complemented with information acquired from relevant literature. The data generated from this process include maps, demographic data, and meteorological data of the area.

4.2.2 Reconnaissance Field Visit

A field reconnaissance visit was carried out to project area and host communities by the EIA study team lead on to firm up sampling strategies, identifies representatives of the host communities that will join the team as local labour and identify options for logistic planning in order to have a hitch-free field campaign. The consultation process that has started at this reconnaissance visit will be maintained throughout the various phases of the study and project execution.

4.2.3 Samples Collection Methodology and Preservation

The field data gathering activities for dry season was carried out between 20th and 21st September, 2021. However, in a bid to capture sufficient environmental data to enable a good impact assessment afterwards; Purposive Sampling Technique was adopted to obtain baseline data on the specific environment of the study area and sampling strategy that will allow for good coverage of the study area was adopted (See Fig. 4.1).

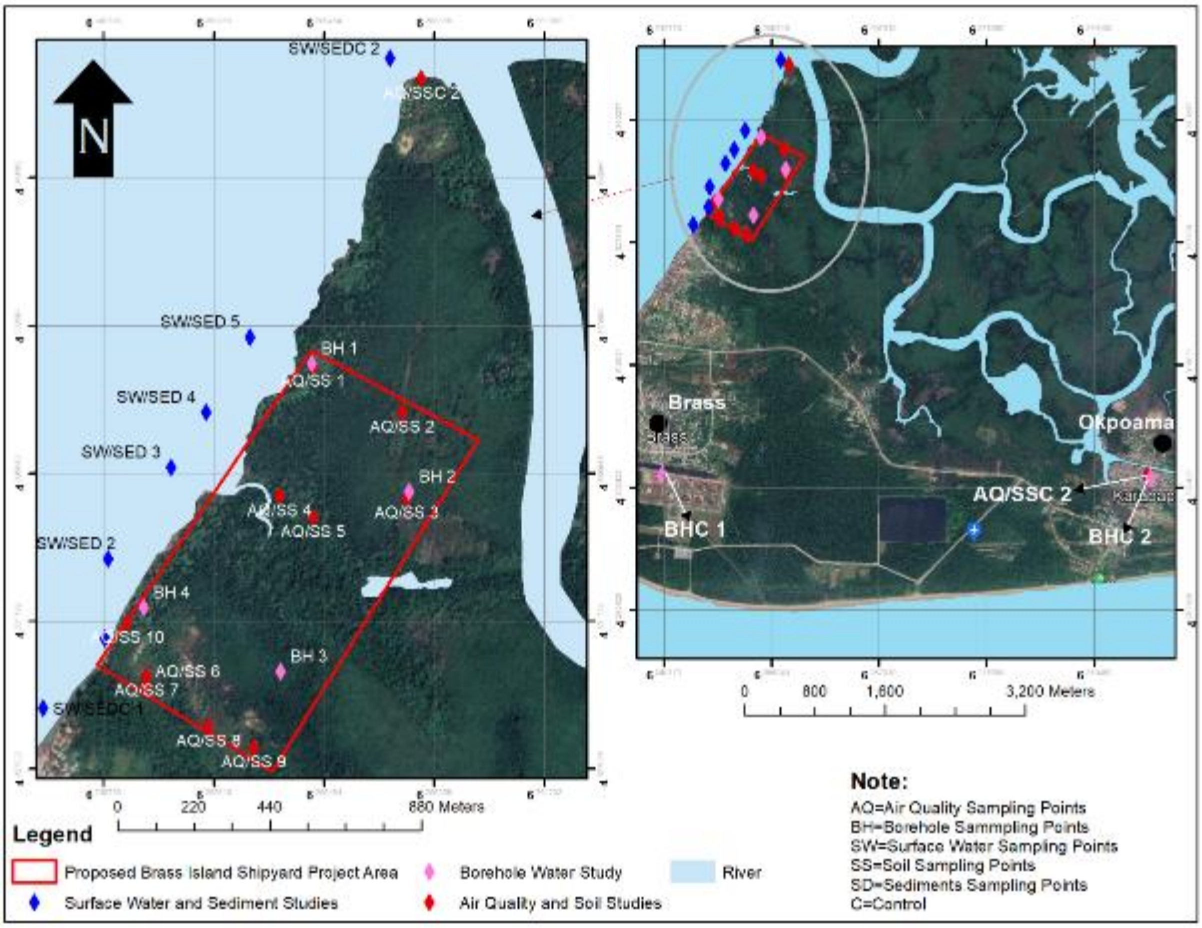


Figure 4.1: Map of the study area showing sampling stations

The study team was grouped into separate sub-teams for the various aspects of the field data gathering exercise. The different sub-teams were;

(a) Soil sampling/biodiversity/vegetation studies team

(b) Socio-economics/Health Risks studies team,

(c) Geology/hydrogeology studies team and

(d) Surface water /Sediment studies team.

Field assistants/guides (local labour) were also engaged to assist the different sub-teams. Detailed methodologies of field data gathering are presented in **Appendix A.**

Geographical Positioning

Positioning at each sampling station during the fieldwork activities was achieved with the aid of a hand-held *Garmin* Global Positioning System (GPS) V, (model CZ 99052-20). At each sampling station, coordinates at which sampling actually took place were documented.

4.2.4 Laboratory Analysis

After the fieldwork exercises, study samples were transported to Tudaka Analytical Nigeria Limited, Warri (an accredited laboratory by DPR and FMENV) for necessary and adequate analyses. Samples were analyzed using standard analytical methods (DPR, 2018; APHA, 1998). The synoptic descriptions of the laboratory analytical methods and procedures employed for the various physical, chemical and biological parameters as well as the detection limits of these parameters are documented in this report. Also documented are synopsis of the QHSE plan adopted in both field data collection and laboratory analysis. Detailed methodologies for laboratory analysis of field samples are presented in **Appendix.**

4.3 Existing Environmental Conditions of the Proposed Project Area

4.4 Ambient Air Quality

Air Quality is the state of the ambient air in each environment. Air quality often depends on a combination of meteorological conditions and cumulative local emission sources. Air monitoring is of critical importance for characterizing health risks, formulating cost-effective abatement strategies, setting, and enforcing appropriate air quality standards and for healthy urban planning (EIA NOGaPS Report, 2019). The following Air Pollution emission parameters were taken into consideration and monitored during field data gathering exercise, in line with the submitted Terms of Reference VOC, SO_2, NO_2, H_2S, CH_3, CO, CO_2, $PM_{2.5}$, and PM_{10}. A total 10 sample points were considered within the project site and two sample points which served as control were within close communities (See Figure 4.2). The following pollutant gases were considered.

- Carbon Monoxide (CO)
- Particulate Matter ($PM_{2.5}$ and PM_{10})
- Volatile Organic compounds (VOC)
- Hydrogen Sulphide (H_2S)
- Carbon dioxide (CO_2)
- Oxides of Sulphur (SO_2)
- Oxides of Nitrogen (NO_2)
- Amonnia (NH_3)
- Methane (CH_4)

To effectively assess the air quality in the study area, information on the ambient air levels and their spatial and temporal variability were considered, the mean field air quality data is as presented in **Tables 4.1** for dry season within 500 meters from the study area and **Table 4.2,** covering wet season data in the study area. Before doing this however, air pollutants were sampled. The objective of air sampling and analysis is to adequately characterise air pollution for the area of interest. Moreover, the characterisation is usually based on the intended use of the data and this use includes the following:

- Checking adherence to air quality standards,
- Observing pollution trends and relating any changes to emission variations,
- Developing and evaluating abatement strategies,
- Assessing health effects or plant damage which may have arisen from exposure to air pollutants (this will normally include geographic and temporal distributions),
- Developing and applying a warning system for prevention of undesired air pollution episodes, and developing and testing pollutant diffusion models.

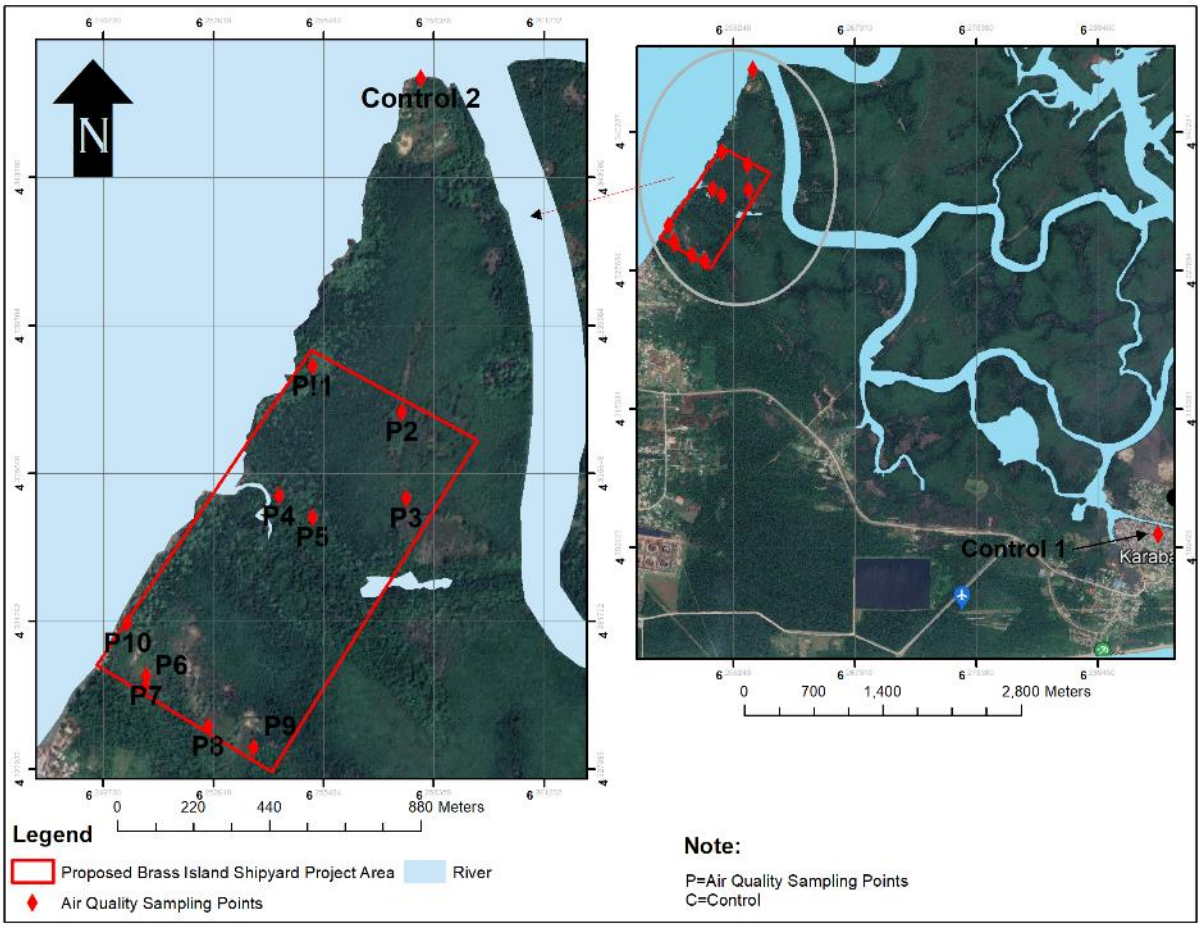


Figure 4.2: Map of the study area showing Air quality sampling stations

Table 4.1: Dry Season Mean Ambient Air Concentrations and Climate Data in the Proposed Tank Farm Project Site

Sampling Points	GPS Coordinates		CO_2	CO	NO_2	SO_2	CH_4	VOC	$PM_{2.5}$	PM_{10}	Temp.	Noise	Wind/S	Wind Direction
	Easting	Northing	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(µg/m3)	(µg/m^3)	(°C)	(dB)	(m/s)	
Point 1	006° 15' 27.44"E	4° 20' 42.85"N	37.4	2.2	0.016	0.011	0.03	4.5	25.5	31.3	33.1	50.2	1.2	NE
Point 2	006° 15' 27.12"E	4° 20' 38.33"N	26.2	1.5	0.012	0.01	0.01	2.5	27.1	31.7	33.0	45.4	0.6	NE
Point 3	006° 15' 30.05"E	4° 20' 38.82"N	26	0.2	<0.01	<0.01	0.03	0.95	23.6	34.2	34.8	49.5	0.4	SW
Point 4	006° 15' 28.42"E	4° 20' 39.52"N	18.6	<0.01	<0.01	<0.01	<0.01	<0.01	24.7	31.1	36.1	47.1	2.1	SW
Point 5	006° 15' 29.16"E	4° 20' 40.09"N	18.9	<0.01	<0.01	<0.01	<0.01	<0.01	25.6	35.7	36.2	49.8	1.7	SE
Point 6	006° 15' 27.09"E	4° 20' 40.40"N	12	<0.01	<0.01	<0.01	<0.01	<0.01	21.3	26.6	36.5	50.3	1.2	NE
Point 7	006° 15' 29.10"E	4° 20' 39.70"N	8.4	<0.01	<0.01	<0.01	0.02	0.7	17.8	19.2	35.6	51.2	0.2	SW
Point 8	006° 15' 35.04"E	4° 20' 38.01"N	13.7	<0.01	<0.01	<0.01	0.03	0.95	24.2	22.6	35.8	57.8	1.0	SE
Point 9	006° 15' 28.06"E	4° 20' 37.41"N	14.9	<0.01	<0.01	<0.01	<0.01	1.3	21.4	19.8	34.6	53.4	0.6	SE
Point 10	006° 15' 30.59"E	4° 20' 45.30"N	8.8	0.45	0.012	0.017	0.03	2.1	22.5	25.0	34.0	55.8	0.4	NW
Controls														
Control Pt.1	006° 17' 23.89"E	4° 18' 25.89"N	4.2	<0.01	<0.01	<0.01	<0.01	<0.01	26.7	31.2	32.9	47.4	1.7	NE
Control Pt. 2	006° 17' 20.65"E	4° 18' 35.59"N	6.4	<0.01	<0.01	<0.01	<0.01	<0.01	21.6	53.4	32.8	48.7	1.4	SW
EGAPSIN/FMEnv/NESREA Standards				20						20		90		
WHO Standards				10						10				
USEPA Standards 24-hour Avg. (µg/m3)					35					150				
OSHA/ASHREA (ppm)			450											

Source: Field Data in the Proposed Tank Farm Project Site Okpoama, Brass LGA Bayelsa State. (Lympson Leosentino Limited Field Data 2021)

Table 4.2: Wet Season Mean Ambient Air Concentrations and Climate Data in the Proposed Brass Island Shipyard Project Site

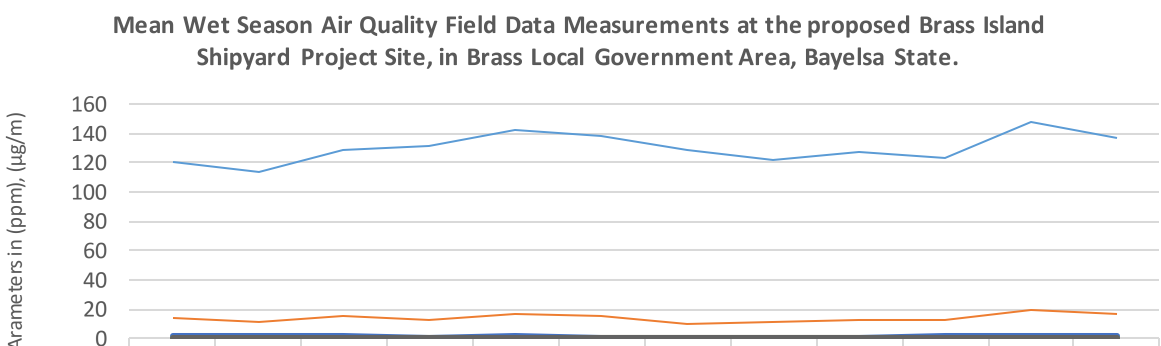
S/N	Parameters	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Control 1	Control 2	FMEnv	WHO	OSHA	NESREA
1	SOx	<0.01	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.02	0.03	<0.01				
2	CO	0.2	0.3	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	0.3	0.9	0.2	20	10		20
3	NH_3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
4	H_2S	0.1	0.11	0.14	<0.1	0.14	0.18	0.11	<0.1	0.1	0.09	0.1	0.11				
5	VOC	1.8	1.4	1.6	0.9	1.9	0.8	0.4	0.2	0.6	1.7	2.4	1.7				
6	NOx	0.024	0.034	0.039	0.02	0.039	0.033	0.019	0.011	0.009	0.02	0.007	0.009				
7	CO_2	121.2	113.4	129.1	132.2	142	138.3	128.4	122.3	128	124	148.4	136.9			450	
8	SPM	14	11	15	13	17	15	10	11	13	13	20	17	20	10		
9	SO_2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
10	Noise level	39.4	42.6	47.6	44.5	48.3	46.2	46.5	46	43.1	48.9	52.9	43.4	90			
11	Wind speed	1.8	1.4	1.4	0.9	1.9	0.7	0.4	0.7	1.1	2.4	1.8	0.4				
12	R/Humidity	76.5	78.4	78.9	82	88.9	88.6	87.8	89.9	90.2	88.7	92.7	90.1				

Source: Field Data in the Proposed Brass Island Shipyard, Brass LGA Bayelsa State. (Lympson Leosentino Limited Field Data 2021)

4.3.2. Air Quality in the Study Area (Field Study)

The air quality of the project site and the communities were adequately captured. Considering the relative health and environmental impact that may arise from atmospheric pollution, data on air quality (VOC, SO_2, NO_2, CH_4, H_2S, CO, CO_2, $PM_{2.5}$, and PM_{10}) were collected from 10 specific locations and two other points as control location.

The group of equipment (AEROQUAL series 500, BTMETER LASER PM2.5BT-5800D, IGREES PM Meter, RKI-GX 2009 Multigas, APRO CO_2 Meter) for air quality sampling were moved from sampling station to sampling station after each round of sampling was concluded at a particular sampling location. For practical reasons, measurements were not made at night. Some weather conditions were, therefore, not covered. The Dry season data were collected in January from previous publications and the Wet Seasons data was collected between 20th September and 21th September 2021. Concentrations of pollutants at each monitoring point were determined using multi-gas handheld analyser equipment that gives instant real time readings. The air quality sampling locations and results are as shown in Figure 4.3. The sampling points were taken in consideration of the project site accessibility, existing road network and community settlements.



	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Control 1	Control 2
SOx	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.03	0.01
CO	0.2	0.3	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.3	0.9	0.2
NH3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
H2S	0.1	0.11	0.14	0	0.14	0.18	0.11	0	0.1	0.09	0.1	0.11
VOC	1.8	1.4	1.6	0.9	1.9	0.8	0.4	0.2	0.6	1.7	2.4	1.7
NOx	0.024	0.034	0.039	0.02	0.039	0.033	0.019	0.011	0.009	0.02	0.007	0.009
CO2	121.2	113.4	129.1	132.2	142	138.3	128.4	122.3	128	124	148.4	136.9
SPM	14	11	15	13	17	15	10	11	13	13	20	17
SO2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Figure 4.3: Mean Field Air Quality Data at proposed Brass Shipyard Project Site

Suspended Particulate Matter

Suspended Particulate Matter (SPM) are finely divided solids or liquids with aerodynamic diameter airborne PM_{10} (atmospheric dynamics equivalent diameter $\leq 10\mu m$) and $PM_{2.5}$ (Atmospheric dynamics equivalent diameter $\leq 0.5\mu m$) derived mainly from combustion related sources that may be dispersed through the air from combustion processes, industrial activities or natural sources, such as dust, fumes, mist, and smoke. The size, chemical composition, and other physical and biological properties of particles vary with location and time.

The mean SPM field data ($PM_{2.5}$ and PM_{10}) ranged from 17.8µg/m3 to 53.4µg/m3 for dry season, which were relatively above standards except for point AQ 7. The highest mean emission of 54.3 µg/m3 was obtained at the second control point (AQ C2), as presented in Figure 4.2A. The emission of PM_{10}, were higher at every point with exception of points AQ 8 and AQ 9. This may be attributed to use of fuel wood in the community and flaring of gas within the study area. This is expected to increase during construction and requires mitigation strategies, such as continuous monitoring to minimize the effect on the workers and residents in the host community.

The wet season data were relatively low with the highest value of 20 µg/m3 obtained at control point 1 at Okpoama community and the lowest value of 10 µg/m3 obtained at Point 7, in the project site. The wet season data showed less emission of particulate matter compared to dry season data. See Figures 4.4A and 4.4B.

	AQ 1	AQ 2	AQ 3	AQ 4	AQ 5	AQ 6	AQ 7	AQ 8	AQ 9	AQ 10	AQ C1	AQ C2
PM2.5	25.5	27.1	23.6	24.7	25.6	21.3	17.8	24.2	21.4	22.5	26.7	21.6
PM10	31.3	31.7	34.2	31.1	35.7	26.6	19.2	22.6	19.8	25	31.2	53.4

Figure 4.4A: Mean SPM Dry Season Data at proposed Tank Farm Project Site within study area (Dry Season)

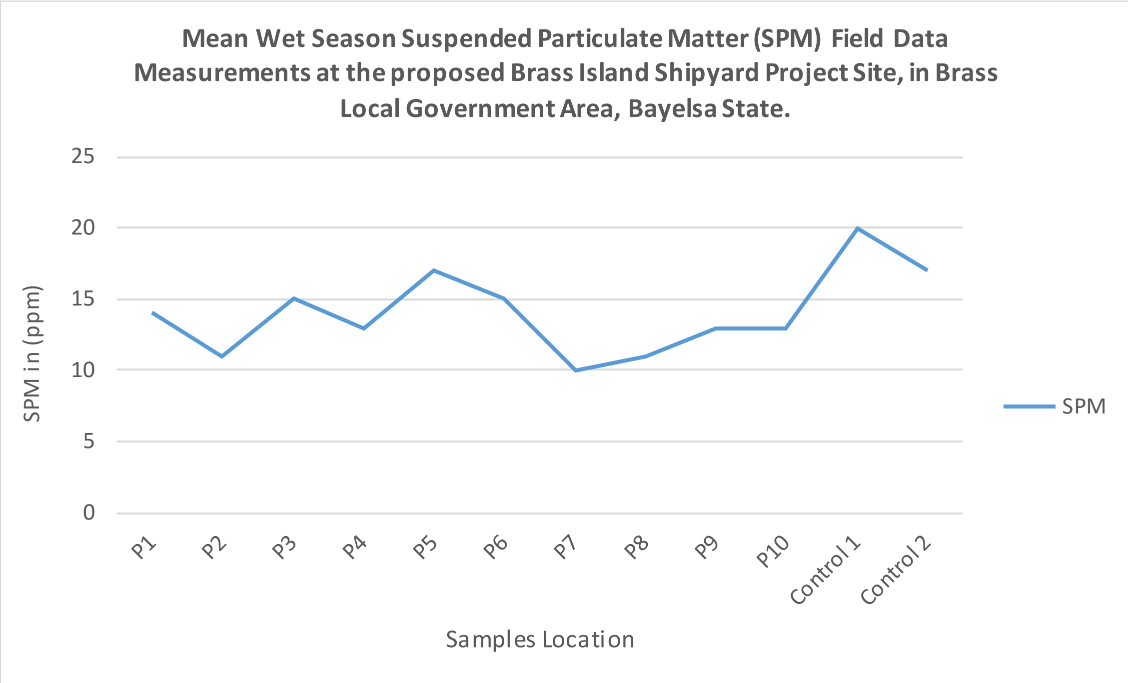


Figure 4.4B: Mean Wet Season SPM Data at proposed Brass Island Shipyard Project Site

Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate, which participates in atmospheric photochemical reactions. VOCs form ground level Ozone by "reacting" with sources of oxygen molecules such as nitrogen oxides (NOx), and carbon monoxide (CO) in the atmosphere in the presence of sunlight (USEPA, 2019).

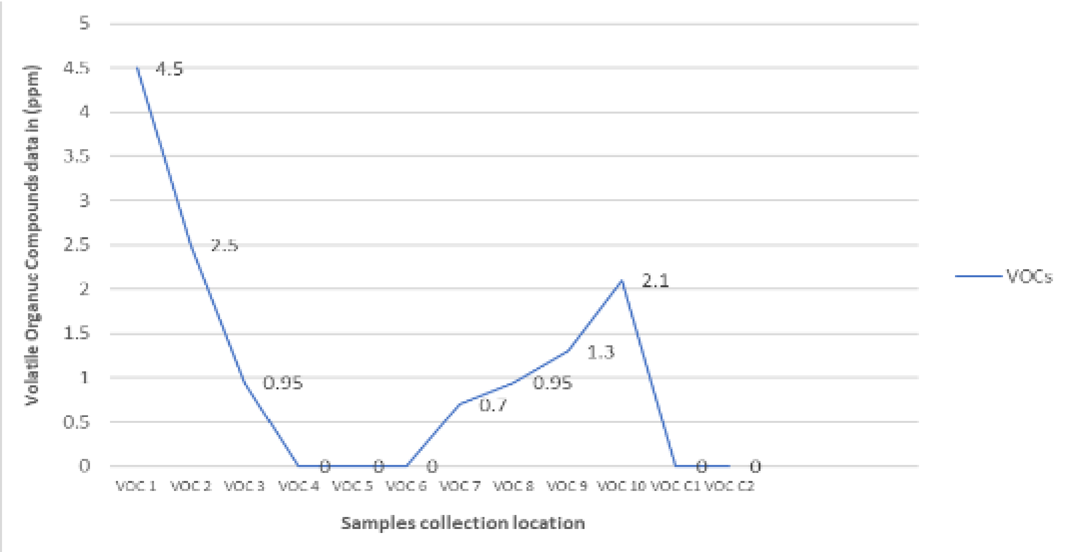


Figure 4.5A: Mean Volatile Organic Compounds Data at proposed Tank Farm Project Site

The mean data obtained during dry season field activities for VOCs within the study area were 4.5ppm highest value and <0.01ppm lowest values at five locations (AQ4, AQ5, AQ6, AQ C1 and AQ C2), inclusive of the two control locations. The wet season mean VOC data were relatively lower at all points ranging from 0.2ppm to 2.4ppm less than the FMEnv, NESREA, and EGAPSIN 2018 standards, as shown in Table 4.5A and Figure 4.5B.

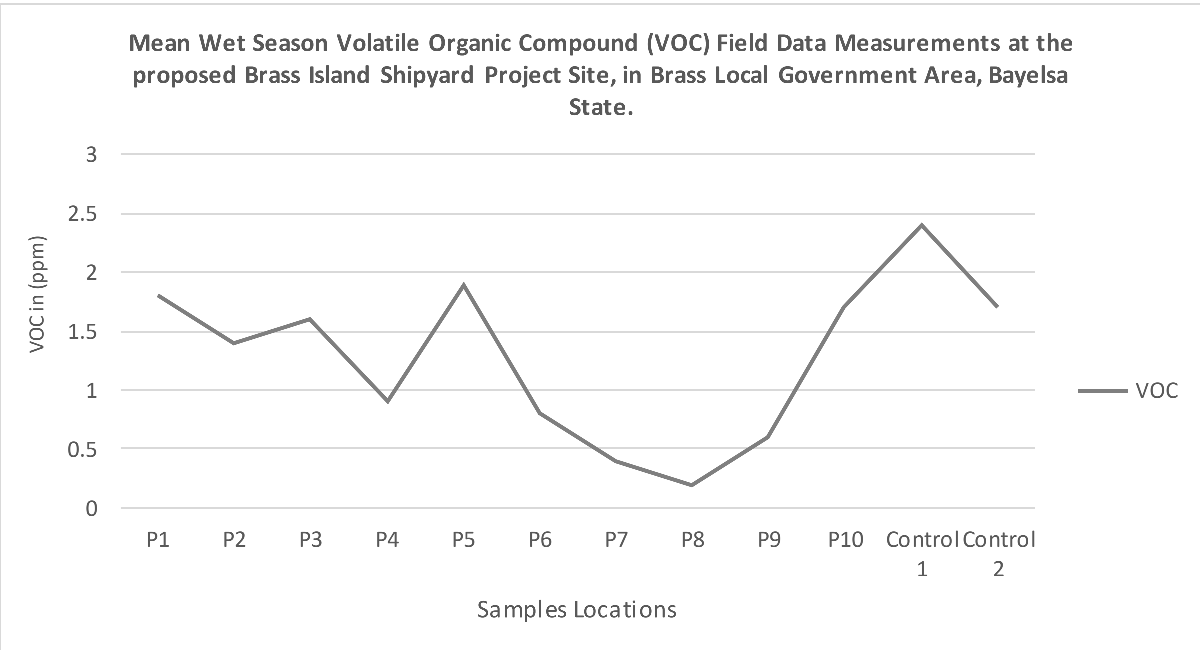


Figure 4.5B: Mean Volatile Organic Compounds Data at proposed Brass Island Shipyard Project Site

Table: 4.3: Mean Volatile Organic Compounds Data of Project Site

S/N	E-Longitude	N-Latitude	VOC (ppm)
P1	006° 15' 18.7"	04° 20' 18.4"	1.8
P2	006° 15' 27.1"	04° 20' 14.1"	1.4
P3	006° 15' 27.5"	04° 20' 06.0"	1.6
P4	006° 15' 15.2"	04° 20' 06.2"	0.9
P5	006° 15' 18.7"	04° 20' 04.2"	1.9
P6	006° 15' 03.0"	04° 19' 48.3"	0.8
P7	006° 15' 03.1"	04° 19' 49.3"	0.4
P8	006° 15' 3.24"	04° 19' 49.16"	0.2
P9	006° 15' 13.2"	04° 19' 42.6"	0.6
P10	006° 15' 01.3"	04° 19' 54.3"	1.7
Control 1	006° 17' 41.7"	04° 18' 13.1"	2.4
Control 2	006° 15' 28.9"	04° 20' 45.4"	1.7

Carbon monoxide (CO)

The pollutant gases Carbon monoxide (CO), Oxides of Sulphur (SOx), Methane (CH_4) and Nitric Oxides (NOx) obtained showed mean average within standards. Carbon monoxide mean emission value is low between (<0.01ppm and 2.2ppm) during dry season, if higher than standards it could lead to hypoxia by various mechanisms, which includes: formation of carboxyhaemoglobin (COHb) with an affinity that is 200 times greater than oxygen when inhaled and could decrease the delivery of oxygen to human body tissues (Okobia, 2015), as shown in Table 4.4.

Table 4.4: Air Quality data at the Proposed Tank Farm Project Site Brass LGA Bayelsa State

Sample Points	Easting (E)	Northing (N)	CO (ppm)	CH_4 (ppm)	SO_2 (ppm)	NO_2 (ppm)	CO_2 (ppm)
AQ 1	006° 15' 27.44"E	4° 20' 42.85"N	2.2	0.03	0.011	0.016	37.4
AQ 2	006° 15' 27.12"E	4° 20' 38.33"N	1.5	0.01	0.01	0.012	26.2
AQ 3	006° 15' 30.05"E	4° 20' 38.82"N	0.2	0.03	<0.01	<0.01	26.0
AQ 4	006° 15' 28.42"E	4° 20' 39.52"N	<0.01	<0.01	<0.01	<0.01	18.6
AQ 5	006° 15' 29.16"E	4° 20' 40.09"N	<0.01	<0.01	<0.01	<0.01	18.9
AQ 6	006° 15' 27.09"E	4° 20' 40.40"N	<0.01	<0.01	<0.01	<0.01	12.0
AQ 7	006° 15' 29.10"E	4° 20' 39.70"N	<0.01	0.02	<0.01	<0.01	8.4
AQ 8	006° 15' 35.04"E	4° 20' 38.01"N	<0.01	0.03	<0.01	<0.01	13.7
AQ 9	006° 15' 28.06"E	4° 20' 37.41"N	<0.01	<0.01	<0.01	<0.01	14.9
AQ 10	006° 15' 30.59"E	4° 20' 45.30"N	0.45	0.03	0.017	0.012	8.8
AQ C 1	006° 17' 23.89"E	4° 18' 25.89"N	<0.01	<0.01	<0.01	<0.01	4.2
AQ C 2	006o 17' 20.65"E	4o 18' 35.59"N	<0.01	<0.01	<0.01	<0.01	6.4

Source: Lympson Leosentino Limited Field work (January, 2021)

The wet season mean field Carbon monoxide data were also relatively within standards with highest value of 0.9ppm and lowest value of 0.1ppm. The highest value of CO 0.9ppm was obtained at Okpoama community (Control 1), while the project site had lower values ranging from 0.1ppm to 0.4ppm. This is as presented in Figure 4.6.

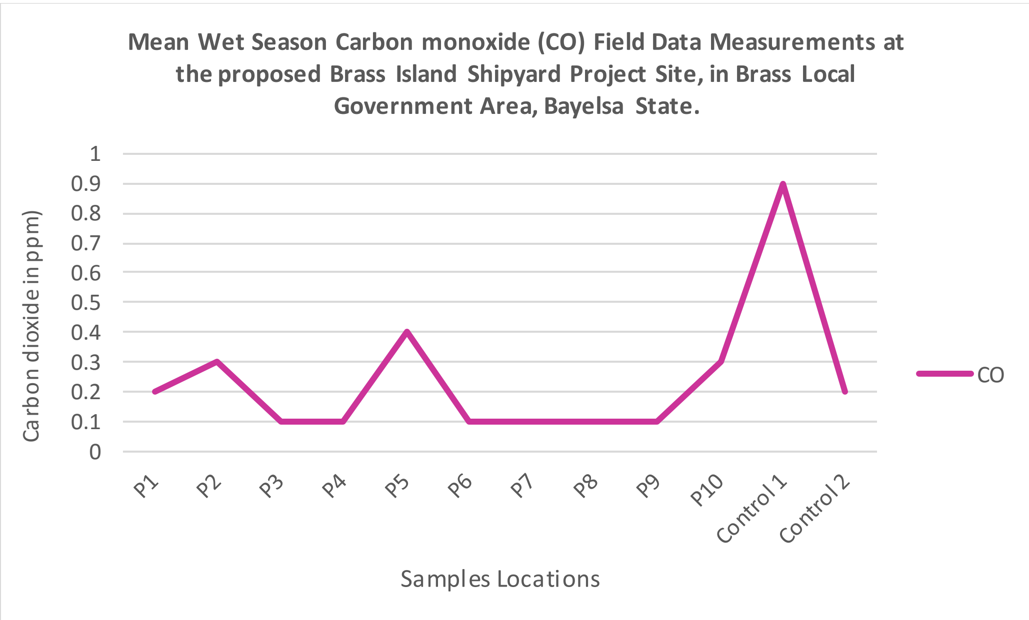


Figure 4.6: Mean Carbon monoxide (CO) Data at proposed Brass Island Shipyard Project Site

Sulphur dioxide (SO_2)

Oxides of Sulphur is categorised as a toxic gas responsible for the smell of burnt matches. It is also produced by the burning of fossil fuels contaminated with sulphur compounds, if in high concentration and inhaled, it could affect human respiratory system, particularly lung function, tract infection and eyes irritation. The mean emission values of SO_2 within the study area were low between <0.01ppm and 0.11ppm) during dry season at every sampling point, including the control locations. It is within FMEnv, NESREA and DPR limit, as presented in Figure 4.7A.

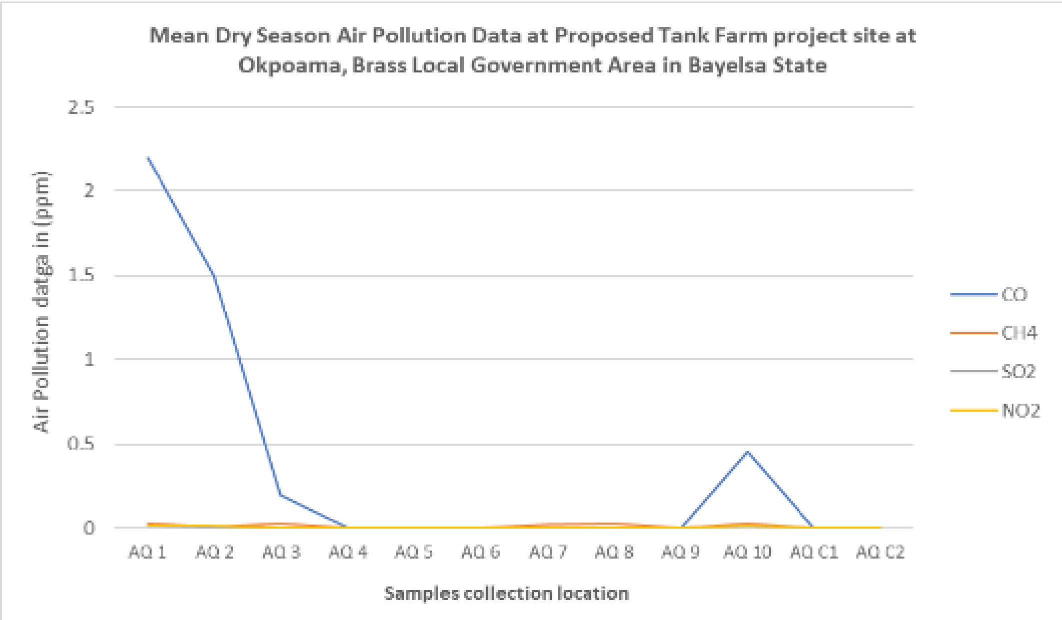


Figure 4.7A: Mean Air Pollution (CO, CH_4, SO_2, NO_2) Data at proposed Tank Farm Project Site

The mean emission values of SO_2 within the study area during wet season were low between <0.01ppm and 0.02ppm at the project site but the control 1 (Okpoama community) location had mean 0.03ppm, see Figure 4.7B. The SO_2 and SOx emission values were within FMEnv and DPR limit.

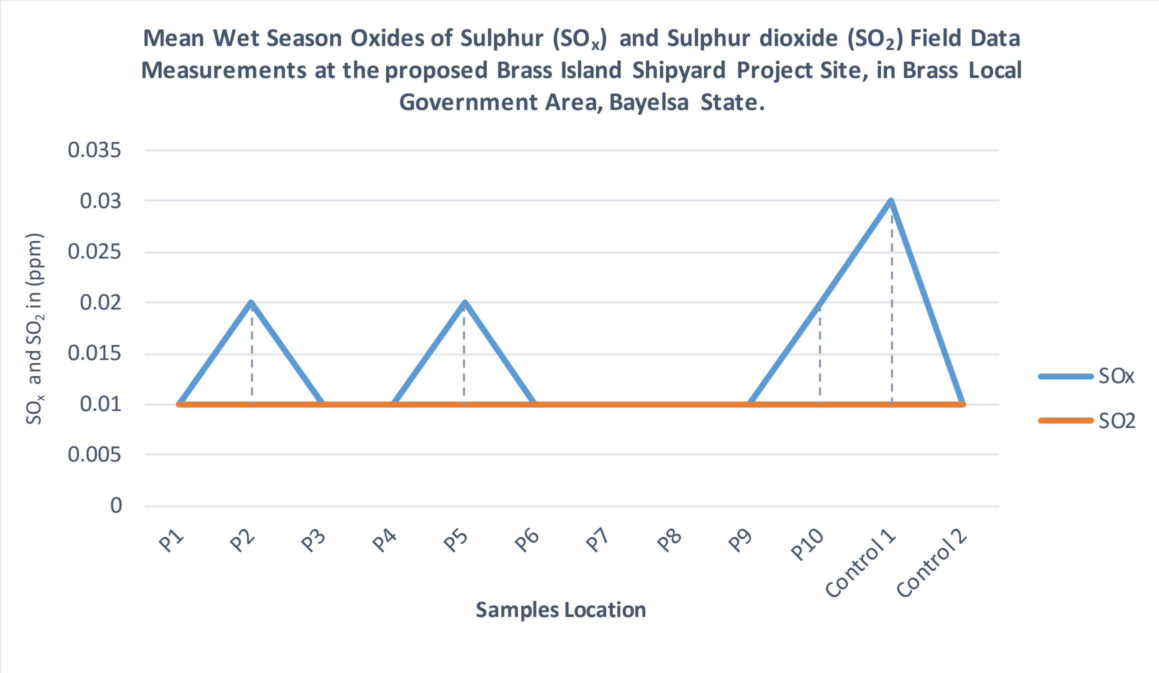


Figure 4.7B: Mean (SO_x and SO_2) field data at proposed Brass Island Shipyard Project Site

Nitrogen dioxide (NO_2)

This is one of the groups of highly reactive gases known as oxides of nitrogen, composed of nitrogen and oxygen. It is a major contributor to particle pollution and to the chemical reaction that makes ozone. It primarily gets in the air from the burning of fuel, when in high concentration and inhaled can result in heart failure and sometimes death in severe cases.

The mean emission value within the study area during the wet season is between 0.011ppm and 0.039ppm. The highest value was obtained in the project site of 0.04ppm approximately. See Figure 4.8 and Table 4.5. The values though are within FMEnv and DPR limits in the project study area.

Table 4.5: Mean NO_2 field data at proposed Brass Island Shipyard Project Site

S/N	E-Longitude	N-Latitude	NOx
P1	006° 15' 18.7"	04° 20' 18.4"	0.024
P2	006° 15' 27.1"	04° 20' 14.1"	0.034
P3	006° 15' 27.5"	04° 20' 06.0"	0.039
P4	006° 15' 15.2"	04° 20' 06.2"	0.02
P5	006° 15' 18.7"	04° 20' 04.2"	0.039
P6	006° 15' 03.0"	04° 19' 48.3"	0.033
P7	006° 15' 03.1"	04° 19' 49.3"	0.019
P8	006° 15' 3.24"	04° 19' 49.16"	0.011
P9	006° 15' 13.2"	04° 19' 42.6"	0.009
P10	006° 15' 01.3"	04° 19' 54.3"	0.02
Control 1	006° 17' 41.7"	04° 18' 13.1"	0.007
Control 2	006° 15' 28.9"	04° 20' 45.4"	0.009

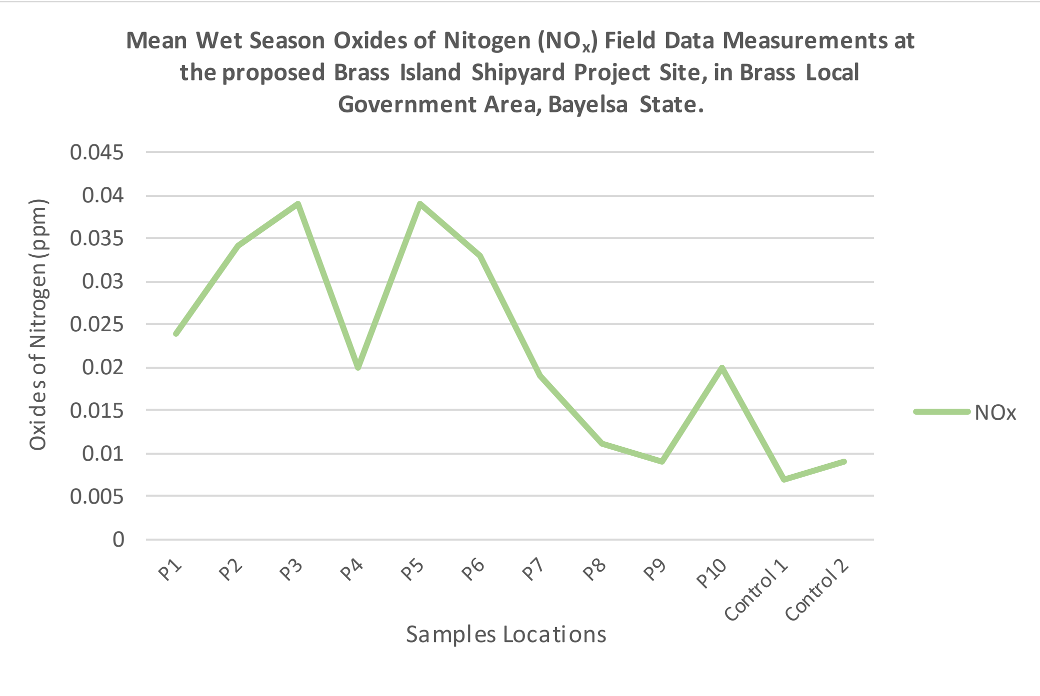


Figure 4.8: Mean NO_2 field data at proposed Brass Island Shipyard Project Site

Carbon dioxide (CO_2)

Carbon dioxide is naturally present in air (about 0.03 per cent) and is absorbed by plants in photosynthesis. It is a major Greenhous Gas which is contributing to Climate Change. The

Mauna Loa Observatory in Hawaii noted in August, 2016 that the mean monthly average measurement of CO_2 increased from 398.93 ppm in 2015 to 402.25 ppm a year later (United States Earth System Research Laboratory (ESRL) and National Oceanic and Atmospheric Administration (NOAA), 2016; Okobia., et al 2017)). The increase of Greenhouse Gas (GHG) emission is a global concern and Carbon Dioxide (CO_2) is a part of the GHG family. It is a known to be colourless, odourless gas produced by burning carbon and organic compounds and by respiration.

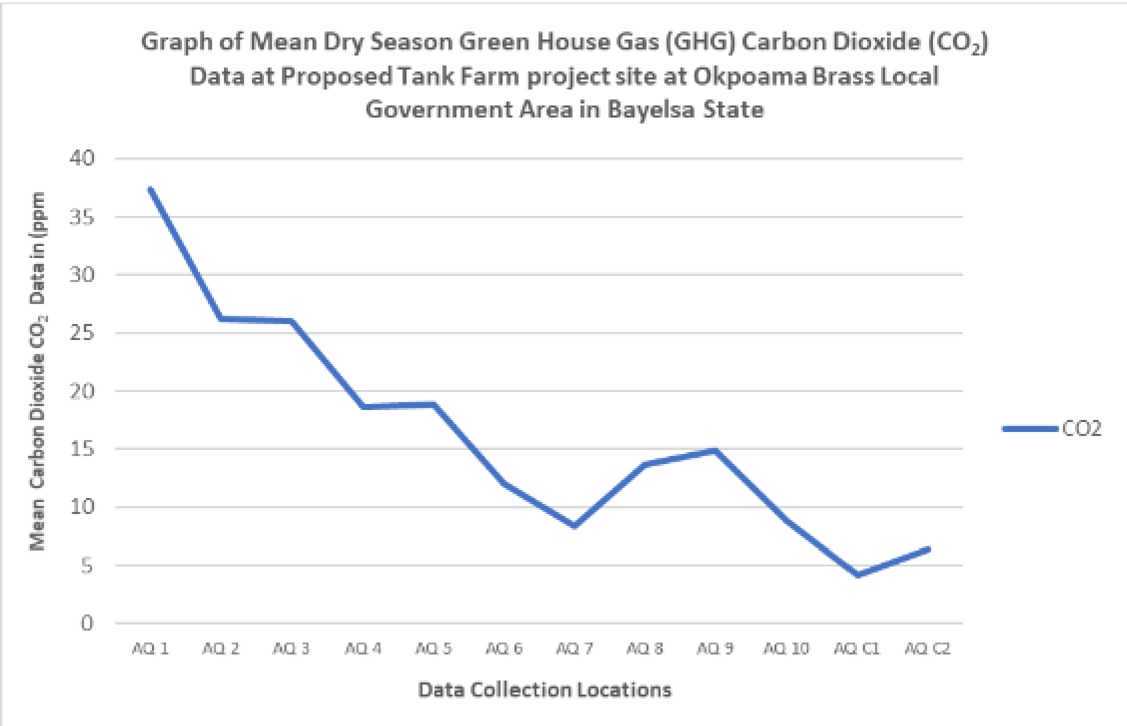


Figure 4.9A: Mean Carbon dioxide (CO_2) Data at proposed Tank Farm Project Site

The mean dry season CO_2 at all sample locations were lower than the OSHA/ASHREA Outdoor Standard of 450ppm (Okobia, et al 2017). The lowest CO_2 mean value was obtained at control 1 4.2ppm, while the highest was at AQ 1 37.4ppm, as in Figure 4.9A. Although the wet season data were relatively higher than the dry season data.

The highest mean wet season emission value is 148ppm, while the lowest emission value is 113.4ppm at point (P2). See Figure 4.9B. This may be higher attributed to the rain during data collection and number of field personnel, the mean wet season CO_2 at all sample locations were lower than the OSHA/ASHREA Outdoor Standard of 450ppm (Okobia, *et al* 2017). This may increase during construction works but should be controlled as it will lead to climate effects (Okobia and Abdul, 2020).

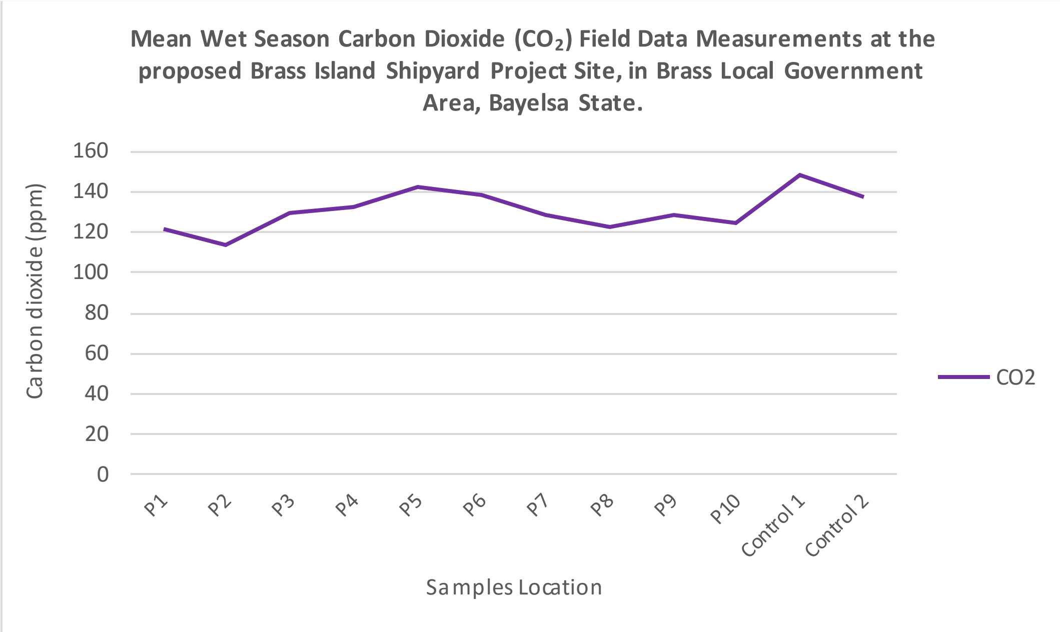


Figure 4.9B: Mean Carbon dioxide (CO_2) Data at proposed Brass Island Shipyard Project Site

Hydrogen Sulphide (H_2S)

Hydrogen Sulphide is said to account for about 9.5% of all United States greenhouse gas emission from human activities. It is evident around decomposed refuse dumpsites in Nigeria. The mean emission value is between <0.01 ppm and 0.11ppm within the study area, as in Table 4.2, which is low and within FMEnv and EGAPSIN 2018 limit in the Oil and Gas industry.

The lowest mean emission value is <0.1ppm at points (P4, P8 and Control 1) respectively, while the highest mean emission value is 0.18ppm at point P6. See Figure 4.10 and Table 4.6.

Table 4.6: Mean Hydrogen Sulphide (H2S) Data at proposed Brass Island Shipyard Project Site

S/N	E-Longitude	N-Latitude	H_2S (ppm)
P1	006° 15' 18.7"	04° 20' 18.4"	0.1
P2	006° 15' 27.1"	04° 20' 14.1"	0.11
P3	006° 15' 27.5"	04° 20' 06.0"	0.14
P4	006° 15' 15.2"	04° 20' 06.2"	0.1
P5	006° 15' 18.7"	04° 20' 04.2"	0.14
P6	006° 15' 03.0"	04° 19' 48.3"	0.18
P7	006° 15' 03.1"	04° 19' 49.3"	0.11
P8	006° 15' 3.24"	04° 19' 49.16"	0.1
P9	006° 15' 13.2"	04° 19' 42.6"	0.1
P10	006° 15' 01.3"	04° 19' 54.3"	0.09
Control 1	006° 17' 41.7"	04° 18' 13.1"	0.1
Control 2	006° 15' 28.9"	04° 20' 45.4"	0.11

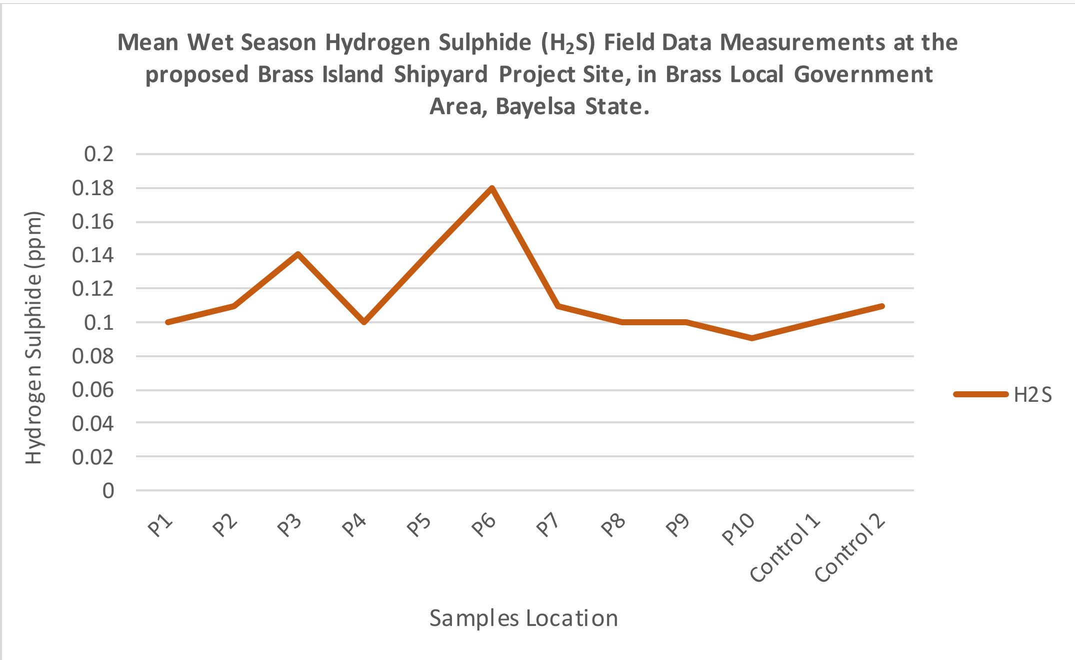


Figure 4.10: Mean H_2S emission Data at proposed Brass Island Shipyard Project Site

Ammonia

Ammonia gas (NH_3) contains nitrogen and hydrogen gases, it is colourless and has a pH value of 11 – 13. is said to account for about 9.5% of all United States greenhouse gas emission from human activities. It is evident around decomposed refuse dumpsites in Nigeria. The mean emission is <0.01 ppm within the study area, as in Table 4.2, which is low and within FMEnv and EGAPSIN 2018 limit in the Oil and Gas industry.

Ambient Noise

Benetech Digital sound meter GM1356 model was used to measure noise levels at all locations. The equipment measures noise via microphone probe that generates signals appropriately proportional to sound waves. The sensor of the sound level meter was directed upwards and an average reading over a period of two minutes was taken to be the Noise-level at each point with the measuring range: calibration instrument standard 94dB at 1KHZ, the time weighting is FAST; Level range is 60 to 10dB.

Table 4.7: Dry Season Mean Noise Pollution in the Proposed Study Area

Sample Points	Northings	Eastings	Noise (dB)
NP 1	4º 20' 42.85"N	006º 15' 27.44"E	50.2
NP 2	4º 20' 38.33"N	006º 15' 27.12"E	45.4
NP 3	4º 20' 38.82"N	006º 15' 30.05"E	49.5
NP 4	4º 20' 39.52"N	006º 15' 28.42"E	47.1
NP 5	4º 20' 40.09"N	006º 15' 29.16"E	49.8
NP 6	4º 20' 40.40"N	006º 15' 27.09"E	50.3
NP 7	4º 20' 39.70"N	006º 15' 29.10"E	51.2
NP 8	4º 20' 38.01"N	006º 15' 35.04"E	57.8
NP 9	4º 20' 37.41"N	006º 15' 28.06"E	53.4
NP 10	4º 20' 45.30"N	006º 15' 30.59"E	55.8
NP C1	4º 18' 25.89"N	006º 17' 23.89"E	47.4
NP C2	4º 18' 35.59"N	006º 17' 20.65"E	48.7

Source: Lympson Leosentino Limited Field work (January, 2021)

The dry season noise level mean data within the study area is as presented in Table 4.7. The highest mean decibels reading is 57.8dB, while the second highest sound level was 55.8dB.

Table 4.8: Wet Season Mean Noise Pollution in the Brass Island Shipyard Project Site

S/N	E-Longitude	N-Latitude	**Noise levels** (dB)
P1	006° 15' 18.7"	04° 20' 18.4"	39.4
P2	006° 15' 27.1"	04° 20' 14.1"	42.6
P3	006° 15' 27.5"	04° 20' 06.0"	47.6
P4	006° 15' 15.2"	04° 20' 06.2"	44.5
P5	006° 15' 18.7"	04° 20' 04.2"	48.3
P6	006° 15' 03.0"	04° 19' 48.3"	46.2
P7	006° 15' 03.1"	04° 19' 49.3"	46.5
P8	006° 15' 3.24"	04° 19' 49.16"	46.0
P9	006° 15' 13.2"	04° 19' 42.6"	43.1
P10	006° 15' 01.3"	04° 19' 54.3"	48.9
Control 1	006° 17' 41.7"	04° 18' 13.1"	52.9
Control 2	006° 15' 28.9"	04° 20' 45.4"	43.4

Source: Lympson Leosentino Limited Field work (January, 2021)

The Wet season noise level data was taken at 10 locations within the project area and 2 within the closest communities to establish the baseline noise levels. The highest mean decibels reading obtained at Control 1 (Okpoama community) is 52.9dB, lower than the dry season highest noise level mean data of 57.8dB. Nevertheless, the graph in figure 4.11 gives a vivid representation of the Noise pollution during wet season, these levels were lower than the FMEnv, DPR and NESREA sound emission limit of 90dB.

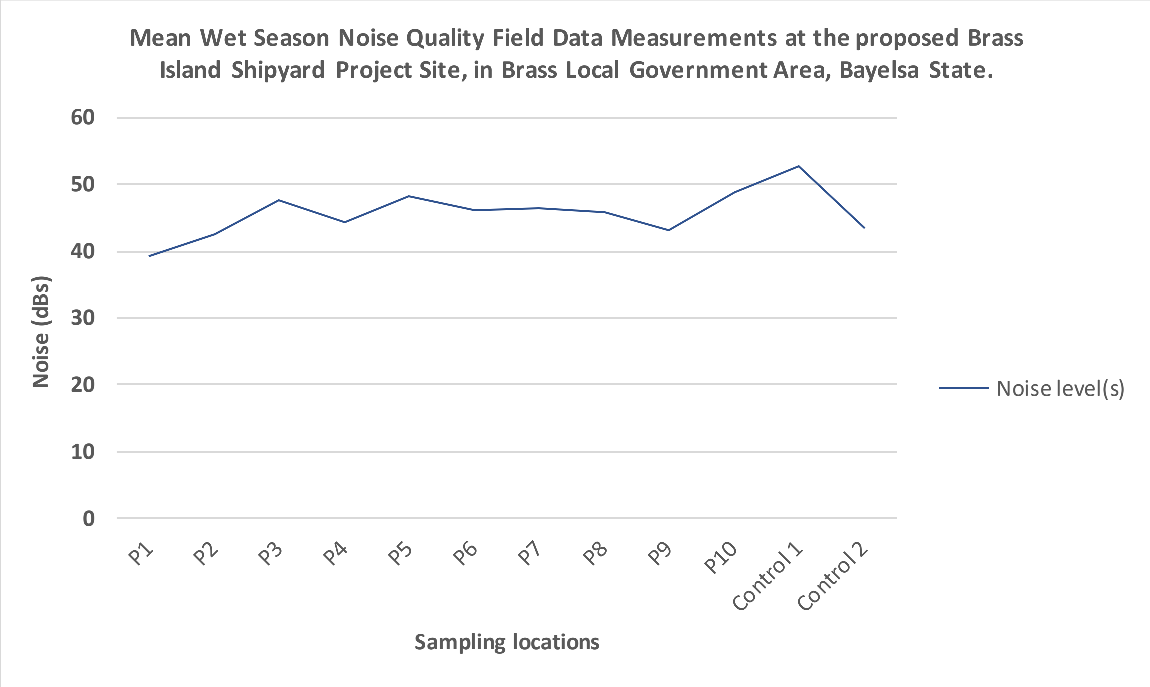


Figure 4.11: Mean Noise level Data at proposed Brass Island Shipyard Project Site

The wet season data recorded within the project site was not higher. It is important to state that the noise level may increase during construction works as construction equipment, vehicular movement and human activities will increase the noise values. This should be noted during the impact mitigation plan or environmental management plan.

Wind Speed

The wind speed of the project area during wet season is presented in Table 4.9, while the diurnal wind speed record for dry season ranges from 0.2 m/s to 2.1 m/s, with a mean of 1.04m/s. The observable directions are South-Westerly (SW), North-Easterly (NE), and South-Easterly (SE). The highest wind speed in the study area during dry season was 2.1m/s and the lowest was 0.2m/s.

Table 4.9: Wet Season Mean Noise Pollution in the Brass Island Shipyard Project Site

S/N	E-Longitude	N-Latitude	Wind Speed (m/s)
P1	006° 15' 18.7"	04° 20' 18.4"	1.8
P2	006° 15' 27.1"	04° 20' 14.1"	1.4
P3	006° 15' 27.5"	04° 20' 06.0"	1.4
P4	006° 15' 15.2"	04° 20' 06.2"	0.9
P5	006° 15' 18.7"	04° 20' 04.2"	1.9
P6	006° 15' 03.0"	04° 19' 48.3"	0.7
P7	006° 15' 03.1"	04° 19' 49.3"	0.4
P8	006° 15' 3.24"	04° 19' 49.16"	0.7
P9	006° 15' 13.2"	04° 19' 42.6"	1.1
P10	006° 15' 01.3"	04° 19' 54.3"	2.4
Control 1	006° 17' 41.7"	04° 18' 13.1"	1.8
Control 2	006° 15' 28.9"	04° 20' 45.4"	0.4

Source: Lympson Leosentino Limited Field work (January, 2021)

The average wind speed is lower during the wet season, as shown in Figure 4.12 and 4.13. This during the months of June to October but windy around August. Calm periods are rare but could be prevalent where there are canopies of tree covers during the day or at late night. It is a result of temperature inversion which leads to a more stable atmosphere within the period with the potential to affect air quality at ground level.

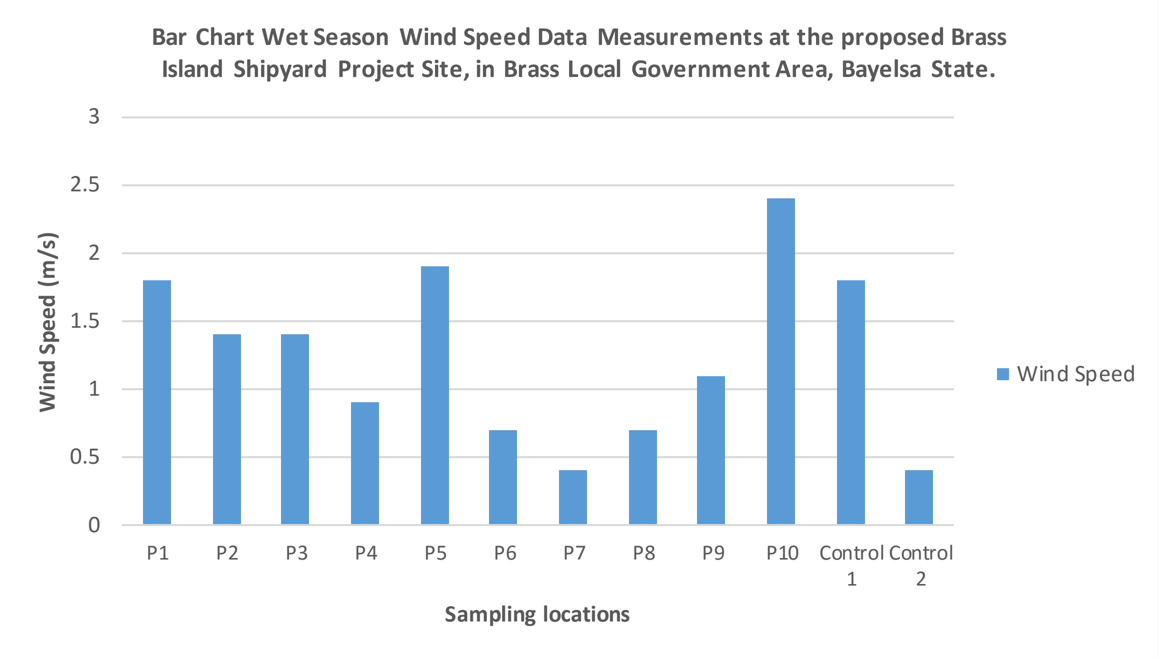


Figure 4.12: Bar chart of Mean Wind Speed at proposed Brass Island Shipyard Project Site

The average wet season wind speed is higher than the dry season. While the dry season highest mean wind speed was 2.1m/s, the wet season highest mean data was 2.4m/s as shown in Figures 4.12 and 4.13.

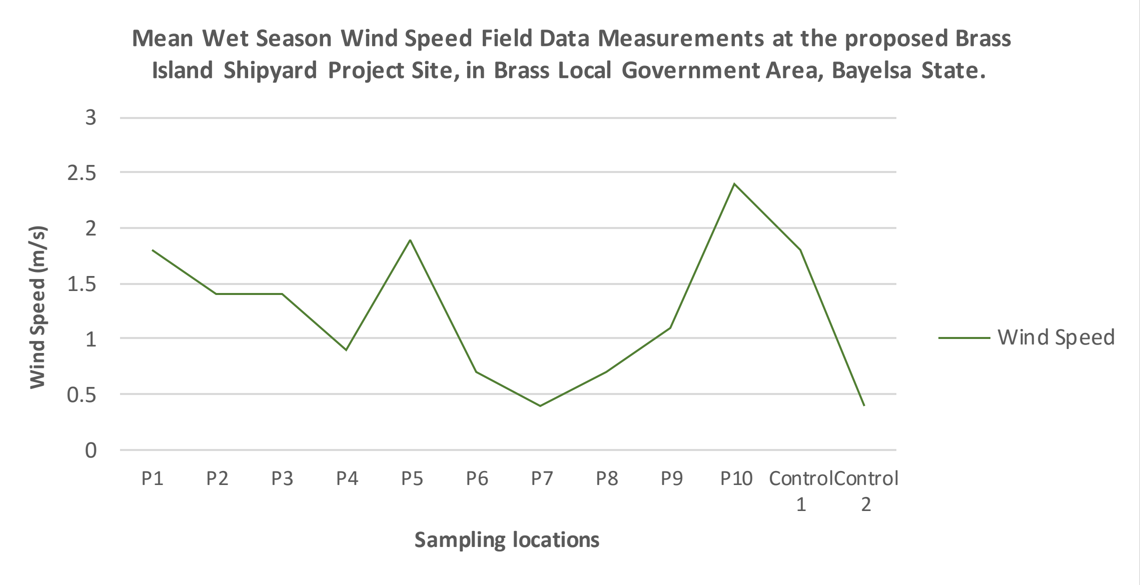


Figure 4.13: Bar chart of Mean Wind Speed at proposed Brass Island Shipyard Project Site

Wind Direction

The wide-area hourly average wind vector (speed and direction) is being analysed at 10 metres above the ground. The wind is based on the location and it is also dependent on local topography and other factors, such as instantaneous wind speed and direction which may vary more widely than hourly averages and every 2kph.

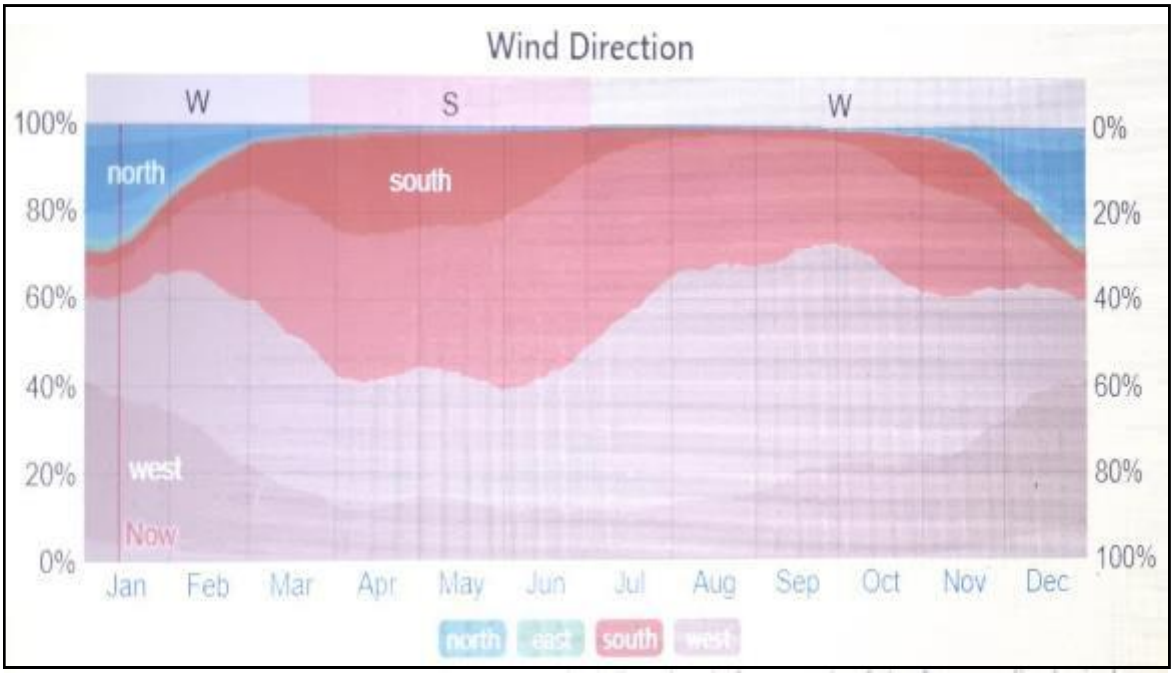


Figure 4.14: Wind Direction at proposed Project Study Area
Source: Weather Spark, 2021

The predominant average hourly wind direction in Brass varies throughout the year. The wind direction is centred on the NW, NE, SE and SW, as in Table 4.5 with concentration around the western axis of Brass. The wind is most often from the south for about 4 months, from 22 March to 2 July, with a peak percentage of 60% around the month of May (Weather Spark, 2021). The wind is most often from the west for about 9 months, from the month of July to March annually, with a peak percentage of 61% early in the month of January, as presented in **Figure 4.14**.

4.5 Surface water Study

4.5.1 Physico-Chemical Characteristics of Surface Water

The physical and chemical characteristics of the Brass and Okpoama surface water are presented in **Table 4.6** below and shown in **Figure 4.15**. Generally, the waters pH ranged from 6.94-7.12 during the dry season while it ranged from 7.6 to 8.6 during the wet season. The electrical conductivity values for dry season range from 30440-34360 µS/cm while it ranged from 6500-11700µS/cm for wet season. The salinity as Chloride for dry season ranged from 8398 to 9898 mg/L while that of wet season ranged from 1530.74 to 5154.08mg/L which was uniformly brackish (water with dissolved solids above 1000 mg/l) within the study area. This shows the extent of salt-water incursion (salinity as chloride) into the proposed project site. Total Dissolved Solids (TDS) for dry season and wet season ranged from 16742 to 18898 mg/L and 3200 to 5900mg/L respectively which were aslo above threshold limits. While Salinity (ppt) ranged from 18.03 to 20.48 during the dry season and franges from 1530.74 to 5154.08mg/l during the wet season. However, all other parameters measured for the surface water were below DPR/FMEnv limits **(Table 4.10).**

The results of analysis of the concentrations of heavy metals present in the surface water within the proposed project site for dry and wet seasons are as shown in Table 4.6 and Table 4.7 respectively. The value for Iron (Fe) for dry season ranged from 0.74-2.16 mg/l with only SW3 below threshold limit while that of wet season was below equipment detection limit of <0.001mg/l hence was below threshold limit. While during the dry season, Zn ranged from 0.12-0.18mg/l while wet season ranged from 0.019 to 0.045mg/l with an average value of 0.0298 while the control values average was 0.018mg/l which were below threshold limit of 3.0mg/l and 15mg/l as stipulated by FMEnv and DPR respectively. However the concentration of, lead, chromium, barium, vanadium and mercury during the dry season were below equipment detection limits of <0.001mg/l while lead, chromium, barium, vanadium, Manganese, cadmium and mercury were below equipment detection limits of <0.001mg/l during the wet season.

However, dissolved oxygen (DO) level range from 6.9 to 7.3mg/l (dry season) and 3.6 to 6.5mg/l (wet season) which are about sufficient for sustaining aquatic life. BOD levels, an impact indicator of polluted water, are below the regulatory limit of 10mg/l and this range between 1.8 to 2.4mg/l for dry season and 1.6 to 2.4mg/l for wet season. However, an average BOD value of over 4.0mg/l in natural waters is classified as polluted. There was no indication of eutrophication in the water bodies, suggesting that the waters are relatively unpolluted with respect to organic matter.

For cation, the level of Ca^{2+} ranged from 280.05 to 429.27mg/l (dry season) and 19.654 to 92.084mg/l (wet season). However, these values were above the DPR threshold limit of 200mg/l for dry season and below for wet season. While Na^{+} values ranged from 6005-7533mg/l (dry season) and 105.98 to 349.6mg/l (wet season). However, K^{+}, and Mg^{2+} were within their respective threshold limit for dry season while that of wet season, K^{+}values ranged from 32.112 to 65.328mg/l and within the threshold limit while that for Mg^{2+} ranged from 55.932 to 171.084mg/l with an average of 106.5416mg/l which is above the controls average value of 77.443mg/l and aslo within the DPR threshold limit of 150mg/l for all sampling points escept for SW1 (171.084mg/l). Importantly, high values of cations may indicate the hardness of the waters in the proposed project area.

Table 4.10: Surface Water Quality in the Proposed Project Area

Parameters	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW C1	SW C2	RANGE	FMENV Limits	DPR Limits
pH	7.12	6.98	7.03	6.94	6.96	7.01	7.06	6.91	6.94-7.12	6.5-8.5	6.5-9.5
Electrical Conductivity (µS/cm)	30440	30940	30740	34280	31800	34360	30160	30840	30440-34360	-	-
TDS (mg/L)	16742	17017	16907	18857	17490	18898	16588	16962	16742-18898	500	2000
Temperature (^{0}C)	27.1	26.8	27.3	27.4	27.5	27.4	27.7	27.2	26.8-27.5	25.0-30.0	<30.0
Colour (Pt-Co)	6.0	8.0	7.0	5.0	8.0	7.0	4.0	2.0	5-8	-	-
Salinity (ppt)	18.03	18.48	18.15	20.43	18.76	20.48	17.63	18.26	18.03-20.48	-	-
TSS (mg/L)	32.94	11.07	20.98	51.49	31.32	41.26	5.22	1.17	11.07-51.49	-	-
Nitrite (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-
DO (mg/L)	7.1	6.9	7.2	7.3	7.0	7.2	7.0	7.1	6.9-7.3	-	-
Turbidity(NTU)	81.50	85.80	85.00	339.00	216.00	130.00	11.10	4.84	81.5-339	5.0	-
BOD_5 (mg/L)	2.25	2.40	1.95	2.10	2.10	1.80	2.25	1.95	1.8-2.4	-	-
COD (mg/L)	80.00	83.20	91.73	85.33	97.07	102.40	92.80	76.80	80-102.4	-	-
THC (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0-0	-	-
Ammonium (mg/L)	0.35	0.31	0.48	0.45	0.41	0.54	0.30	0.26	0.31-0.54	-	-

Chloride (mg/L)	8398	8598	9498	9898	8648	9298	8548	8448	8398-9898	-	-
Nitrate (mg/L)	2.97	3.88	2.34	1.25	3.15	1.52	1.23	1.74	1.25-3.88	-	-
Phosphate (mg/L)	<0.01	0.07	<0.01	0.01	0.01	0.01	<0.01	<0.01	0.01-0.07	-	-
Sulphate (mg/L)	1413	1465	1446	1584	1492	1637	1621	1431	1413-1637	-	-
Total hardness (mg/L as $CaCO_3$)	1060	890	1034	1340	853	990	852	900	853-1340	-	500
Carbonates (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0-0	-	-
Total Alkalinity (mg/L as $CaCO_3$)	96.0	106.0	78.0	80.0	82.0	108.0	74.0	78.0	78-108	-	-
Oil & Grease (mg/L)	<0.01	0.34	<0.01	<0.01	0.82	0.34	<0.01	<0.01	0.34-0.82	-	-
Cu (mg/L)	0.03	0.03	0.05	0.03	0.05	0.04	0.02	0.01	0.03-0.05	1.0	-
Fe (mg/L)	1.87	2.00	0.74	2.08	1.99	2.16	2.17	1.80	0.74-2.16	-	1.0
Ni (mg/L)	1.51	1.66	1.49	1.77	1.65	1.73	1.56	1.49	1.49-1.77	-	-
Zn (mg/L)	0.12	0.18	0.13	0.16	0.14	0.17	0.19	0.17	0.12-0.18	3.0	15
Pb (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	0.05	0.05
Mn (mg/L)	0.16	0.08	0.13	0.12	0.10	0.10	0.15	0.21	0.08-0.16	-	-
Cd (mg/L)	0.13	0.12	0.13	0.14	0.13	0.14	0.13	0.13	0.12-0.14	-	-
Cr (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-
Ba (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-
V (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-
Hg (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	0.001	-
Na (mg/L)	6419	6274	6152	7533	6005	6120	5428	5605	6005-7533	-	-
K (mg/L)	13.49	19.65	17.82	15.90	14.97	11.39	9.82	10.29	11.39-19.65	-	-
Ca (mg/L)	280.05	321.95	312.20	326.83	317.01	429.27	336.59	322.21	280.05-429.27	-	200
Mg (mg/L)	93.35	115.24	98.07	108.94	110.96	102.76	112.20	106.10	93.35-115.24	-	150
TPH (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-
PAH (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-
BTEX (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	-	-

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.11: Surface Water Quality in the Proposed Project Area during the wet season

Parameters (Units)	SW 1	SW 2	SW 3	SW 4	SW 5	Range	Average	SW-C1	SW-C2	Control Average	FMENV Limits	DPR Limits
pH	8.6	8.1	7.9	7.6	7.7	7.6-8.6	7.98	7.5	7.4	7.45	6.5-8.5	6.5-9.5
Temp (°C)	28.1	27.3	27.4	27.6	27.3	27.3-28.1	27.54	26.9	27.6	27.25	25.0-30.0	<30.0
TDS (mg/l)	5900	4500	3600	3300	3200	3200-5900	4100	5200	2400	3800	500	2000
EC (µS/cm)	11700	9000	7200	6700	6500	6500-11700	8220	10500	4800	7650	-	-
Turbidity (N.T.U)	147.2	174.9	176.7	191.7	135.1	135.1-191.7	165.12	227.7	52.61	140.155	5	-
DO (mg/l)	4.7	4.2	3.6	4.5	6.5	3.6-6.5	4.7	4.1	5.6	4.85	-	-
TSS (mg/l)	160	190	200	210	150	150-210	182	240	70	155	-	-
Total Alkalinity (mg/l)	0.46	0.4	0.36	0.32	0.34	0.32-0.46	0.376	0.3	0.28	0.29	-	-
Salinity (mg/l)	5154.08	3483.62	2017.39	1644.88	1530.74	1530.74-5154.08	2766.142	3890.85	478.67	2184.76	-	-
BOD (mg/l)	2.4	1.9	1.6	2.1	2	1.6-2.4	2.0	1.6	1.4	1.5	10.0	-
COD (mg/l)	5.85	4.52	3.81	5	4.76	3.81-5.85	4.788	3.9	3.33	3.615	-	-
Chloride (mg/l)	2862.4	1934.7	1120.4	913.52	850.13	850.13-2862.4	1536.23	2160.86	265.84	1213.35	-	-
SO_4 (mg/l)	271.99	207.45	165.96	152.13	147.52	147.52-271.99	189.01	239.72	110.64	175.18	-	-
NO_3 (mg/l)	28.91	22.05	17.64	16.17	15.68	15.68-28.91	20.09	25.48	11.76	18.62	-	-
NO_2 (mg/l)	0.54	0.41	0.33	0.3	0.29	0.29-0.54	0.374	0.48	0.22	0.35	-	-
PO_4 (mg/l)	0.43	0.38	0.35	0.31	0.29	0.29-0.43	0.352	0.41	0.16	0.285	-	-

NH_4 (mg/l)	0.16	0.11	0.09	0.08	0.06	0.06-0.16	0.1	0.13	0.05	0.09	-	-
Na (mg/l)	349.6	309.57	215.4	149.85	105.98	105.98-349.6	226.08	175.09	65.06	120.075	-	-
K (mg/l)	65.328	53.924	46.93	37.442	32.112	32.112-65.328	47.1472	51.36	28.25	39.805	-	-
Ca (mg/l)	92.084	71.397	40.581	21.673	19.654	19.654-92.084	49.0778	91.856	31.414	61.635	-	200
Mg (mg/l)	171.084	140.82	93.891	70.981	55.932	55.932-171.084	106.5416	102.089	52.797	77.443	-	150
Oil & Grease (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
THC (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
TPH (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
PAH (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
BTEX (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Mn (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	-
Cd (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	-
Cr (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	-
Ni (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	-
V (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	-
Pb (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	0.05	0.05
Ba (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	-
Hg (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	0.001	-
Fe (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	-	1
Zn (mg/l)	0.025	0.019	0.045	0.033	0.027	0.019-0.045	0.0298	0.018	0.022	0.02	3	15

Source: Lympson Leosentino Limited Field work (September, 2021)

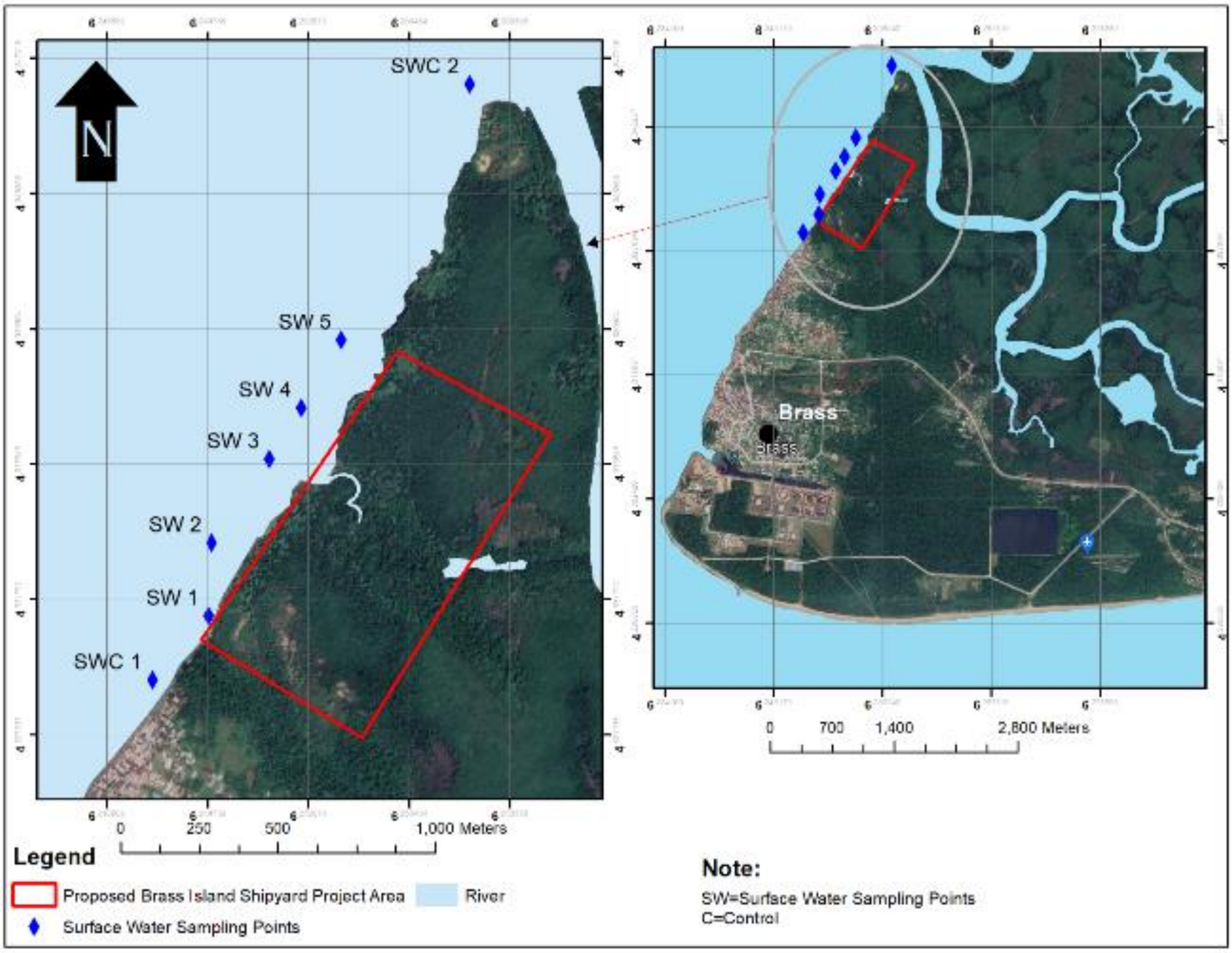


Figure 4.15: Map of the study area showing Surface water sampling stations

4.5.2 Microbiological Characteristics of Surface Water

Generally, microbiology is the scientific study of living organisms which the naked eye cannot see, but are however around us. Microorganisms are essential components of the aquatic ecosystem and are involved in the synthesis of many organic and inorganic compounds during primary production as well as the decomposition of the organic matter. The two groups of microorganisms studied are bacteria and fungi, which are the most important organic matter decomposers in the environment. The microbial status of surface water quality in the study as expressed in their values is presented in **Table 4.12** and **Table 4.13**.

Bacteria: These are unicellular microorganisms that are ubiquitous in nature, which means that they are virtually found everywhere. They are classified into autotrophic and heterotrophic bacteria. Most bacteria are heterotrophic (THB) and thus depend on organic matter for nutrient. They include the nitrogen-fixing and non-nitrogen-fixing groups. The non-nitrogen-fixing group are the most prevalent bacteria and account for much of the decomposition of organic materials. The bacteria genera Klebsiella, is reported to be associated in nitrogen fixation with numerous grasses (Donahue, *et al*, 1990). Some bacteria have the special ability to degrade hydrocarbons and they are referred to as hydrocarbon utilising bacteria (HUB).

Analysis result of surface water samples collected in the proposed project area indicated that the total heterotrophic bacteria (THB) count in the surface water samples ranged between 1.4 x 10^4 – 4.8 x 10^4 cfu/ml (dry season) and 5.11 x 10^8 – 7.83 x 10^8 cfu/ml (wet season). The predominant bacterial species were, *Staphylococcus spp., Pseudomonas spp., Streptococcus spp., and Escherichia spp*. The microbial load of HUB in the surface water body was not detected during the dry sason while that of wet season ranged from 2.18 x 10^5 to 3.27 x 10^5 cfu/ml.

Fungi analysis result of surface water samples collected in the dry season from the sampling stations in the study area indicated that the total heterotrophic fungi (THF) count in the surface water samples ranged between 1.0 x 10^2 to 3.5 x 10^2 cfu/ml while that of wet season ranged from 1.5 x 10^3 to 3.5 x 10^3 cfu/ml. However, microbial load of HUF in the surface water body was not detected during the dry season study while it ranged from 0.5 x 10^2 to 2.1 x 10^2 cfu/ml during the wet season study. The predominant fungi species were *Penicillium spp., Aspergillus spp. Mucor spp*. Feacal Coliform (MPN/100ml) was not detected during the dry season while during the wet season, the values ranged from 40 to 90 MPN/100ml while the Total Coliform count ranged from 190 to 310 MPN/100ml.

Table 4.12: Microbiological Characteristics of Surface Water in the Proposed Project Area for Dry Season

Parameters (Unit)	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW C1**	**SW C2**	**Range**
THB (x 10^4) (cfu/ml)	2.3	4.8	2.6	3.2	1.4	2.7	1.6	2.0	1.4-4.8
THF (x 10^2) (cfu/ml)	3.1	2.2	1.7	3.5	1.9	1.0	2.6	1.8	1.0-3.5
HUB(x 10^2) (cfu/ml)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
HUF(x 10^2) (cfu/ml)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
SRB(x 10^2) (cfu/ml)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
Feacal Coliform (MPN/100ml)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.13: Microbiological Characteristics of Surface Water in the Proposed Project Area during wet season

Parameters (Units)	SW 1	SW 2	SW 3	SW 4	SW 5	SW-C1	SW-C2	Range
Total Coliform Count (MPN/100ml)	240	270	310	190	210	240	170	190-310
Faecal Coliform Count (MPN/100ml)	60	70	90	40	40	70	200	40-90
THB x 10^8 (cfu/ml)	5.34	5.71	7.83	5.11	5.23	5.58	4.96	5.11-7.83
THF x 10^3 (cfu/ml)	1.9	2.4	3.5	1.5	1.7	2.2	1.4	1.5-3.5
HUB x 10^5 (cfu/ml)	2.41	2.64	3.27	2.18	2.32	2.87	2.13	2.18-3.27
HUF x 10^2 (cfu/ml)	0.7	1.2	2.1	ND	0.5	0.9	ND	0.5-2.1

Source: Lympson Leosentino Limited Field work (September, 2021)

4.6 Sediment Analysis

4.6.1 Physico-Chemical Characteristics of Sediment

Insoluble solid particles resting at the bottom of water bodies (aquatic environment) constitute sediment. The sediment status of an area is thus an indicator of the toxicity or pollution status of the aquatic environment (marine ecosystem). Marine sediments can be sensitive indicators for monitoring contaminants in aquatic environments (Pekey et al., 2004; Atgn et al., 2000). The bottom sediments serve as a reservoir for heavy metals and therefore deserve special consideration in the planning and design of aquatic pollution research studies (Badri and Aston, 1983). Heavy metals, such as cadmium, mercury, lead, copper and zinc, are regarded as serious pollutants of aquatic ecosystems because of their persistence, toxicity and ability to be incorporated into food chains (Kishe and Machiwa, 2003).

In the study area (See **Figure 4.16)**, sediment samples were collected at the point from which surface water was sampled. Results obtained for the physico-chemical characteristics of sediments of the study area are presented in **Table 4.14** for dry season and **Table 4.15** for wet season.

The analysis shows that for dry season, the value for pH were slight acidic and ranged from neutral 5.68-6.29 which is within DPR permissible limits of 6.6-9.5 unlike the values for wet season which ranged from 6.3-7.4. Also, the electrical conductivity, ranged from 49920 to 58800 µs/cm (dry season) and 4.68 to 11.12 µs/cm during the wet season study.

The ranges in the concentrations of heavy metals in the sediment sample for dry seasons: Fe (297.5-768.75mg/kg); V (0.1 – 0.4mg/kg); Cu (04.86-8.50mg/kg), Ni (1.85-6.15mg/kg) and Zn (30.73-39.75mg/kg). In wet season, the results of analysis ranges as follows: Fe (5628.72-7603.76 mg/kg); V (<0.001mg/kg); Cu (0.157-0.571mg/kg), Ni (0.053-0.172mg/kg) and Zn (21.762-31.524mg/kg) which were above the DPR threshold limits except for Vanadium (V) was below detection limits for both dry and wet season studies.

Table 4.14: Physico-Chemical Characteristics of Sediment from the Okpoama Tank farm Project Area, 2021 for Dry Season

Parameters	**SED 1**	**SED 2**	**SED 3**	**SED 4**	**SED 5**	**SED 6**	**SED C1**	**SED C2**	**Range**	**DPR Limits**
pH (1:1, sediment to water)	6.14	5.76	6.24	6.29	5.68	6.20	5.74	5.83	5.68-6.29	6.5-9.5
Electrical Conductivity (µs/cm)	55590	53880	49920	58200	56700	58800	50700	50400	49920-58800	
Temperature (°C)	26.3	26.5	26.6	27.0	27.0	26.9	25.4	26.7	26.3-27	<30° C
Redox Potential(mV)	+94	+76	+34	+112	+17	+89	+146	+135	0-0	<500
Nitrite (mg/kg)	0.217	0.193	0.227	0.165	0.198	0.169	0.208	0.160	0.165-0.227	
Chloride (mg/kg)	6736	7445	4963	5849	4786	6558	4609	5495	4785.75-7444.5	
Salinity(mg/kg)	12169	13450	8966	10568	8646	11848	8326	9927	8646.18-13449.6	
Carbonate (mg/kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0-0	
Sulphate (mg/kg)	6681	7506	4858	5527	4714	6367	4602	5485	4713.62-7506.41	
TOC (%)	1.68	1.64	1.83	1.56	0.31	1.48	3.28	2.94	0.31-1.83	1%
Phosphate (mg/kg)	3.37	1.43	1.40	2.02	2.53	1.50	2.37	1.43	1.4018-3.366	
Oil and Grease (mg/kg)	9.16	12.59	10.02	15.45	9.13	10.24	7.16	6.31	9.13-15.445	
Ammonium (mg/kg)	1.04	0.91	1.09	0.78	0.94	0.81	0.99	0.74	0.776-1.09	
Nitrate (mg/kg)	2.91	2.54	3.05	2.17	2.64	2.27	2.77	2.08	2.172-3.052	
Total Nitrogen (%)	0.45	0.41	0.30	0.35	0.34	0.36	0.35	0.28	0.3-0.45	

THC (mg/kg)	4.35	3.65	2.96	2.26	2.96	2.26	1.91	0.87	2.26-4.349	
CEC (meq/100g)	7.93	6.57	8.54	6.27	6.02	7.10	5.70	5.07	6.02-8.54	
Sand (%)	2	3	2	3	4	1	1	4	01-04	
Silt (%)	62	62	81	69	80	88	77	81	62-88	
Clay (%)	36	35	19	28	16	11	22	15	11-36	
Texture, Triangle (%)	silty clay loam	silty clay loam	silty loam	silty loam	silty loam	silty	silty loam	silty loam	0-0	
Cu (mg/kg)	8.10	8.50	5.43	5.51	5.42	4.86	1.41	1.32	4.86-8.5	<0.05
Fe (mg/kg)	651.25	511.25	373.75	297.50	551.25	768.75	506.25	479.15	297.5-768.75	<0.02
Ni (mg/kg)	4.05	3.30	5.10	1.85	6.15	5.70	4.60	1.30	1.85-6.15	<0.05
Zn (mg/kg)	39.42	39.75	30.73	31.97	32.31	31.33	2.63	2.56	30.73-39.75	<0.05
Pb (mg/kg)	1.55	2.10	1.10	1.20	0.65	0.65	0.20	0.10	0.65-2.1	<0.20
Mn (mg/kg)	6.05	5.05	4.80	6.70	6.70	7.10	5.80	4.40	4.8-7.1	
Cd (mg/kg)	0.55	0.41	0.11	0.17	0.10	0.19	0.10	0.08	0.10-0.55	<0.02
Cr (mg/kg)	2.90	1.35	1.80	0.95	0.95	0.50	0.25	0.10	0.5-2.9	<0.10
Ba (mg/kg)	2.70	2.00	3.50	3.05	1.65	0.80	0.10	0.20	0.8-3.5	100
V (mg/kg)	0.15	<0.001	0.22	0.40	0.30	0.10	<0.001	<0.001	0.1-0.4	<1.10
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	<0.10
Na (meq/100g)	1.61	1.60	0.71	0.71	1.60	0.62	0.65	0.66	0.62-1.61	<0.05
K (meq/100g)	0.12	0.09	0.17	0.07	0.09	0.13	0.08	0.07	0.07-0.17	
Ca (meq/100g)	2.71	2.91	2.34	2.87	2.44	2.57	2.40	1.97	2.34-2.91	0.10
Mg (meq/100g)	3.49	1.96	5.32	2.62	1.89	3.78	2.57	2.37	1.89-5.32	0.10
TPH (mg/kg)	2.847	2.016	1.748	2.001	1.911	1.868	1.275	0.553	1.748-2.847	
PAH (mg/kg)	0.060	0.020	<0.001	<0.001	0.080	<0.001	<0.001	<0.001	0.02-0.08	
BTEX (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0-0	

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.15: Physico-Chemical Characteristics of Sediment in the NCDMB Proposed shipyard Project Area for wet season

Parameters (Unit)	Sed 1	Sed 2	Sed 3	Sed 4	Sed 5	Range	Average	Sed C1	Sed C2	Average	DPR Limit
pH	7.4	7.1	6.7	6.3	6.9	6.3-7.4	6.88	7.2	6.5	6.85	6.5-9.5
Electrical Conductivity (mS)	7.31	11.12	6.82	4.68	7.54	4.68-11.12	7.49	6.86	9.42	8.14	-
Textural class	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	-
Colour	Dark	Dark	Dark	Dark	Dark	Dark	Dark	Dark	Dark	Dark	-
Cl (mg/kg)	912.36	1392.81	852.47	585.15	930.24	585.15-1392.81	934.61	957.38	912.73	935.055	-
SO_4 (mg/kg)	233.965	357.037	218.581	149.994	238.452	149.994-357.037	239.606	245.503	233.965	239.734	-
NO_3 (mg/kg)	99.645	152.061	93.093	63.882	101.556	63.882-152.061	102.047	104.559	99.645	102.102	-
PO_4 (mg/kg)	38.69	59.042	36.146	24.804	39.432	24.804-59.042	39.623	40.598	38.69	39.644	-
NH_4 (mg/kg)	7.65	11.68	7.15	4.91	7.8	4.91-11.68	7.838	8.03	9.88	8.955	-
Na (mg/kg)	436.972	666.831	408.239	280.141	445.352	280.141-666.831	447.507	458.521	563.873	511.197	<0.05
K (mg/kg)	176.198	268.883	164.613	112.96	179.577	112.96-268.883	180.446	184.888	227.368	206.128	-
Ca (mg/kg)	654.23	542.12	325.65	296.12	285.76	285.76-654.23	420.78	243.92	231.23	237.575	0.1
Mg (mg/kg)	29810	27682	30114	27123	25123	25123-30114	27970.4	19283	17123	18203	0.1
Oil & Grease	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
THC (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
TPH (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
PAH (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

BTEX (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cd (mg/kg)	0.045	0.053	0.074	0.123	0.082	0.045-0.123	0.075	0.041	0.055	0.048	<0.02
Cr (mg/kg)	0.286	0.321	0.197	0.637	0.241	0.197-0.637	0.336	0.197	0.209	0.203	<0.10
Ni (mg/kg)	0.172	0.116	0.096	0.053	0.102	0.053-0.172	0.108	0.079	0.053	0.066	<0.05
V (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<1.10
Pb (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.20
Ba (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	100
Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.10
Fe (mg/kg)	6723.23	7603.76	5628.72	6192.23	5823.12	5628.72-7603.76	6394.21	4623.89	4123.11	4373.5	<0.02
Zn (mg/kg)	29.423	31.524	21.762	25.873	24.391	21.762-31.524	26.595	20.134	17.672	18.903	<0.05
Cu (mg/kg)	0.157	0.341	0.571	0.212	0.178	0.157-0.571	0.292	0.151	0.123	0.137	<0.05
Mn (mg/kg)	97.623	111.12	88.234	91.653	82.345	82.345-111.12	94.2	76.542	65.432	70.987	-

Source: Lympson Leosentino Limited Field work (September, 2021)

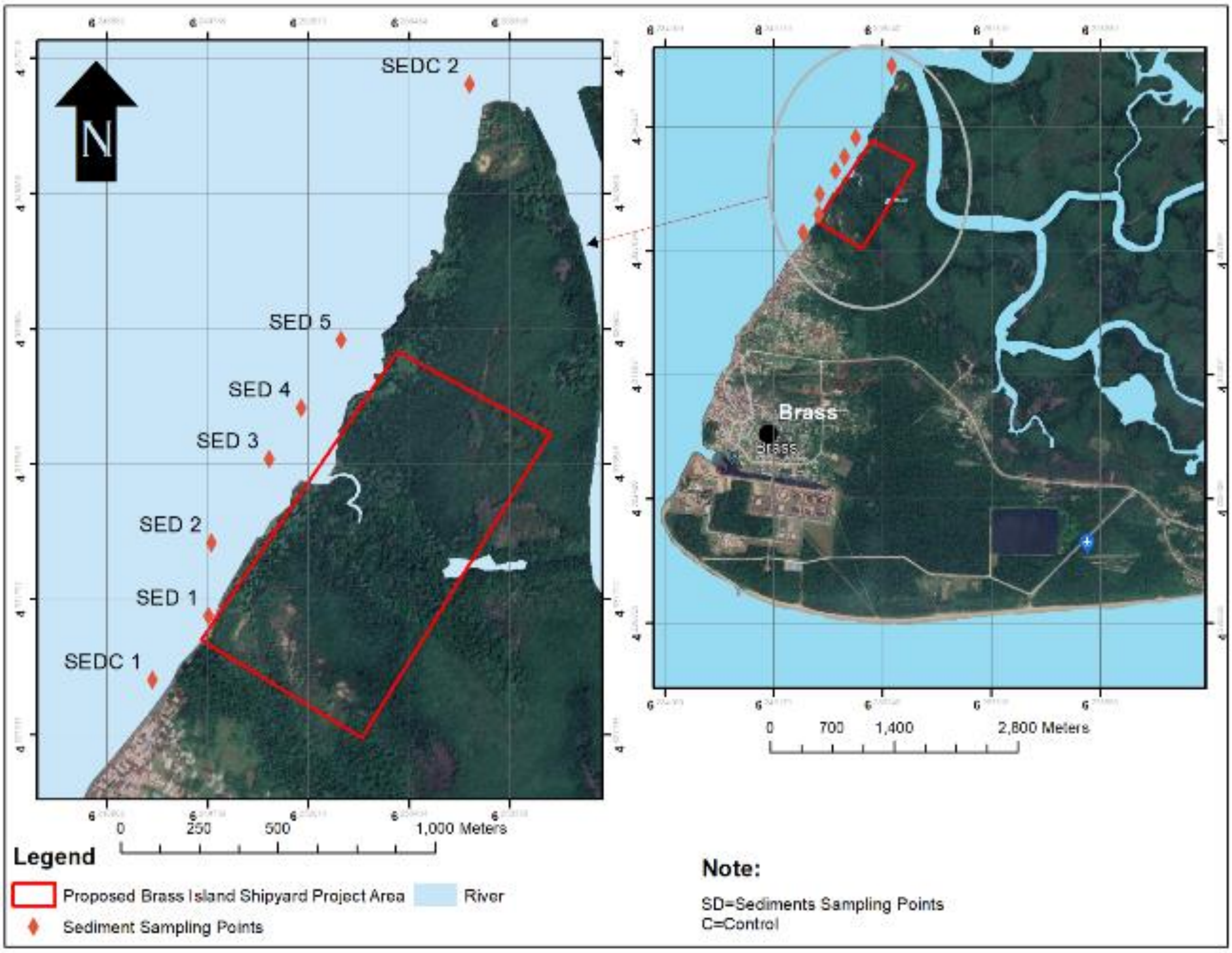


Figure 4.16: Map showing Sediment sampling points

4.6.2 Microbiological Characteristics of Sediment

The microbial status of the sediment samples in the proposed projectr area are presented in **Table 4.16** and **Table 4.17**.

Bacteria: Analysis result of sediment samples collected from the sampling stations in the study area indicated that the total heterotrophic bacteria (THB) count in the sediment samples ranged between 2.0x 10^3 - 3.5 x 10^3 cfu/g for dry season while that of wet season ranged between 5.27x 10^8 to 7.29 x 10^8 cfu/g. The predominant bacterial species were *Staphylococcus spp.*, *Bacillus spp*, and *Pseudomonas spp.* The microbial load of HUB in the sediment samples ranged between 2.2 x 10^2 – 4.8 x 10^2 cfu/g (dry season) and 2.6 x 10^5 to 4.11 x 10^5 cfu/g (wet season).

Table 4.16: Sediment Microbiological Characteristics from the Okpoama Tank farm Project Area, 2021 for Dry Season

Parameters	SED 1	SED 2	SED 3	SED 4	SED 5	SED 6	SED C1	SED C2	Range
THB (x 10^4) (cfu/g)	3.4	2.9	4.3	2.0	3.2	2.5	2.2	3.1	2.0-3.5
THF (x 10^2) (cfu/g)	2.7	3.8	2.2	3.1	4.8	3.6	2.6	4.0	2.2-4.8
HUB (x 10^2) (cfu/g)	Nil	0.5	Nil	Nil	0.8	Nil	Nil	Nil	Nil
HUF (x 10^2) (cfu/g)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SRB (x 10^2) (cfu/g)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Feacal Coliform (MPN/100ml)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.17: Sediment Microbiological Characteristics in the Proposed Project Area for wet season

Parameters (Unit)	Sed 1	Sed 2	Sed 3	Sed 4	Sed 5	Sed C1	Sed C2	Range	DPR Limit
THB x 10^8 (cfu/g)	5.98	6.13	7.29	5.27	5.49	6.02	5.14	5.27-7.29	-
THF x 10^3 (cfu/g)	2.4	2.6	3.1	2.1	2.3	2.5	1.8	2.1-3.1	-
HUB x 10^5 (cfu/g)	3.12	3.53	4.11	2.69	2.87	3.24	2.56	2.69-4.11	-
HUF x 10^2 (cfu/g)	1.3	1.6	1.8	ND	0.9	1.4	ND	0.9-1.8	-

Source: Lympson Leosentino Limited Field work (September, 2021)

4.7 Soil Studies

Soil is an unconsolidated mineral matter on the immediate surface of the earth that serves as a natural medium for the growth of land plants and has been subjected to and influenced by genetic and environmental factors of parent material, climate (including moisture and temperature effects), macro- and microorganisms, and topography, all acting over a period of time and producing a product -soil- that differs from the material from which it was derived in many physical, chemical, biological, and morphological properties and characteristics. Soil is a complex system, consisting of three phases: soil gases; soil water; and organic/inorganic solids. For a soil impacted by wastes, a fourth phase, nonaqueous phase liquids (NAPLs), may also be present. The soil samples were collected within the proposed project area as shown in Figure 4.17 below.

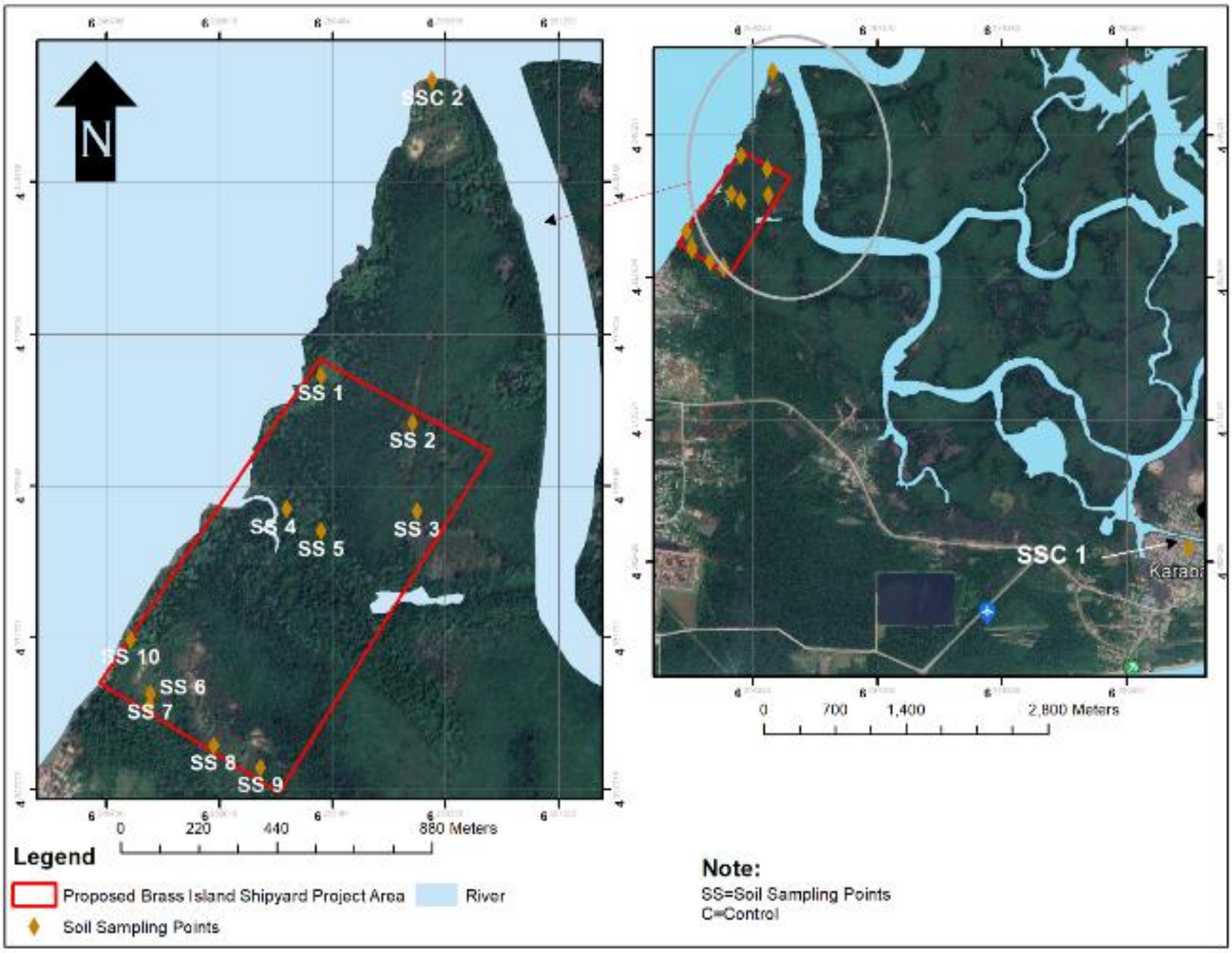


Figure 4.17: Map showing Soil sampling point within the proposed project area

4.7.1 Physico-Chemical Characteristics of Soil Samples in the Proposed Project Area

Summary of results obtained for the physico-chemical characteristics of soil samples of the study area in top (0-15cm) and bottom (15-30cm) layers are presented in **Tables 4.18 and Table 4.19** for dry season and wet season respectively while the details are presented in **Appendix D**.

Table 4.18: Summary of Results of Soil Chemistry (Top and Bottom) from Okpoama Tank farm Project, 2021

Parameters	Unit	Top Soil (0-15cm)		Bottom Soil (15-30cm)	
		Average	Range	Average	Range
pH (1:1, soil to water)		3.908	2.87-5.21	3.929	2.97-5.31
Electrical Conductivity	µs/cm	4044.600	142-15295	4034.1	145-13755
Temperature	^{O}C	26.640	25.3-27.5	26.58	25.1-27.8
Nitrite	mg/kg	0.125	0.05-0.213	0.1073	0.032-0.189
Chloride	mg/kg	575.354	38.99-2304.25	662.752	42.54-2127
Sulphate	mg/kg	539.774	41.111-2270.434	633.5229	36.555-2049.448
Carbonate	mg/kg	0.000	0-0	0	0-0
TOC	%	0.894	0.66-1.17	0.805	0.12-1.13
Phosphate	mg/kg	2.076	0.83-3.912	1.638	0.652-3.47
Ammonium	mg/kg	0.586	0.214-1.008	0.5047	0.148-0.892
Nitrate	mg/kg	1.645	0.598-2.821	1.39	0.413-2.497
Porosity	%	52.273	44.9-58	52.012	45.64-56.88
Total Nitrogen	%	0.275	0.17-0.44	0.23	0.08-0.37
THC	mg/kg	1.496	0.522-2.609	2.1224	0.869-3.306
CEC	meq/100g	5.462	2.207-12.433	4.431059	2.19026-9.545221
Cu	mg/kg	2.025	0.15-4.65	1.5	0.1-3.6
Fe	mg/kg	1646.875	681.00-2613.25	1393.95	604.25-2631
Ni	mg/kg	1.563	0.3-3.15	1.457143	0.9-2.4
Zn	mg/kg	8.934	0.175-15.05	5.578889	0.485-8.07
Pb	mg/kg	0.950	0.3-1.8	0.766667	0.2-1.4
Mn	mg/kg	3.390	0.9-7.1	3.32	1.15-5.95
Cd	mg/kg	0.881	0.25-2	0.75	0.2-2.05

Cr	mg/kg	1.100	0.25-2	0.807143	0.05-1.75
Ba	mg/kg	0.900	0.2-2	1.407143	0.35-2.8
V	mg/kg	0.886	0.25-1.55	0.55	0.15-0.85
Hg	mg/kg	-	-	-	-
Na	meq/100g	1.909	0.219-6.361	1.32347	0.260609-3.851304
K	meq/100g	0.178	0.080-0.295	0.150174	0.059128-0.278
Ca	meq/100g	1.851	1.179-3.053	1.630515	1.004-3.211
Mg	meq/100g	1.525	0.730-3.188	1.3269	0.443-2.359
TPH	mg/kg	0.399	0.008-1.476	0.965667	0.01-2.19
PAH	mg/kg		0-0		0-0
BTEX	mg/kg		0-0		0-0

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.19: Summary of Results of Soil Chemistry (Top and Bottom) from the NCDMB Proposed Shipyard Project Site for wet season

Parameters (units)		Top Soil (0-15cm)		Bottom Soil (15-30cm)	
		Range	Average	Range	Average
pH		5.2-7.4	6.43	5.4-7.8	6.73
EC (µS/cm)		0.09-1.69	0.43	0.13-3.62	0.62
Grain size	Sand (%)	13.6-87.2	55.01	14.3-85.6	48.99
	Silt (%)	7.3-46.4	26.93	8.7-50.3	27.39
	Clay (%)	4.5-64.6	17.98	5.7-76.1	23.78
Textural class		Clay - Sandy loam	Sandy loam	Clay - Sandy loam	Sandy loam
Porosity (%)		41-75	56.17	47-81	62.67
Permeability (cm/s)		0.03-0.11	0.05	0.02-0.08	0.04
Bulk density (g/cm)		1.22-1.58	1.36	1.24-1.62	1.41
TOC (%)		1.26-5.52	3.05	1.63-4.94	3.07
SO_4 (mg/kg)		2.31-43.28	10.89	3.33-92.71	15.86
NO_3 (mg/kg)		0.69-12.86	3.24	0.99-27.55	4.71
NO_2 (mg/kg)		0.06-1.09	0.2725	0.08-2.33	0.40
PO_4 (mg/kg)		0.48-8.95	2.25	0.69-19.17	3.28
NH_4 (mg/kg)		0.01-0.02	0.015	0.01-0.04	0.02
Na (mg/kg)		67.56-145.38	106.61	53.13-139.28	84.07
K (mg/kg)		40.22-91.25	73.57	22.58-63.21	46.59
Ca (mg/kg)		179.62-308.71	232.39	143.23-276.12	189.94
Mg (mg/kg)		120.79-332.29	199.24	115.28-271.23	167.26
O&G (mg/kg)		<0.01	<0.01	<0.01	<0.01
THC (mg/kg)		<0.01	<0.01	<0.01	<0.01
TPH (mg/kg)		<0.01	<0.01	<0.01	<0.01
PAH (mg/kg)		<0.01	<0.01	<0.01	<0.01
BTEX (mg/kg)		<0.01	<0.01	<0.01	<0.01
As (mg/kg)		<0.001	<0.001	<0.001	<0.001
Cd (mg/kg)		0.016-0.056	0.0343	0.011-0.039	0.021
Cr (mg/kg)		0.096-0.516	0.237	0.075-0.442	0.177
Ni (mg/kg)		0.019-0.198	0.0781	0.011-0.094	0.055
V (mg/kg)		<0.001	<0.001	<0.001	<0.001
Pb (mg/kg)		0.156-1.112	0.613	0.114-0.876	0.442
Ba (mg/kg)		<0.001	<0.001	<0.001	<0.001
Hg (mg/kg)		<0.001	<0.001	<0.001	<0.001
Fe (mg/kg)		987.65-2354.12	1518.59	880.76-2097.65	1340.85
Zn (mg/kg)		1.098-5.542	3.172	0.786-279.18	25.67
Cu (mg/kg)		0.165-0.761	0.352	0.114-0.564	0.265

Source: Lympson Leosentino Limited Field work (September, 2021)

Particle Size Distribution: PSD analysis of the soil samples for dry season indicated sand (06.0-82.0%), clay (04.0-48.0%) and silt (7.0-80.0% in the top soil while the bottom soil as, sand (05.0-84.0%), clay (4.0-52.0%) and silt (4.0-67.0%).

Physico-Chemical characteristics of soil samples within the proposed project area

pH: The degree of acidity or alkalinity is usually considered a master variable that affects nearly all soil properties-chemical, physical and biological. pH influences aggregate stability as well as air and water movement in the soil. The amount of acid or alkali in the soil determines the availability of many nutrients for plant growth and maintenance.

In the dry season, the soil analysis reveal pH values of the surface (0 – 15cm) and subsurface (15 – 30cm) soils of the study area showed that the soils were acidic with values ranging from 2.87-5.21 for top soils and from 2.97-5.31 for the sub-surface. While during the wet season, the soils were slightly acidic to neutral (with values that range from 5.2-7.4 for top soils and from 5.4-7.8 for the sub-surface. This is consistent with recorded data on soils of the study area and of the Niger Delta region (NDES, 1997; Anderson, 1967). Generally, the soils of the Niger-Delta area vary from the order Oxisols to Ultisols. Ultisols are strongly acidic, extensively weathered soils of tropical and subtropical climates (Soil Survey Staff, 1975, Odu *et al*, 1985).

Electrical Conductivity: Electrical conductivity is a measure of the electric current carrying ability of an aqueous solution. The dry season electrical conductivities of surface soils in the area ranged between 142 µS/cm and 15295µS/cm while the range in subsurface soils was between 145.0 and 13755.0µS/cm. While during the wet season, the EC values ranged between 0.09µS/cm to 1.6µS/cm for surface soils and 0.13 and 3.62µS/cm for subsurface soils.

Cation Exchange Capacity (CEC): Exchangeable cations are those that are readily released from the surface of the soil minerals or from within the crystal lattice and substituted with cations absorbed from the leaching solution. The dry season cation exchange capacity in the surface soil ranged between 2.207 to 12.433meq/100g with a mean average of 5.462 meq/100g while the range in subsurface soils was 2.190-9.545meq/100g with a mean average of 4.431059 meq/100g. However, CEC was not measured during the the wet season.

The calcium ions for dry season study of surface soils ranged between 1.179-3.053meq/100g with an average mean value of 1.851 meq/100g while the range in subsurface soils was 1.004-3.211meq/100g with an average mean of 1.6305 meq/100g. While that of wet season ranged between 179.62 mg/kg to 308.71mg/kg with an average mean value of 232.39mg/kg while the range in subsurface soils was 143.23 mg/kg to 276.12mg/kg with an average mean of 189.94mg/kg.

The potassium ions of surface soils during the dry season ranged between 0.080-0.295meq/100g for surface soils while the range in subsurface soils was 0.059-0.278meq/100g. The wet season value for potassium ion ranged between 40.22 to 91.25mg/kg for surface soil and 22.58 mg/kg to 63.21mg/kg for subsurface soils. Magnesium ions during the dry season of surface soils in the area ranged between 0.730-3.188meq/100g while for subsurface soils ranged from 0.443-2.359meq/100g. While, Magnesium ions during the wet season ranged from 120.79 mg/kg to 332.29mg/kg for surface soil and 0115.28 mg/kg to 271.23mg/kg for subsurface soils. While sodium ions of surface soils during the dry season ranged between between 0.219-6.361meq/100g while the range in subsurface soils was 0.261-3.851eqm/100g. For wet season, the value for surface soils ranged between 67.56 mg/kg to 145.38mg/kg while that of subsurface soils ranged between 53.13mg/kg to 139.28mg/kg.

Nutrients: The dry season study shows that nitrate concentrations in surface soil samples ranged from 0.598-2.821mg/kg while in the subsurface layer nitrate ranged from 0.413-2.497mg/kg. The wet season data ranged from 0.69-12.86mg/kg while in the subsurface layer nitrate ranged from 0.99-27.55mg/kg. The dry season average mean concentration of phosphate in surface soil was 2.076mg/kg which ranged from 0.83-3.912mg/kg while that in subsurface was 1.638mg/kg and ranged from 0.652-3.47mg/kg. While the average mean concentration of phosphate for wet season in surface soil was 2.25mg/kg which ranged from 0.48-8.95mg/kg while that of subsurface soil average mean value was 3.28mg/kg and ranged from 0.69-19.17mg/kg. Also, the dry season concentration of ammonium in the surface soil ranged from 0.214-1.008mg/kg with while that in subsurface ranged from 0.148-0.892mg/kg. While the ammonium concentration for wet season within the surface soil ranged from 0.01-0.02mg/kg while that of subsurface soil ranged from 0.01-0.04mg/kg. Concentration of total organic carbon (TOC) for dry season in the soil samples surface soil ranged from 0.66-1.17% while that in subsurface ranged from 0.12-1.13% while TOC was not measured during the wet season.

However, the background concentrations of nitrogen, phosphorous, and Sulphur usually encountered in mineral and organic soils are 10 – 150 mg/kg, 2 – 20 mg/kg, 3 – 40 mg/kg and 5-30mg/kg, respectively (Allen, 1965). The importance of these nutrients in plants cannot be over-emphasized. Chlorophyll, plant proteins and nucleic acids are nitrogen compounds, which play major roles in plant growth.

Total Hydrocarbon Content (THC): The dry season THC level for the surface soil in the study area range between 0.522-2.609mg/kg while the subsurface soil ranged from 0.869-3.306mg/kg. while for wet season, THC level for the surface soil and subsurface soil within the study area were below equipment detection limit of <0.01mg/kg.

Polycyclic Aromatic Hydrocarbon (PAH): Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds that consist of fused aromatic rings and do not contain heteroatom or carry substituent. As a pollutant, they are of concern because some compounds have been identified as carcinogenic, mutagenic, and teratogenic (Fetzer, 2000). PAHs are also found in foods. The polycyclic aromatic hydrocarbon (PAH) in the soil samples in the proposed project area were below equipment detection limit of <0.001mg/kg for dry season and below <0.01mg/kg for wet season.

BTEX: BTEX is the acronym used for four compounds found in petroleum products: benzene, toluene, ethylbenzene and xylene. Acute exposures to high levels of BTEX have been associated with skin and sensory irritation, central nervous system and respiratory problems (USEPA, 2005). The levels of BTEX in soil samples in the study area were below equipment detection limit of <0.001mg/kg for both seasons.

Heavy Metals

The concentrations range of heavy metals for surface and subsurface soil samples in the study area is as presented:

Barium: The dry season concentration of barium ranged from 0.2-2.00mg/kg for surface soil while that of subsurface soil ranged from 0.35-2.80mg/kg. For wet season, the concentration of barium was below detection limit of <0.001mg/kg.

Manganese: The dry season Mn values ranged from 0.9 to 7.1 mg/kg with a mean average value of 3.39mg/kg, while the subsurface soil has values ranged from 1.15 to5.95mg/kg with a mean concentration average value of 3.32mg/kg. However, the Mn was not measured during the wet season.

Total Iron: The dry season Iron level of the surface soil of the area ranged from 681.00-2613.25mg/kg, while the subsurface soil has values that ranged between 604.25-2631mg/kg. While the wet season iron level of the surface soil of the area ranged from 987.65-2354.12mg/kg, while that of subsurface soil values ranged from 880.76-2097.65mg/kg.

Cadmium: The dry season concentration of cadmium ranges from 0.25-2.00mg/kg for surface soil while 0.2-2.05mg/kg for subsurface soil. The wet season concentration of cadmium range from 0.016-0.056mg/kg for surface soil while 0.011-0.039mg/kg for subsurface soil.

Chromium: The dry season chromium level of the surface soil of the area ranged from 0.25-2.00mg/kg, while the subsurface soil has values that ranged between 0.05-1.75mg/kg. Similarly, that of wet season for surface soil of the area ranged from 0.096-0.516mg/kg, while the subsurface soil has values that ranged between 0.075-0.442mg/kg.

Lead: The dry season lead level of the surface soil of the area ranged from 0.3-1.8mg/kg, while the subsurface soil has values ranged from 0.2-1.4mg/kg. Also, for wet season, lead level of the surface soil of the area ranged from 0.156-1.112mg/kg, while the subsurface soil has values ranged from 0.114-0.876mg/kg.

Copper: The dry season copper level of the surface soil of the area ranged from 0.15-4.65mg/kg, while the subsurface soil has values that ranged between 0.1-3.6mg/kg. Also, for wet season, the copper level of the surface soil of the area ranged from 0.165-0.761mg/kg, while the subsurface soil has values that ranged between 0.114-0.564mg/kg.

Nickel: The dry season nickel level of the surface soil of the area ranged from 0.3-3.15mg/kg, while the subsurface soil has values that ranged between 0.9-2.4mg/kg. Also, the wet season nickel level of the surface soil of the area ranged from 0.019-0.198mg/kg, while the subsurface soil has values that ranged between 0.011-0.094mg/kg.

Vanadium: The dry season level of vanadium for the surface soil of the area ranged from 0.25-1.55mg/kg, while the subsurface soil has values that ranged between 0.15-0.85mg/kg. Dissimilarly, the wet season level of vanadium for the surface soil and subsurface soil was below equipment detection limit of <0.001mg/kg.

Zinc: The zinc level for dry sason ranged from 0.175-15.05mg/kg for surface soil of the area, while the subsurface soil has values ranging between 0.485-8.07mg/kg. For wet season, zinc level of the surface soil of the area ranged from 1.098-5.542mg/kg, while the subsurface soil has values that ranged between 0.786-279.18mg/kg.

Mercury: The concentration of mercury (surface soil and subsurface soil) was below equipment detectable limit of 0.01mg/kg for dry season and 0.001mg/kg for wet season. .

4.7.2 Microbiologically Characteristics of Soil Samples in the Proposed Project Area

The microbial status of the soil samples in the study as expressed in their range of values are presented in **Table 4.20** and **Table 21** while the details are presented in **Appendix D**.

Table 4.20: Summary of Soil Microbiological Characteristics from the Okpoama Tank farm Project Area, 2021 for Dry Season

Parameters	Unit	Top Soil (0-15cm)		Bottom Soil (15-30cm)	
		Average	Range	Average	Range
THB (x 10^4)	cfu/g	5.100	2.6-6.8	3.33	1.3-4.5
THF (x 10^2)	cfu/g	4.420	2.9-6.1	3.18	1.4-4.8
HUB (x 10^2)	cfu/g	1.320	0.8-2.1	-	-
HUF (x 10^2)	cfu/g	0.733	0.2-1.0	-	-
SRB (x 10^2)	cfu/g		-	-	-
Feacal Coliform	MPN/100ml		-		-

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.21: Summary of Soil Microbiological Characteristics in the NCDMB Proposed Shipyard Project Area (Wet season)

Parameters (units)	Top Soil (0-15cm)		Bottom Soil (15-30cm)	
	Range	Average	Range	Average
THB x 10^8 (Cfu/g)	1.47-2.83	2.00	1.41-2.47	1.74
THF x 10^3 (Cfu/g)	0.19-0.72	0.35	0.13-0.4	0.25
HUB x 10^5 (Cfu/g)	0.25-1.04	0.491818	0.17-0.83	0.407778
HUF x 10^2 (Cfu/g)	0.13-0.37	0.212857	0.14-0.21	0.175

Source: Lympson Leosentino Limited Field work (September, 2021)

Bacteria: the analysis result of soil samples collected from the sampling stations during the dry season and wet season at the surface levels in the study area shows that the total heterotrophic bacteria (THB) count in the ranged between 2.6x 10^4 – 6.8 x 10^4 cfu/g and 1.47 x 10^8-2.83x 10^8 cfu/g respectively while the subsurface level THB counts ranged between 1.3 x 10^4 – 4.5 x 10^4 cfu/g and 1.41x 10^8 – 2.47 x 10^8 cfu/g for dry and wet season respectively. The predominant bacterial species were *Streptococcus spp., Bacillus spp, Pseudomonas spp. Lactobacillus spp, Mycobacterium spp,* and *Arthrobacter spp.* The microbial load of HUB in the soil samples at the surface level during the dry and wet season ranged between 0.8 x 10^2 – 2.1x 10^2 cfu/g and 0.25 x 10^5 - 1.04x 10^5 cfu/g respectively while that of subsurface soil ranged from 0.17×10^2 - 0.83×10^2 cfu/g for wet season and was not detected during the dry season.

Fungi: The analysis result of soil samples collected from the sampling stations at the surface levels in the study area indicated that the total heterotrophic fungi (THF) count in the ranged between 0.2×10^2 – 1.0×10^2 cfu/g and 0.19×10^2 – 0.72×10^2 cfu/g for dry and wet season respectively while their subsurface level ranged 0.13×10^2 – 0.4×10^2 cfu/g for wet season and was not detected during the dry season. The predominant fungi species were *Aspergillus spp., Mucor spp, Fusarium spp, Candida spp, Cladosporium spp, Rhodotorula spp,* and *Penicillium spp.*

4.8 GEOLOGY AND HYDROGEOLOGY

4.8.1 GEOLOGY, GEOMORPHOLOGY AND HYDROGEOLOGY

Brass Island lies on Quaternary-Recent sediments known as the Mangrove swamp deposits which are marked by superficial dark organic, greyish brown, peaty clays and sandy silts (Ekundayo, 2006) which are underlain by fine to medium grained sands. The deposits overlie the major subsurface lithostratigraphic units of the Niger Delta which from bottom to top are the Akata, Agbada and Benin Formations. The geomorphology of the area is characterized by low, flat lands which are bordered by the Brass River. Three borehole points (See **Table 4.18**) on the Island were visually assessed, drilled, sampled for analysis and their geographic positions were recorded using the hand held Global Positioning System (GPS)

4.8.2 GROUNDWATER RECHARGE ASSESSMENT

Groundwater recharge is simply the quantity of water (principally atmospheric water) which infiltrates the saturated zone of groundwater occurrence. The level of groundwater recharge is dependent on the atmospheric precipitation, Surface run-off, evapotranspiration, soil moisture and seepage/ hydrologic classification characteristics of soils that constitute the unsaturated zone. The mean annual precipitation on the Island was determined by obtaining the average value of an eighty-four (84-year) rainfall record of Niger Delta weather belt covering Brass Island. The record (which ranges from 1931-2015) was archived by Nigeria Meteorological Agency (NIMET) and sourced by Adejuwon (2012). The hydrologic soil classification was achieved based on Particle Size Distribution (PSD) Analysis which revealed the soils of the unsaturated zone had over 60% clay content with significant proportions of silts and low sand content. These descriptions were typical of hydrologic soils of group D characteristics.

From the Hydrologic perspective, the quantification of surface run-off and evapo-tanspiration is subject to large uncertainties and errors hence groundwater recharge assessment is centered on estimations using empirical equations. One of the most reliable of them all is that of Williams and Kissel (1991) which incorporates precipitation and soil hydrologic classification as shown below:

$R= [(P-22.67)^2 /(P+34.00)]$ ……. (Equation 2)

Where:

R= Groundwater recharge

P = mean Annual Rainfall of the area in inches (=128.05 inches or 3250mm)

NB: The above equation is only applicable to group D soils

4.8.3 GROUNWATER FLOW DIRECTION ANALYSIS

The perpendicular line to the equipotential line shows the groundwater flows from the South-Easterly to North-Westerly direction of the island (**Figure 4.18**). The flow direction is at variance with the regional groundwater flow direction which runs from North to south of the Niger-Delta (Akpoborie, 2011, Abam and Nwankwaola, 2020). This implies that the flow directional pattern of the island is localized. Such localized flow was influenced by the proximity of the Island to the river which is marked by low hydraulic head. The groundwater flow pattern also implies that in event oil spill or leakage, contaminant migration from the shipyard would tend towards the River along the North-westerly direction. The groundwater flow direction of the Island is also conflicting with that of River Brass which confirms that in event of high tides, a reverse flow of the river will not alter the groundwater flow direction.

4.8.4 GROUNDWATER RECHARGE ANALYSIS

On the basis of the above equation (i.e equation 2), the estimated groundwater recharge of the area is 1739mm which is about 54% of the annual rainfall of the area. This implies there is high rate of infiltration than surface run-off and evapo-transpiration in the Island. This also means that groundwater contamination vulnerability in the area is high. The high recharge in spite of the clayey-silty soil cover implies that the lateral distribution of the superficial soil cover is irregular (i.e laterally heterogeneous) with pockets of sands creating windows for rainwater infiltration. Such irregularities had also been reported by Okogbue (1989) and Ekundayo (2006).

Borehole points were established as shown in Table 4.22 while the ground water flow direction was considered at BH1, BH3 and BH4 only as shown in Figure 4.18.

Table 4.22: Borehole Information for Ground Water Flow Direction

Borehole No	**BH1**	**BH2**	**BH3**	**BH4**
GPS Coordinates	4°20’18.64” N 6°15’18.61” E	4°20’06.65” N 6°15’27.79” E	4°18’31.75” N 6°15’54.72” E	4°19’55.71” N 6°15’02.83” E
Water level (m)	1.20	0.80	0.50	0.30
Elevation (m)	20.20	17.14	29.07	18.11
Hydraulic Head (H) in meters	19.55	16.63	28.57	17.81

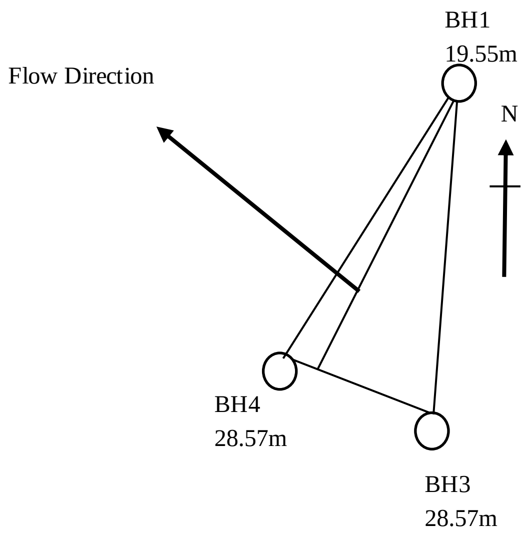


Figure 4.18: Flow Net Diagram showing groundwater flow direction

4.8.5 Ground Water Quality

The quality of any water resources is its suitability for the intended use. This thus, is a function of the physical, chemical and biological (bacteriological) characteristics of the water which in turn depends on the geology of the area and impacts of human activities. The laboratory analysis results of the groundwater samples obtained from these boreholes and the community portable water are presented in **Table 4.24** while **Table 4.23** shows the results for okpoama Tank farm Project area. **Figure 4.24** shows the four (4) borehole locations for groundwater sampling point within the proposed Brass Island Shipyard site and two (2) control boreholes outside the proposed project area.

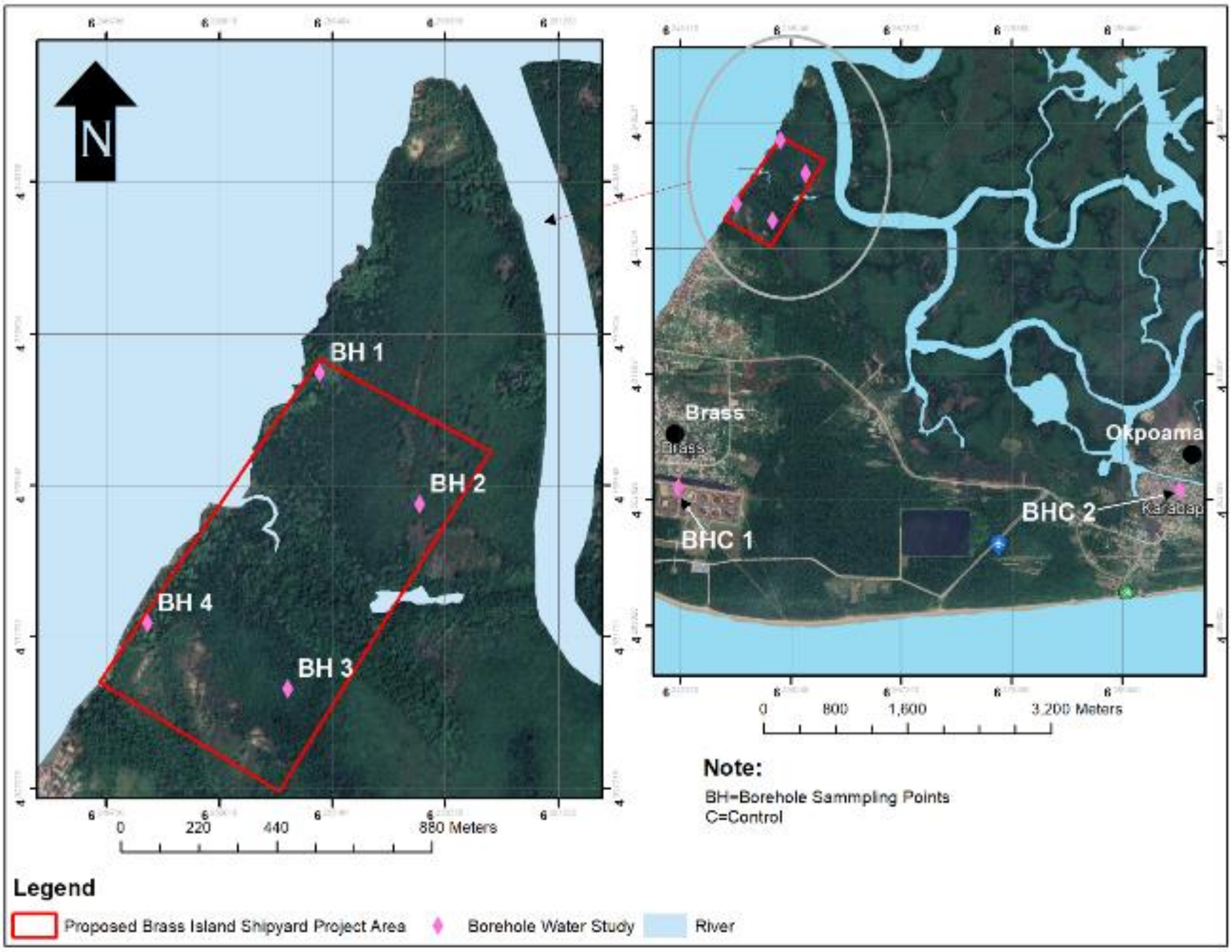


Figure 4.19: Map shoing the Borehole distribution within the Proposed Brass Island Project site

4.8.5.1 Physico-chemical Properties of Ground water quality

***pH*:** The parameter pH (negative base-10 logarithm of hydrogen ion activity in moles per liter) is one of the most fundamental water-quality parameters. It is easily measured, indicates whether water will be corrosive or will precipitate scale, determines the solubility and mobility of most dissolved constituents, and provides a good indication of the types of minerals groundwater has reacted with as it flows from recharge to discharge areas or sample sites. For these reasons it is one of the most important parameters that describe groundwater quality.

The groundwater is pH values ranging from 6.64-6.87 at an average temperature of 31.7°C during the dry season while it ranges from 6.9 to 7.7 with an average temperature of 27.93 °C duing the wet season (**Table 4.19 and Table 4.20**). All of these values fall within the DPR regulatory requirement for groundwater pH and temperature. However, pH values outside of the range 6.5 to 8.5 can lead to high dissolved concentrations of some metals for which there are drinking-water standards and associated health effects. Water with pH values higher than 8.5 or lower than 6.5 can produce aesthetic effects such as staining and etching or scaling of equipment.

Total Dissolved Solids

Total dissolved solids (TDS) are the sum of all dissolved chemicals in water, expressed as mg/L. TDS values are a general indicator of the suitability of groundwater for various uses (Mazor, 1991):

Potable water: up to 500 mg/L TDS: *Slightly saline water:* adequate for drinking and irrigation:

500 to 1,000 mg/L TDS: *Medium saline water:* potable only in cases of need; may be used for some crops and Aquiculture:

1,000 to 2,500 mg/L TDS: *Saline water:* adequate for aquiculture and industrial use:

2,500 to 5,000 mg/L TDS: *Brackish water:*

5,000 to 35,000 mg/L TDS (the salinity of seawater)

Brine: TDS greater than 35,000 mg/L

The FMENV and WHO has set a secondary drinking water of 500 mg/L for total dissolved solids. Water having TDS values greater than 500 mg/L has an unpleasant taste and may stain objects or precipitate scale.

TDS values of the groundwater samples ranges from 1291-1887mg/L for dry season and ranges from 3100 to 16600mg/L for wet season and both can be classified as saline. This shows the level of salt water encroachment in those boreholes within the proposed project location. This is probably due to the closeness of these boreholes (locations) to the sea **(Table 4.19**).

Specific Electrical Conductance (Conductivity)

Specific electrical conductance, also referred to as conductivity, is a measure of the ease with which water conducts an electrical current. It is an indirect measure of water quality and is proportional to total dissolved solids concentrations. Conductance or conductivity is reported in micromhos per centimeter at a standard temperature, usually 25°C, or the numerically equivalent micro siemens per centimeter (µS/cm) in the international system of units (Hem, 1985). Because conductance does not directly indicate water quality, there are no health or water-use standards based on this parameter. Conductivity values of the groundwater samples ranges from 2348mg/L-3340mg/L for dry season and 6200 to 33200mg/L for wet season.

Total Suspended Solids

Suspended particulate material is reported as total suspended solids (TSS). Total suspended Solids concentrations range from 18.31mg/L-21.15mg/L for dry season and ranges from 60 to 120mg/L for wet seaso. There is no health or cosmetic standards for total suspended solids in water. However, some metals and pesticides are preferentially absorbed onto or included in the matrix of suspended material, so water high in total suspended solids may also contain important amounts of metals that may have health or safety implications. Also, high amounts of suspended material can clog plumbing systems and stain clothing and water containers. Nigerian standard for drinking water quality recommends that TSS levels be less than 35 mg/L.

Heavy Metals in Groundwater

The assessment of heavy metal status is because of the concerns relating to their presence in water. Such concerns are toxicity, bioaccumulation and hazards to human health (GEMS 1992). The heavy metals concentration in groundwater of the study area is presented in **Table 4.23 and Table 4.24**. During the dry season, Pb, Cd, Cr, Ba, V, and Hg were not detected in the groundwater samples. Zn values ranged between 0.01 and 0.04 mg/l while that of Iron ranged from 0.47mg/l to 0.71mg/l. During the wet season study, Ni, V, Pb, Ba, and Hg were not detected in the groundwater samples. Mn, Cd, and Cr where only detected in BH 4 with values of 0.145 mg/l, 0.019mg/l and 0.006mg/l respectively. However, the level of Zn ranged between 0.01 and 0.04 mg/l (dry season) and 0.017-0.071mg/l (wet season) while that of Iron ranged from 0.47mg/l to 0.71mg/l (dry season) and 0.009-0.821mg/l (wet season).

Chloride and Sulphate Chloride (Cl) is present in most natural groundwater at low to moderate amounts. It is a highly conservative anion; once in solution it is generally not involved in oxidation/reduction reactions, does not form complexes with other major ions or precipitate out as low-solubility minerals and not readily absorbed onto the aquifer matrix. The values for chloride ranges from 619.2mg/L to 879.04mg/L during the dry season and ranges from 1724.92mg/L to 10223.68mg/L during the wet season.

Sulphate (SO_4) is one of the major anions in most groundwater. The most significant sources of sulphate in groundwater are oxidation of iron sulphide minerals in coal or shale and dissolution of the calcium-sulfate minerals gypsum or anhydrite in carbonate strata. The Sulphate concentration of ambient groundwater samples is primarily controlled by bedrock lithology.

The concentration of Sulphate during the dry season ranges from 81.242mg/L to 98.6mg/L while during the wet season, the values ramges from 32.91mg/L to 365.26mg/L. FMENV and WHO has set a secondary maximum contaminant level (SMCL) of 250 mg/L for chloride and 40mg/L for sulphate because water containing more than this amount has an unpleasant taste that makes it unsuitable for domestic use and Chloride contents of 30mg/l and above are indicative of salt water contamination.

Nutrients

The nutrients nitrogen and phosphorus occur naturally and also may be introduced to groundwater systems from urban and agricultural fertilizer applications, livestock or human wastes, and fossil fuel combustion. High nutrient levels in groundwater generally indicate contamination from fertilizer, sewage systems, or confined feedlot operations. Excessive nutrients can lead to algal blooms and eutrophication in surface-water systems, and excessive nitrate or nitrite in drinking water can pose health hazards.

Nitrogen

Nitrogen in water occurs predominantly as either the anion nitrate (NO -) under oxidizing – conditions or the cation ammonium (NH) under reducing conditions. Nitrite (NO-) and ammonia +4(NH) are thermodynamically less stable forms of aqueous nitrogen that may be present under reducing conditions. Because it is positively charged, ammonium is readily adsorbed on soil and mineral particles, thus limiting its mobility, whereas the negatively charged nitrate and nitrite anions are highly mobile. Nitrite, ammonium, and ammonia are unstable in oxidizing environments such as aerated groundwater (Hem, 1985). For this reason, high concentrations of these species in shallow groundwater are indicators of likely contamination by sewage or other forms of organic waste.

Nitrite concentrations in groundwater are generally low because nitrite reacts quickly to nitrate in oxidizing environments and to nitrogen gas in reducing environments (Fetter, 1993).

Nitrate, nitrite, ammonia, and ammonium concentrations are reported differently for different purposes. Analyses for environmental purposes generally report the concentrations as equivalent amounts of nitrogen (nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen, or ammonium-nitrogen). Consequently, reported nitrogen data must be examined closely to determine how they were recorded and concentration units must be standardized before data summaries and evaluations can be made.

The concentration of nitrate in the groundwater of the area ranges from 2.96mg/l to 3.33mg/Lduring the dry season and ranges from 15.19mg/l to 81.34mg/l during the wet season. The value for Ammonia concentration ranges from 1.057mg/l to1.189mg/l during the dry season and for wet season, it ranges from 0.871 mg/l to 0.871 mg/l. However, the values recorded for nitrate concentration falls below DPR regulatory limit of 10.0mg/l.

Phosphorus

Phosphorus is a common element in the earth's crust, most inorganic phosphorus compounds and minerals have low solubility, which limits phosphorus concentrations in natural waters. Phosphorus species are readily adsorbed onto soil particles and organic material, which limits their mobility in nature. The concentration of Phosphate in the groundwater of the area ranges from 0.065mg/l to 0.109mg/l during the dry season and ranges from 0.07 mg/l to 0.36 mg/l during the wet season. There is no health-based water-quality standards for phosphorus species in water.

Other Inorganic

This miscellaneous group includes metals present in non-trace quantities such as calcium, magnesium, potassium and sodium. Many of these ions are major contributors to the overall salinity of groundwater. Extremely high concentrations of these species make water unfit for human consumption and for many industrial uses. The health related problems are not as those caused by the other contaminant groups. However, high concentrations of even relatively non-toxic salts, for example, sodium can disrupt cell or blood chemistry with serious consequences.

The concentration of calcium for dry season ranges from 45.128mg/l -93.33mg/l and for wet season, it ranges from 42.183mg/l to 161.358mg/l. The dry season concentrations of potassium ranges from 18.82mg/l to 45.22mg/l and 27.872mg/l to 128.044mg/l for wet season. While for dry season, magnesium ranges from 15.043mg/l to 55.78mg/l while for wet season, it ranges from 61.28-256.47mg/l. The concentration of sodium ranges from 389.126-508.815mg/l during the dry season while that of the wet season ranges from 79.68mg/l to 515.59mg/l.

Organic Compounds

The laboratory results for the organic contaminants in the groundwater samples TPH, PAH, THC and other organic contaminants like (O & G) are all below detectable limits of 0.001mg/l indicating that the groundwater is not polluted by petroleum hydrocarbon.

Table 4.23: Physio - Chemical Properties of Groundwater Sample from the Okpoama Tank farm Project Area, 2021 for Dry Season

Parameters	Unit	GW 1	GW 2	GW 3	GW C	Average	RANGE	FMENV Limits	DPR Limits
pH		6.87	6.81	6.64	7.03	6.773333	6.64-6.87	6.5-8.5	6.5 – 9.2
Electrical Conductivity	µS/cm	3340	2348	3080	1780	2922.667	2348-3340		
TDS	mg/L	1887	1291	1394	979	1524	1291-1887	500	2000
Temperature	0C	25.7	26.1	26.1	26	25.96667	25.7-26.1	25.0-30.0	< 30.0
Colour	Pt-Co	13	10	15	9	12.66667	10.00-15.00		
Salinity	ppt	1.72	1.17	1.56	0.88	1.483333	1.17-1.72		
TSS	mg/L	21.15	20.32	18.31	14.84	19.92667	18.31-21.15	-	1.5
Nitrite	mg/L	0.015	0.028	0.016	0.013	0.019667	0.015-0.028		
DO	mg/L	5.7	5.6	5.9	5.7	5.733333	5.6-5.9	>5.0	-
Turbidity	NTU	118	115	132	97.6	121.6667	115-132	5	-
BOD5	mg/L	1.65	1.95	1.95	2.1	1.85	1.65-1.95		
COD	mg/L	27.73	21.33	23.47	19.07	24.17667	21.33-27.73		
THC	mg/L	<0.01	<0.01	<0.01	<0.01	0	0-0		
Ammonium	mg/L	1.057	1.189	1.123	0.414	1.123	1.057-1.189		
Chloride	mg/L	879.04	619.2	824.93	508.71	774.39	619.2-879.04		
Nitrate	mg/L	2.96	3.33	3.145	1.158	3.145	2.96-3.33	10mg/l	10mg/l
Phosphate	mg/L	0.065	0.109	0.094	<0.01	0.089333	0.065-0.109		
Sulphate	mg/L	98.6	81.242	83.696	53.45	87.846	81.242-98.6		

Parameters	Unit	GW 1	GW 2	GW 3	GW C	Average	RANGE	FMENV Limits	DPR Limits
Total hardness	mg/L as CaCO3	308	174	221	174	234.3333	174-308		
Carbonates	mg/L	0	0	0	0	0	0-0		
Total Alkalinity	mg/L as CaCO3	84	72	86	70	80.66667	72-86		
Oil & Grease	mg/L	<0.01	<0.01	<0.01	<0.01	0	0-0		
Cu	mg/L	0.011	<0.001	<0.001	<0.001	0.011	0.011-0.011		
Fe	mg/L	0.848	2.712	1.914	1.684	1.824667	0.848-2.712		
Ni	mg/L	1.336	0.888	1.128	1.266	1.117333	0.888-1.336		
Zn	mg/L	0.1293	0.0673	0.141	0.2264	0.112533	0.0673-0.141		
Pb	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
Mn	mg/L	0.381	0.419	0.336	0.316	0.378667	0.336-0.419		
Cd	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
Cr	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
Ba	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
V	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
Hg	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
Na	mg/L	436.0775	389.126	508.815	269.9	444.6728	389.126-508.815		
K	mg/L	7.751	5.526	5.623	2.648	6.3	5.526-7.751		
Ca	mg/L	93.33	45.128	46.666	37.949	61.708	45.128-93.33		
Mg	mg/L	55.78	15.043	25.556	19.316	32.12633	15.043-55.78		
TPH	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
PAH	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		
BTEX	mg/L	<0.001	<0.001	<0.001	<0.001	0	0-0		

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.24: Physio - Chemical Properties of Groundwater Sample within the NCDMB Proposed Shipyard Project Area (Wet season)

Parameters (Units)	BH 1	BH 2	BH 3	BH 4	Range	Average	BH C1	BH C2	Average	FMENV Limits	DPR Limits
pH	7.7	7.5	7	6.9	6.9-7.7	7.275	8.2	7.5	7.85	6.5-8.5	6.5 – 9.2
Temperature (°C)	27.2	28.4	28	28.1	27.2-28.4	27.925	28.5	27.6	28.05	25.0-30.0	< 30.0
TDS (mg/l)	16200	16600	8200	3100	3100-16600	11025	110	720	415	500	500
EC (µS/cm)	32600	33200	16400	6200	6200-33200	22100	230	1440	835		
Turbidity (N.T.U)	41.89	43.91	61.37	94.63	41.89-94.63	60.45	11.37	178.7	95.035	5	-
DO (mg/l)	3.7	4.2	4.4	4.6	3.7-4.6	4.225	5.8	6.301	6.0505	>5.0	-
TSS (mg/l)	60	60	80	120	60-120	80	20	200	110	-	1.5
Total Alkalinity (mg/l)	13.92	13.46	0.38	0.28	0.28-13.92	7.01	1.02	0.44	0.73	-	-
Salinity (mg/l)	17099.03	18,408.76	4806.59	3105,89	4806.59-18408.76	13438.13	37.01	411.71	224.36	-	-
BOD (mg/l)	1.1	1.3	1.1	1	1.0-1.3	1.125	1.1	0.9	1	-	-
COD (mg/l)	2.39	2.83	2.5	2.17	2.17-2.83	2.4725	2.44	1.96	2.2	-	-
Chloride (mg/l)	9496.3	10223.68	2669.44	1724.92	1724.92-10223.68	6028.585	20.55	228.65	124.6	-	-
SO_4(mg/l)	346.82	365.26	108.02	32.91	32.91-365.26	213.2525	4.07	23.19	13.63	-	-
NO_3 (mg/l)	79.384	81.34	40.18	15.19	15.19-81.34	54.0235	0.54	3.53	2.035	-	10
NO_2 (mg/l)	1.48	1.52	0.75	0.28	0.28-1.52	1.0075	<0.01	0.07	0.07	-	-
PO_4(mg/l)	0.331	0.36	0.13	0.07	0.07-0.36	0.22275	<0.01	<0.01	<0.01	-	-
NH_4 (mg/l)	0.871	<0.01	<0.01	<0.01	0.871-0.871	0.871	<0.01	<0.01	<0.01	-	-
Na (mg/l)	502.72	515.59	281.76	79.68	79.68-515.59	344.9375	8.42	21.02	14.72	-	-
K (mg/l)	107.361	128.044	62.282	27.872	27.872-128.044	81.38975	1.768	7.208	4.488	-	-

Ca (mg/l)	145.002	161.358	88.827	42.183	42.183-161.358	109.3425	3.21	10.395	6.8025	-	-
Mg (mg/l)	231.952	256.467	101.412	61.28	61.28-256.47	162.7778	5.128	13.223	9.1755	-	-
O&G (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
THC (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
TPH (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PAH (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
BTEX (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Mn (mg/l)	<0.001	<0.001	<0.001	0.145	<0.001-0.145	0.145	<0.001	<0.001	<0.001	-	-
Cd (mg/l)	<0.001	<0.001	<0.001	0.019	<0.001-0.019	0.019	<0.001	<0.001	<0.002	-	-
Cr (mg/l)	<0.001	<0.001	<0.001	0.006	<0.001-0.006	0.006	<0.001	<0.001	<0.003	-	-
Ni (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.004	-	-
V (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	-	-
Pb (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.006	-	-
Ba (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.007	-	-
Hg (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.008	-	-
Fe (mg/l)	0.013	0.009	0.011	0.821	0.009-0.821	0.2135	0.004	0.006	0.005	-	-
Zn (mg/l)	0.035	0.017	0.022	0.071	0.017-0.071	0.03625	0.008	0.011	0.0095	-	-
TCC (MPN/100ml)	40	60	40	40	40-60	45	90	20	55	-	-
FCC (MPN/100ml)	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-
THB x10^8 (cfu/ml)	2.91	3.06	2.54	2.82	2.54-3.06	2.8325	3.86	2.37	3.115	-	-
(cfu/ml)	0.6	0.9	0.4	0.5	0.4-0.9	0.6	1.1	0.3	0.7	-	-
HUB x10^5 (cfu/ml)	1.57	1.92	1.42	1.5	1.42-1.92	1.6025	2.17	1.15	1.66	-	-
HUF x10^2 (cfu/ml)	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-

Source: Lympson Leosentino Limited Field work (September, 2021)

4.8.3.2 Microbiological Characteristics of Groundwater Samples

The microbial status of ground water samples in study area as expressed in their values are presented in **Table 4.25** and **Table 4.26.**

Bacteria: Analysis result of ground water samples collected from the sampling stations in the study area indicated that the total heterotrophic bacteria (THB) count in the ground water samples ranged between $1.3 \times 10^4 – 2.0 \times 10^4$ cfu/ml for dry season and ranged from 2.54×10^8 to 3.06×10^8 cfu/ml for wet season. The predominant bacterial species were *Streptococcus spp, Enterobacter spp*., and *Enterococcus spp*. The microbial load of HUB in the ground water samples was not detected during the dry season but for wet season, the HUB ranged from 1.42×10^5 to 1.92×10^5 cfu/ml.

Fungi: The analysis result for the predominant total heterotrophic fungal (THF) species in the ground water samples of the area were *Penicillium spp.*, and *Aspergillus spp.*, with counts that ranged between $1.0 \times 10^2 – 2.1 \times 10^2$ cfu/ml for dry season and ranged between 0.4×10^3 to 0.9×10^3 cfu/ml for wet season. The microbial load of HUF in the ground water samples was not detected during the dry and wet season studies.

Table 4.25: Microbiological Characteristics of Ground water Samples from the Okpoama Tank farm Project Area, 2021 for Dry Season (Dry Season)

Microbiological Test:	Unit	GW1	GW2	GW3	GWC	Average	Range	0
THB (x 10^4)	cfu/ml	1.3	1.8	2	1.6	1.7	1.3-2.0	2
THF (x 102)	cfu/ml	1	2.1	1.4	0.8	1.5	1.0-2.1	2.1
HUB (x 102)	cfu/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil
HUF (x 102)	cfu/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SRB (x 102)	cfu/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Feacal Coliform	MPN/100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Source: Lympson Leosentino Limited Field work (January, 2021)

Table 4.26: Microbiological Characteristics of Ground water Samples from the NCDMB Brass Island Shipyard Proposed Project Area (Wet Season)

Parameters (Units)	BH 1	BH 2	BH 3	BH 4	Range	Average	BH C1	BH C2	Average	FMENV Limits	DPR Limits
TCC (MPN/100ml)	40	60	40	40	40-60	45	90	20	55	-	-
FCC (MPN/100ml)	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-
THB x 10^8 (cfu/ml)	2.91	3.06	2.54	2.82	2.54-3.06	2.8325	3.86	2.37	3.115	-	-
THF x 10^3 (cfu/ml)	0.6	0.9	0.4	0.5	0.4-0.9	0.6	1.1	0.3	0.7	-	-
HUB x 10^5 (cfu/ml)	1.57	1.92	1.42	1.5	1.42-1.92	1.6025	2.17	1.15	1.66	-	-
HUF x 10^2 (cfu/ml)	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-

Source: Lympson Leosentino Limited Field work (September, 2021)

4.9 HYDROBIOLOGICAL STUDIES

4.9.1 HYDROBIOLOGY

Hydrobiology studies are concerned with species composition, community structure and diversity of the biota (phytoplankton, zooplankton, benthic invertebrates, and fisheries) of the aquatic environment, their interactions amongst themselves and their relationships with the physico-chemical components of the environment. The results of field and laboratory investigations of the ecological studies of Study area are presented below. Samples were collected at five (5) sampling stations (SW1, SW2, SW3, SW4, and SW5) within the proposed project area and two (2) control sampling stations (SWC 1 and SWC 2) outside the proposed project area.

4.9.2 Phytoplankton

Phytoplanktons are the autotrophic microscopic plant organisms (prokaryotic or eukaryotic algae) that live near the surface of water bodies, which adsorbs light to supports photosynthesis. Phytoplanktons are of great ecological significance as they constitute the major portion of primary producers in the aquatic ecosystems and are at the base of the aquatic food pyramid. Majority of phytoplankton species are used for biological monitoring of the environment since they cannot survive in adverse environmental conditions like high turbidity, anoxic state, extreme salinity and low nutrient level. Major important members of this group include the divisions Chlorophyta (green algae), Cyanophyta (blue-green algae) and Bacillariophyta (diatoms).

A total of 58 phytoplankton taxa were recorded during this study as shown in Table 4.27. These belong to seven divisions: Bacillariophyta, Chlorophyta, Cyanophyta, Dinophyta, Euglenophyta), Xanthophyta and Chrysophyta (See Table 4.23 and Table 4.24).

Table 4.27: Phytoplankton species identified in the Study Area

S/N	DIVISION	Species
1	**Bacillariophyta**	*A. granulata var. augustissima*
2		*Anomoeneis serians (Breb.)*
3		*Aulocoseira granulata*
4		*Cyclotella spp*
5		*Cymbella gracillis*
6		*Cymbella lata*
7		*Diatoria* sp.
8		*Eunotia lineolata* Hustd.
9		*Gomphonemena accuminatum*
10		*Navicula cf. radiosa Kutz.*
11		*Navicula vividula*
12		*Naviculla bacillium*
13		*Nitzchia spectabilis*
14		*Nitzschia sigma*
15		*Penularia undalata,*
16		*Penularia undalata,*
17		*Pseudonitzchia spp.*
18		*Ulnotia pectinali*
19	**Chlorophyta**	*Cariteria multifilis*
20		*Carteria globasa*
21		*Chlamydomonas nivalis*
22		*Chlamydomonas* sp.
23		*Cladophoria* spp.
24		*Coelastrum reticulate*
25		*Cosmarium obsolatum*
26		*Crucigenia tetrapedia*
27		*Microsteria* spp.
28		*Microstria rotata*
29		*Pediopera rugurosum*
30		*Pleurotenium trumata*
31		*Spirogyra sp*
32		*Volvox aureus*
33		*Xantidium* spp.
34	**Cyanophyta**	*Anabena flos – aqua*
35		*Lyngbya conctreta*
36		*Merismapedia elagans*
37		*Mycrocystis incerta*
38		*Oscillatoria nigra*
39		*Oscillatoria amphibia*
40		*Oscillatoria bornettia*
41		*Oscillatoria brevita*
42		*Oscillatoria limosa*
43		*Oscillatoria simplisima*
44		*Raphidiopsis curvata*
45		*Spirulina princeps*

46	**Dinophyta**	*Ceratium furca*
47		*Ceratium fusus*
48		*Dinophysis caudata*
49		*Gymnodium sp*
50		*Peridinium sp*
51		*Prorocentrium spp.*
52	**Euglenophyta**	*Euglena acus*
53		*Euglena caudate*
54		*Phacus austreatus*
55		*Phacus longicauda*
56	**Xanthophyta**	*Tribonema viride*
57		*Tribonema vulgare*
58	**Chrysophyta**	*Dinobryon sertularia*

Bacillariophyta were the dominant phytoplankton community followed by the Chlorophyta and Cyanophyta. The Xanthophyta and Chrysophyta were the least in terms of occurrence and abundance. Bacillariophyta contributed 31.03%, while Chlorophyta and Cyanophyta contributed 25.86% and 20.69% respectively of the total phytoplankton population. Dinophyta and Euglenophyta contributed only 10.34% and 6.90% of the total phytoplankton biomass of the water. Contributions from Xanthophyta and Chrysophyta were the least with 3.45% and 1.72% respectively (Table 4.28 and Figure 4.20).

Table 4.28: Phytoplankton number of taxa and individuals with percentages

Taxa Group	Number of taxa	% of Taxa Distribution	No of individuals	% Abundance of individual
Bacillariophyta	18	31.03	206850	66.33
Chlorophyta	15	25.86	58540	18.77
Euglenophyta	4	6.90	2880	0.92
Cyanophyta	12	20.69	23670	7.59
Dinophyta	6	10.34	18340	5.88
Chrysophyta	1	1.72	570	0.18
Xanthophyta	2	3.45	1010	0.32
TOTAL	58	100.00	311860	100.00

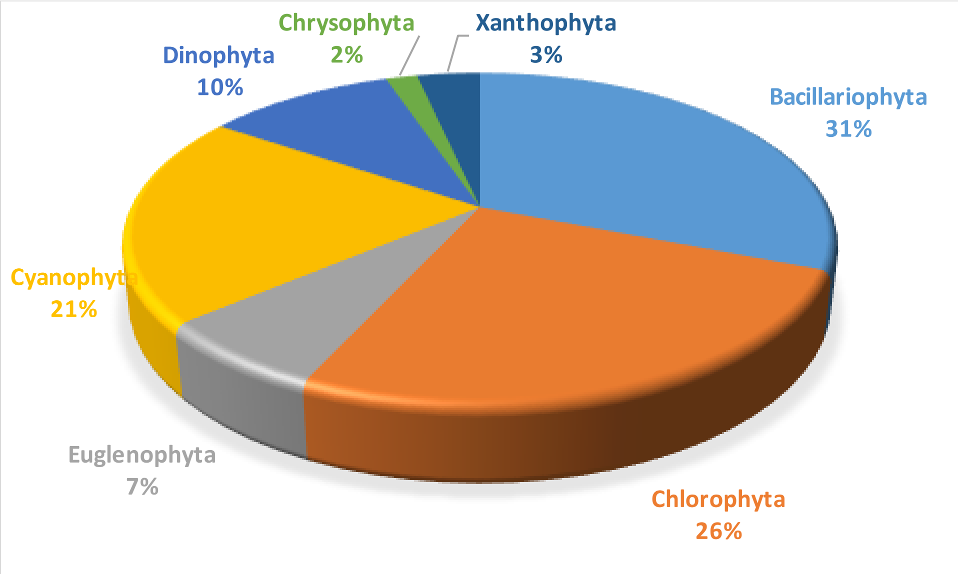


Figure 4.20: Phytoplankton taxa number and percentage contribution of the proposed Project site

4.9.3 Zooplankton

Zooplanktons are microscopic animals found mainly in the pelagic zone of water bodies where they depend on water currents and waves for locomotion. They consist of Rotifers, Cladocera, Calanoid, Copepoda and Planktonic Ostracoda, Shrimps, Decapod crustaceans, larval forms of bivalve molluscs and various fishes which made part of the important components of inland and coastal waters. Zooplankton community may be holoplanktonic (those organisms that spend their entire life cycle as zooplankton e.g. rotifers, cladocerans and copepods) or meroplanktonic (organisms that spend only part of their life cycle as plankton e.g. larvae of fish, crabs, molluscs and polychaete worms). The meroplanktonic forms are more sensitive to pollution than the holoplanktonic community because the former is composed largely of larval forms, that are, by their nature more sensitive to environmental perturbation. Besides the interruption of delicate food webs, the decimation of larval stocks can have serious impacts on the recruitment levels of economically important fish species. The zooplankton occupy a central position in the food webs of aquatic ecosystems and many of them feed largely on phytoplankton, algae and bacterial, and in turn, fall prey to numerous invertebrate and fish predators. They are good biological indicators of water quality as their sensitivity to environmental factors (natural and man-made), makes them of considerable significance in pollution and environmental impact assessment studies.

Occurrence and distribution of zooplankton in the Study area are presented in **Tables 4.29** and **Table 4.30.** Forty one (41) species of zooplankton were recorded during the sampling period. This is made up of holoplankton (80.49%) and meroplanktonic (19.51%) zooplankton forms respectively.

Among the holoplankton, the major occurring zooplankton group in the study area was Cladoceran (36.36%), Copepods (27.27%), Rotifers (24.24%), and Protozoa (12.12%), while within the meroplankton shrimp zoea and larva were the dominant groups (Figure 4.21).

Table 4.29: Zooplankton distribution and abundance in the study area

S/N	DIVISION	Species
HOLOPLANKTONIC		
	CLADOCERA	
1	**Bosminidae**	*Bosmina longirostris*
2		*Bosminopsis deitersi*
3	**Chydoridae**	*Alona affinis*
4		*Alona diaphana*
5		*Alonella excisa*
6	**Moinidae**	*Moina micrura*
7		*Monia dubia*
8		*Moinodaphnia macleayi King*
9	**Sididae**	*Diaphanosoma excisum*
10		*Penilia sp*
11	**Daphnidae**	*Ceriodaphnia cornuta Sars*
12		*Simocephalus latirostris Stingelin*
	COPEPODA	
13		*Acanthocyclops viridis*
14		*Centropages typicus*
15		*Copepod nauplius*
16		*Macrocyclops albidus*
17		*Macrocyclops distinctus*
18		*Microcyclops varicans Sars*
19		*Mesochra sulfunensis*
20		*Nitocva lacustris*
21		*Paracalanus parvus*
	ROTIFERA	
22	**Brachionidae**	*Brachionus angularis*
23		*Brachionus caudatus*
24		*Brachionus falcatus*
25	**Euchlanidae**	*Euchlanis sp*

26	**Trichocercidae**	*Trichocerca cylindrica*
27		*Trichocerca longiseta*
28	**Lecanidae**	*Lecane leontina Murray*
29		*Lecane leontina Murray*
	PROTOZOA	
30		*Arecella mitrata*
31		*Frontonia leucas*
32		*Holophrya vesiculosa*
33		*Tintinnopsis* sp.
MEROPLANKTONIC		
34		Shrimp zoea
35		Shrimp larva
36		Gastropod veligar larva
37		Doloidid larva
38		Zoae (Crab)
39		Polycheate larva
40		Fish eggs
41		Fish larva

Table 4.30: Zooplankton number of taxa and individuals with percentages

	Number of taxa	%	No of individuals	%
Cladocera	5	16.67	9160	46.22
Copepoda	9	30.00	7890	39.81
Rotifera	4	13.33	120	0.61
Protozoa	4	13.33	910	4.59
Meroplanktonic	8	26.67	1740	8.78
TOTAL	30	100.00	19820	100.00

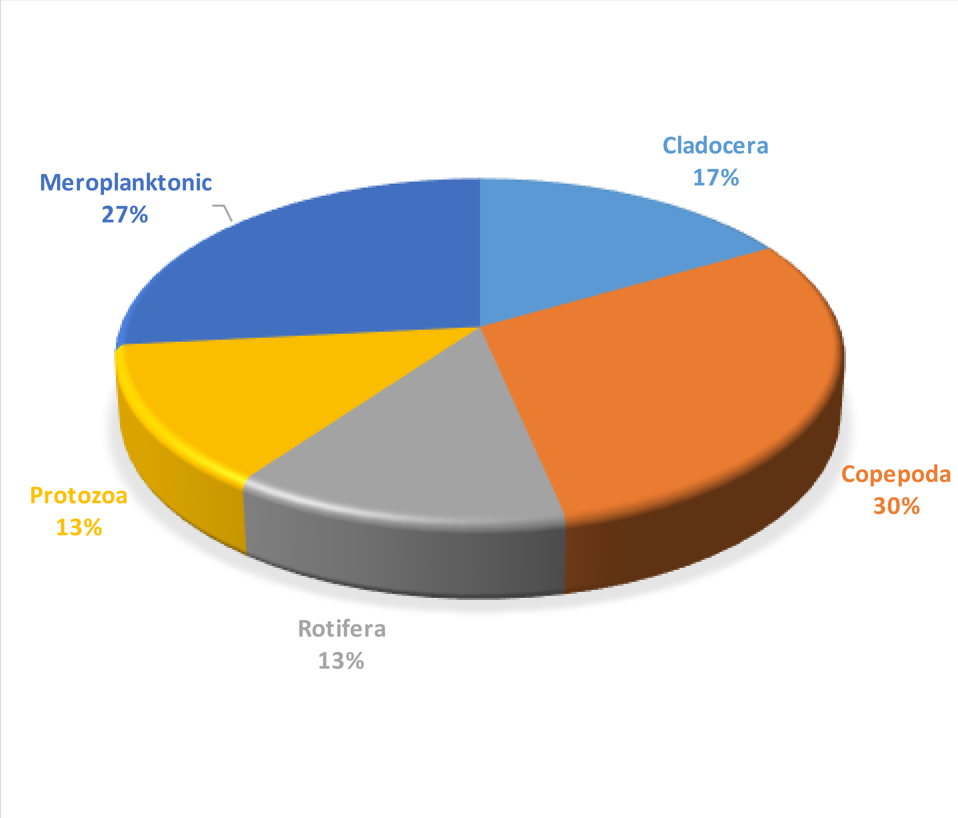


Figure 4.21: Percentage composition of Zooplankton division in the Study Area

4.9.4 Benthic Invertebrate Fauna

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

The composition, abundance and diversity of macrobenthic invertebrate fauna in the study area are presented in Table 4.31 and Table 4.32. A total of thirty one (31) benthic invertebrates were recorded during the study. These benthic invertebrates belong to the following: Crustacea, Gastropod, Bivalves, Annelids and Insecta group. Annelida (25.81%) has the highest number of taxa and spread of species in the area followed by Insecta (22.58%), Crustacea and Gastropoda (19.35% each) and while benthic Bivalves (12.90%) was the lowest with respect to taxonomic spread in the study area (Figure 4.22). *Eiseniella tetrahedral*, *Tubifex sp* and *Lumbricus sp* were the dominant *annelida* species, while *Uca* *tangeri* was the dominant *Crustacean species,* while *Tympanotonus fuscatus* and *Crassostrea gasar* were the dominant *Gastropods* and *Bivalves species* respectively.

Table 4.31: Macro-invertebrate distribution and abundance in the study area

S/N	GROUP	Scientific Name	Common Name
	Crustacea		
1		Alpheus pontederiae	Snapping shrimp
2		Callinectes amnicola	Swimming crab
3		Cardisoma armatum	Rainbow crab
4		Mysis sp	
5		Palaemon maculates	
6		Uca tangeri	Fiddler crab
	Gastropoda		
7		Littorina sp	
8		Glyphoturris rugirima	
9		Oenopota uschakovi	
10		Pachymelania aurita	
11		Thais sp	
12		Tympanotonus fuscatus	Mud-flat periwinkle
	Bivalve		
13		Crassostrea gasar	Oysters
14		Mutela Larva,	
15		Mercenaria mercenaria	
16		Cerastoderma glaucum	
	Annelida		
17		Capitella sp	
18		Nereis pelagica	
19		Notomastus aberans	
20		Eiseniella tetrahedral	
21		Tubifex sp	
22		*Dero* sp,	
23		Naidid sp.	

24		*Lumbricus* sp.	
	Insecta		
25		Baetis sp	Mayfly larva
26		Coenagrion sp	Dragonfly larva
27		Chironomus sp	
28		Libellula sp.	
29		*Chlorosypha* sp.	
30		Odonnata larva	
31		*Enochrus* sp.	

Table 4.32: Zooplankton number of taxa and individuals with percentages

Group	No of Species	% Species Abundance	No of individuals	% of Individual Abundance
Crustacea	6	19.35	22980	65.71
Gastropoda	6	19.35	6980	19.96
Bivalve	4	12.90	870	2.49
Annelida	8	25.81	1730	4.95
Insecta	7	22.58	2410	6.89
TOTAL	31	100.00	34970	100.00

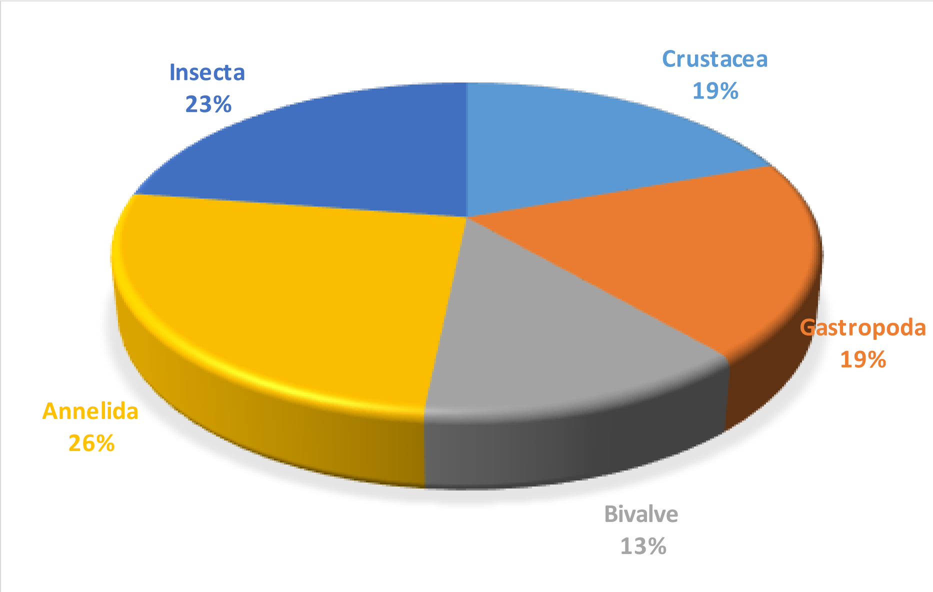


Figure 4.22: Percentage composition of Benthic Invertebrates fauna in the Study Area

4.10 Fisheries Studies

Brass and Okpoama Rivers serves as the main source of fishing activities within the project area. Some locals and fishermen from other communities/state were actively engaged in fishing during the study period. Some of the common fishing gears used within the proposed project area include gillnet, setnet, scoopnet, stownet, long line, circular lift net, cast nets and ghost shrimp traps. Typically, gillnets and setnets measures around 6 to 12metres in length and 2 to 4metres in width. Nets are manually operated using paddles and poles. However, the people are also involved in farming, welding, palm wine tapping, trading and other petty businesses.

The species composition from the fishermen catches in the area is shown in Table 4.33. The analysis is of catches in the proposed project site reveals that *Tilapia guineensis* constituted the most dominant fish species, closely followed by *Caranx spp, Dentex angolensis and Epinephelus aeneus* while *Sepia officinalis* was among the least common fish species hauled by the fishermen. However, comparing the number of fishermen hauling particular fish species and the amount of fish landed, the *Caranx spp* was found to be the most hauled fish species by the majority of fishermen.

Table 4.33: Fish species composition of fishermen catches in the area

S/N	Species	Common Name	Local conservation status
Family: Carangidae			
1	*Caranx hippos*	Crevalle jack	A
2	*Caranx crysos*	Blue runner	R
Family: Clupeidae			
3	*Sardinella aurita*	Round sardinella	A
Family: Cichlidae			
4	*Tilapia guineensis*	Tilapia	A
Family: Elopiidae			
5	*Elops lacerta*	West African ladyfish	A
Family: Lutjanidae			
6	*Lutjanus agennes*	African red snapper	C
Family: Oxudercidae			
7	*Periophthalmus barbarus*	Mudskipper	A
Family: Portunidae			
8	*Portunus Validus*	Smooth crab	A
Family: Scieanidae			
9	*Pseudotolithus elongatus*	Bobo croaker	A
10	*Pseudotolithus senegalensis*	Cassava croaker	C
Family: Scombridae			

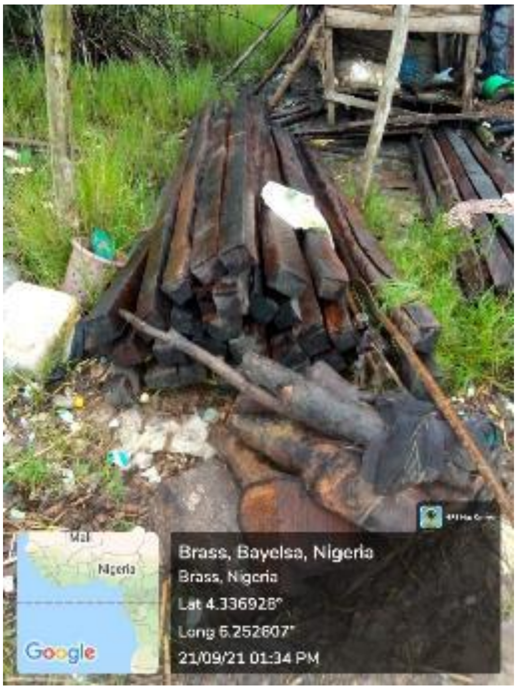
11	*Scomberomorus tritor*	West African Spanish mackerel	C
Family: Sepiidae			
12	*Sepia officinalis*	Common cuttlefish	R
Family: Serranidae			
13	*Epinephelus aeneus*	White grouper	C
Family: Sparidae			
14	*Dentex canariensis*	Canary dentex	A
15	*Dentex sp*		A
Family: Sphyreanidae			
16	*Sphyreana barracuda*	Barracuda	C

NB: A =abundance, C = common, R =Rare

4.11 Vegetation and Wildlife Studies

4.11.1 Vegetation Studies

The Environmental impact assessment (EIA) of the **Brass Island Shipyard** commenced from the 19th to 21st September, 2021. The site is located at Itimapiri (by Tie-wei Creek- Twon Kubu) Okpoama Kingdom and Twon Kingdom in Brass Local Government Area of Bayelsa State, Nigeria. The location is mainly dominated by mangrove swamp, tropical rain forest, swampy and coastal terrain. The major occupations of the rural dwellers are largely fishing, hunting, and logging (Plate 4.1a-4.1d). Species of wildlife were found in the area.



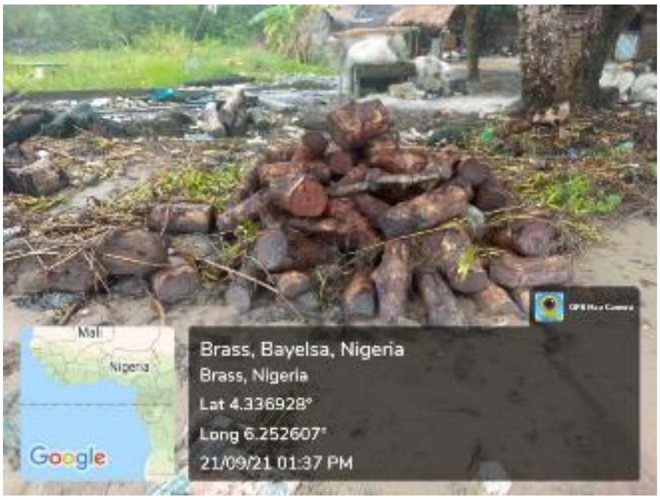


Plate 4.1a **Plate 4.1b**

Plate 4.1c **Plate 4.1d**

Plates 4.1: shows Logging activities by local people

Environmental evaluation studies of the vegetation types, plant pathology, floral composition and Herbarium study was done in sampling points of about 1000m x 10m each, these sampling distances were chosen after a reconnaissance survey of the study area. Three (3) Belt transects were laid where observations were made in the study area following the methods outlined by (Kershaw, 1977;

Magurran, 1987; Sutherland, 1997; Bamidele and Akinnibosun, 2012). Vegetation at the various observation points within 50 m^2 frame quadrat were identified to species level and documented using appropriate botanical literatures such as (Keay, 1989; Keay *et al.*, 1964; Akinnibosun and Odiete, 2008; Akinnibosun and Odiete, 2008; Akinnibosun and Odiete, 2008; Akinnibosun and Omatsola, 2011; Akobundu, 1999; Idu *et al.*, 2006). Sampling quadrats measuring 100 m X 100 m each were studied at intervals along a 100 m transect at each sampling location. Interviews were conducted with some local community people to know the medicinal and economical use of the plant species such as *Bambusoideae* (Bamboo) used for building houses, floors, roof constructing bridges. *Raphia vinifera* (Raffia palm) is used for the production of raffia wine. The plants were also observed to identify the prevalent plant diseases in the study area if any using a hand lens, etc. The establishment of the proposed modular refinery will distort and displace vegetation and animal life which may lead to plant and animal extinction. The way of life of the Rural dwellers will be affected negatively especially the farmers and hunters as their farmland and forest is taken over by the Shipyard, affecting their economic benefit. Virgin mangrove swamp is very rich in clean air because plants take carbon dioxide from the atmosphere and release Oxygen into the atmosphere. Removing trees and plants in the forest reduces the volume of oxygen which will expose the atmosphere to air pollution. If the Shipyard is not properly managed it could lead to environmental pollution (Air, soil and water pollution). At the same time the Shipyard would provide job employment for the rural dwellers. *Ecitoninae spp* (soldier ant) and *Lumbricus terrestris* (earthworm) where spotted around the fresh water swamp with lots of leaf droppings (organic matter composition), the ants were busy foraging for food (leaf droppings) while the earthworm burrowing into the soil, by their activity in the soil, earthworms offer many benefits: increased nutrient availability, better drainage, and a more stable soil structure, all of which help improve farm productivity. Worms feed on plant debris (dead roots, leaves, grasses, manure) and soil to survive; earthworms need moist soils that have sufficient residue or organic matter for food they improve soil structure, water movement, and nutrient cycling and plant growth. They are not the only indicators of healthy soil systems, but their presence is usually an indicator of a healthy system. The unidentified species were collected, pressed and mounted in plant press and taken to the Botany Department University of Benin, Benin City, Edo State for proper identification.

Transect 1

Rain Forest Vegetation

Rain forest vegetation is known for its stratified vegetation, with a high biodiversity of tree species. There are mainly three (3) layers of vegetation. The densest being the middle/canopy with trees between 14 -26 meters in height forming a closed canopy and allowing little sunlight penetration to the forest floor. This layer also hosts a rich community of epiphytes and lianas. The emergent layer consists of fewer sparsely distributed giant trees towering above the canopy layer reaching between 32-43meters in height, with trunk girths of 3 meters and above.

Vegetation height in mature vegetation reaches average height of 20 meters. While emergent trees reached 25 meters. Among the species emerging above the canopy layer in the rainforest areas are *Irvingia gabonensis* var. *gabonensis, Sterculia oblonga, Lophira alata, Uapaca spp Eliaes guineensis, Klainedoxa gabonensis* and *Albizia adianthifolia.* Canopy layer species include *Chrysobalanus icaco elliptus, Garcinia cola, Guarea thompsonii, Nauclea latifolia, Alstonia boonei, Vitex grandifolia, Ceiba pentandra, Ficus exasperata,* and *Fleroya ledermannii.*

Plate 4.2: Cocos nucifera (coconut palm)

Plate 4.3: Asplenium bulbiferum (fern)

Transect 2

Mangrove swamp

Mangroves, seagrass beds, and coral reefs work as a single system that keeps coastal zones healthy. Mangroves provide essential habitat for thousands of species. Some of the plant species in this area include: *Avicennia germinans* (Black mangroves), and *Avicennia marina* of the Family Avicenniaceae; *Laguncularia racemosa* (White mangrove) of the family Family Combrataceae; *Rhizophora mangle* (Red mangroves); *Rhizophora racemose, Rhizophora Africana, Rhizophora mucronata* (Loop- root mangrove), *Rhizophora stylosa* (Stilted mangrove), and *Ceriops tagal* of the family Rhizophoracea, *Avicennia germinans* (Black mangrove) of the family Family Acanthaceae, *Calamus sp* (Rattan palm), *Elaeis guineensis* (oil palm), and *Cocos nucifera* (coconut palm) of the family Family Arecaceae; *Acrostichum speciosum* (Mangrove fern) and *Acrostichum aureum* (Golden leather fern) of the family Family Pteridaceae; and *Spartina alterniflora* or *Sporobolus alterniflora* (salt mash cord grass or salt-water cord grass) of the family Family poaceae. *Asplenium bulbiferum* (fern) of the Family Aspleniaceae were also seen attached to the stems of *Elieas guineensis* in some parts of the fringes of the Brass River estuary. *Prunus dulcis* (red almond) of the family Family Rosaceae were also seen on the fringes of the estuary. *Eichhornia crassipes* (Water hyacinth) of the family Family Pontederiaceae were also seen on the fringes of the estuary and were also floating in the estuary. These water hyacinths were abundant during the period of the EIA because it the rainy season. They drifted into the estuary from the fresh water environment and are able to survive in the estuary because of the dilution of the salinity of the water that had occurred because of the rainy season.

Plate 4.4a

Plate 4.4b

Plates 4.4: Acrosticum speciosum (Mangrove fern)

Plate 4.5: ***Rhizophora mangle*** **(Red mangroves)**

Plate 4.6: ***Laguncularia racemosa*** **(White mangrove)**

Plate 4.7: Red mangrove seedling

Plate 4.8: Picture showing Eichhornia crassipes

Plate 4.9: ***Elaeis guineensis*** **(Young oil palm)**

Plate 4.10: ***Calamus sp*** **(Rattan palm)**

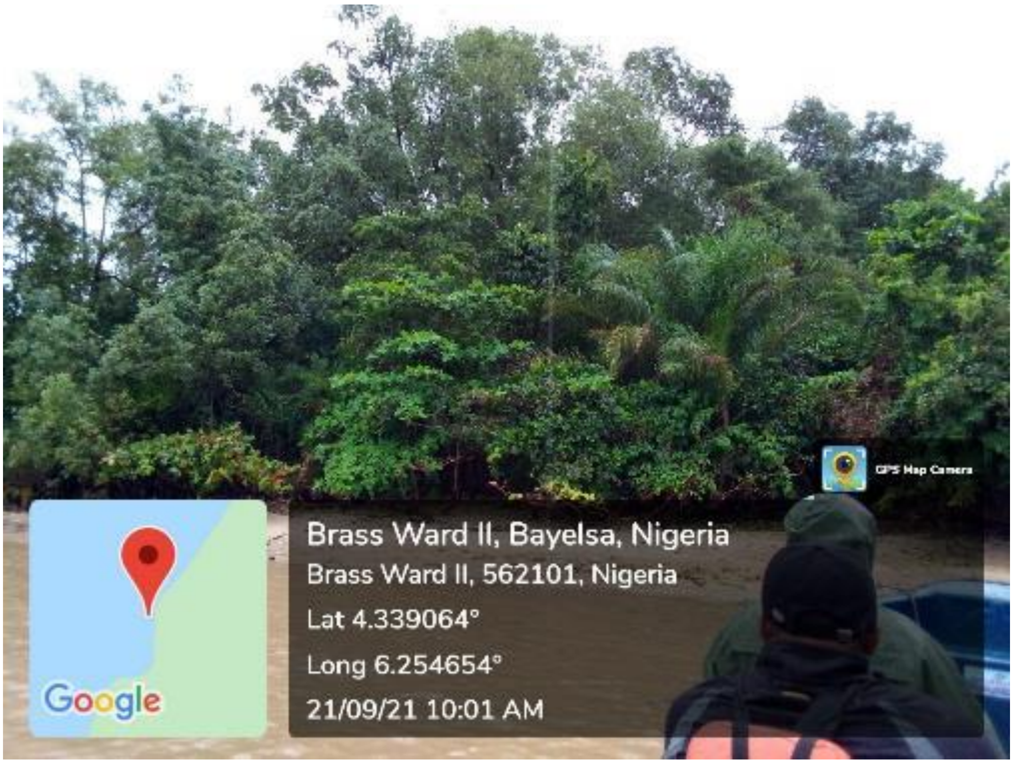


Plate 4.11: Showing the stratification of the mangrove forest area.

Transect 3

Fresh water swamp

The freshwater swamp bears several tall tree species with broad leaves and buttress/ stilt roots to support their enormous weights. Most of the freshwater swamps are thick and differentiated into two or three canopies or strata and consists of economic trees like– *Ancistrophyllum secundiflorum Raphia spp., Oxytenanthera abbycinica, Pandanus candelabrum, Hellea ledermanni, Alchornea cordifolia, Albizia lebbeck, Tectona grandis, Musanga cecropoides, Aistonia boonel, Terminaia spp., Cleistopholis patens, Albizia spp., Symphiona globugerina, Uapaca guineensis, Ceiba pentandra* among others.

As the name implies Fresh Water Swamp vegetation consists of plant species that can only thrive in fresh water environments. These are majorly plants that can tolerate flooding or at least for most parts of the season. This vegetation usually has the occurrence of heavy rainfall that ensures constant fresh water supply, and has its water table close to the surface. In terms of vegetation structure and species composition, the timber species including *Fleroya ledermannii, Ceiba pentandra, Alstonia boonei*, and *Lophira alata*. Others tree species include *Pycnanthus angolensis, Spondianthus preusii, Sacoglottis* *gabonensis, Uapaca spp., Albizia adianthifolia, Irvingia gabonensis, Klainedoxa gabonensis, Treculia africana,* and *Elaeis guineensis*. Average tree height reaches 15-20 m and emergent species can reach heights of 25 to 30 m: occurring at low densities.

The plant species includes trees, shrubs and herbs. Among the herbs are vines (herbaceous climbers) and ferns. Woody climbers (Lianas) were seen climbing or entangling some trees such as palm tree (*Elaeis* guineensis). Economic trees and shrubs were among the life forms categories found at these locations. However, the areas sampled has a open canopy, due to high lumbering activities in the study area. Forests lose their structure to logging activities, with the repeated felling of twigs and undersized timber for fuel and lumber purposes, there is limitation for the native species to thrive. The water table is typically close to the surface. The dominant tree species encountered here are the Oil palms, *Fleroya ledermannii* (trade name: Abura), *Alstonia boonei*, *Ceiba pentandra*, *Ficus spp*, and *Spondianthus preusii*. *Staudtii stipitata* and *Albizia adianthifolia* are also common.

Plate 4.12: Ancistrophyllum secundiflorum

Plate 4.13: Ancistrophyllum secundiflorum

Plate 4.14: Buttress Roots

Plate 4.15: Buttress Root

Plate 4.16: Silt root

Plate 4.17: Fresh water swamp

Plate 4.18: Fresh water swamp

Table 4.34: Summary of Plant species within the study area

S/N	SPECIES NAME	Family	T1	T2	T3	Uses
1	*Acanthus* sp.	Acanthaceae	+	-	-	Medicinal
2	*Adenialobata*	Pasifloraceae	-	-	-	Medicinal
3	*Ageratum conyzoides*	Asteraceae	-	-	+	Medicinal/animal feed
4	*Albizia zygia*	Fabaceae	-	-	-	Timber/wood
5	*Alchornea cordifolia*	Euphorbiaceae	+	-	-	Medicinal
6	*Ananas* sp.		-	-	-	Food
7	*Andropogon* sp.	Poaceae	+	-	-	Animal feed
8	*Uvaria chamae*	Annonaceae	+	-	+	Medicinal
9	*Uvaria aminickiae*	Annonaceae	+	-	-	Medicinal
10	*Anthocliesta sp*	Bignonaceae	-	-	-	Medicinal/wood
11	*Anthonathama crophylla*	Fabaceae	-	-	-	Medicinal/firewood
12	*Asystasia gigantica*	Acanthaceae	+	-	-	Medicinal
13	*Bambusa vulgaris*	Poaceae	-	-	-	Construction/building
14	*Baphia nitida*	Fabaceae	-	-	-	Medicinal/firewood
15	*Carica papaya*	Caricaceae	-	-	-	Food
16	*Chromoleana odorata*	Asteraceae	+	-	-	Medicinal
17	*Cintrocima pubescence*	Fabaceae	-	-	-	Fodder
18	*Cloredendron* sp	Acanthaceae	+	-	+	Medicinal
19	*Cola* sp.	Tilaceae	+	-	-	Food/firewood
20	*Combretum platypterum*	Combretaceae	-	-	-	Medicinal
21	*Combretum* sp.	Combretaceae	+	-	-	Medicinal
24	*Cyperus*sp	Cyperacea	-	-	-	Fodder
25	*Dioscore bulbifera*	Dioscoraceae	+	-	+	Food/medicinal
26	*Elieas guineensis*	Araceae	-	-	+	Food/construction/building
27	*Emilia sonchifolia*	Asteraceae	-	-	-	Medicinal
28	*Ficus*sp.	Moraceae	-	-	-	Medicnal/firewood
29	*Funtimia*sp.	Apocynaceae	+	-	+	Medicinal/firewood
30	*Glyphea*sp.	Tilaceae	-	-	-	Firewood
31	*Harunganamada gascriensis*	Hypericaceae	+	-	-	Firewood/medicinal

32	*Heveabra silenesis*	Euphorbiaceae	-	-	-	construction/building
33	*Hibiscus haspa*	Malvaceae	-	-	-	Medicinal
34	*Hyptes* sp.	Lamiaceae	+	-	-	Medicinal
35	*Icacinamannii*	Icacinaceae	+	-	-	Food/medicinal
36	*Icacinatrichantha*	Icacinaceae	-	-	-	Food/medicinal
37	*Macaranga* sp.	Euphorbiaceae	-	-	+	Medicinal
38	*Makemia* sp.	Asteraceae	-	-	+	Medicinal
39	*Mangifera indica*	Anacardiaceae	-	-	-	Food/construction/building
40	*Manihot esculenta*	Euphorbiaceae	-	-	-	Food
41	*Milletia arborens*	Fabaceae	+	-	+	Firewood/building
42	*Mimosa invosa*	Fabaceae	+	-	-	Medicine
43	*Miniphyton fulvum*	Euphorbiaceae	+	-	-	Firewood
44	*Musa* sp	Aracaceae	-	-	-	Food
45	*Napoleona imperialis*	Lecythidaceae	-	-	-	Food/medicinal
46	*Newbuldia leavis*	Bignonaceae	-	-	-	Cultural/firewood
47	*Panicum laxum*	Poaceae	-	-	-	Fodder
48	*Panicum maximum*	Poaceae	-	-	-	Fodder
49	*Puraria* sp.	Fabaceae	-	-	-	Fodder
50	*Sida acuta*	Malvaceae	+	-	-	Fodder/medicinal
51	*Sida* sp.	Malvaceae	+	-	-	Fodder/medicinal
52	*Smilax anceps*	Smilaceae	+	-	+	Medicinal
53	*Solanum turvum*	Solanaceae	-	-	+	Medicinal
54	*Spondia smombin*	Anacardiaceae	+	-	-	Food/medicinal
55	*Stachytarpheta cayennensis*	Verbenaceae	+	-	-	Medicinal
56	*Tectonia grandis*	Verbenaceae	-	-	-	Construction/building/firewood
57	*Trema orientalis*	Cannabaceae	-	-	+	Firewood
59	*Urenalobata*	Malvaceae	-	-	-	Basket making
60	*Uvaria* sp.	Annonaceae	+	-	-	Medicinal
61	*Xanthosoma mafafa*	Aracaceae	-	-	-	Food
62	*Avicennia germinans*	Avicenniaceae	-	+	-	Construction/building/firewood
63	*Avicennia marina*	Avicenniaceae	-	+	-	Construction/building/firewood

64	*Laguncularia racemosa*	Combrataceae	-	+	-	Construction/building/firewood
65	*Rhizophora mangle*	Rhizophoracea	-	+	-	Construction/building/firewood
66	*Rhizophora racemose*	Rhizophoracea	-	+	-	Construction/building/firewood
67	*Rhizophora Africana*	Rhizophoracea	-	+	-	Construction/building/firewood
68	*Rhizophora mucronate*	Rhizophoracea	-	+	-	Construction/building/firewood
69	*Rhizophora stylosa*	Rhizophoracea	-	+	-	Construction/building/firewood
70	*Ceriops tagal*	Rhizophoracea	-	+	-	Construction/building/firewood
71	*Avicennia germinans*	Acanthaceae	-	+	-	Construction/building/firewood
72	*Calamus sp*	Arecaceae	-	+	-	Food
73	*Cocos nucifera*	Arecaceae	-	+	-	Food
74	*Eichhornia crassipes*	Pontederiaceae	-	+	-	Fodder/ Construction
75	*Acrostichum speciosum*	Pteridaceae	-	+	-	Fishing
76	*Acrostichum aureum*	Pteridaceae	-	+	-	Fishing
77	*Spartina alterniflora* or *Sporobolus alterniflora*	Poaceae	-	+	-	Not known
78	*Asplenium bulbiferum*	Aspleniaceae	-	+	-	Not known
79	*Prunus dulcis*	Rosaceae	-	+	-	Food

Note: + = present, - = absent

Plant Pathological Assessment

A survey of the health status of wild plant species and economic crops in the project area revealed the presence of fungal, bacterial and viral infections on the foliage of both categories of plants.

The widespread pathological conditions are leaf spot and chlorosis, which were found in over 30% of the specimens examined. Other diseases include necrosis, leaf mosaic, wet rot, and powdery mildew. The causal organisms include *Aspergillus* spp., *Fusarium* spp., *Penicillium* sp. and *Ganoderma pseudoferreum* among others. Generally, the health status of most of the plant species in the study area from observations seem normal. It should be noted that necrotic and chlorotic symptoms are common with forest and bush fallow plants (Table 4.35)

Table 4.35: Common Plant Diseases and Causal Organisms in the Study Area

Plant Species	Type of Disease	Causal Organism
Manihot esculenta	Leaf mosaic Chlorosis	*Mosaic virus*
Teifairia	Powdery mildew leaf spot	*Oidium levea*
Paspalum laxawn	Necrosis Leaf spot	*Aspergillus sp.*
Panicum maximum	Necrosis Leaf spot	*Aspergillus niger*
Urena lobaia	Leaf spot	*Fusarium oxysporium*
Arachis hypogaea	Rossette	*Cercospora beticola.*
Arachis hypogaea	Tikka	*Cercospora personata*

4.11.2 Wildlife Studies

The wildlife inventory for the study area was carried out by the use of pitfall traps, examining the animal footprints, droppings, interview with local hunters, etc. During the cause of the fieldwork campaign, birds and some other reptiles were observed and identified. Also, the local markets were visited to see and identify the predominant wildlife species.


Plate 4.19a

Plate 4.19b

Plate 4.19c

Plates 4.19: The Pitfall Traps

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

Mammal

The mammalian fauna of the proposed area consists mainly of Antelopes (*Hippotragus equines*), Spotted grass mouse (*Lemniscomys striatus*), Geoffroy's ground squirrel (*Xerus erythropus*), Tree squirrel (*Funisciurus pyrrhopus*), Giant rat (*Cricetomys gambianus*), Stripped mouse (*Hvbomvs triviraatus*), Cane rat (*Atherurus africanus*), Porcupine (*Taphozous peli*), *Galago sp,* Red colombus monkey (*Precolombus* sp.), Mona monkey (*cercopithecus* sp.), Pangolin (*Manis sp.*), Squirrels (*Anomalrus sp.*), *Protoxerus* sp., *Epixerus* sp., *Funisciurus* spp., *Xerus* sp.), *Lemniscomys straitus, Arvicanthis sp., Cricetomys gambianus, Thrynomys sp., Vivera civetta, Genetta sp.*, Straw-coloured fruit bat (*Eidolon helvum*), Bats (*Crocidura sp.*), and Musk shrews (*Epomophorus spp.*).

Aves

The avian fauna of the proposed area consists mainly of Reed cormorant (*Phalacrocorax africanus*), Kites, hawks, swifts (Micropopidae) and herons. Red eye dove *Streptoprelia semitorquata*, The mourning dove (*Zenaida macroura*), Carmine bee-eater *Merops nubicus,* Black kite (*Milvus migrans*), Red kite (*Milvus milvus*), The Atlantic canary or wild canary (*Serinus canaria*), hawk (*Polyboroides radiatus*), African grey parrot (*Psittacus erithacus*), Hooded vulture (*Necrosyrtes monachus*), Egret (*Ardea alba*), Heron (*Ardea sp.*), Barn owl (*Tyto alba*), and Spotted eagle owl (*Bubo atricanus*).

Ardea sp. (heron)

Milvus milvus (Red kite)

Plate 4.20: The mourning dove (*Zenaida macroura*)

Plate 4.21: Phalacrocorax africanus

Plate 4.22: African grey parrot (*Psittacus erithacus*)

Amphibians

The common amphibians in the area include *Bufo regularis* (Common African Toad), *Bufo latiformis* (Toad), *Rana temporaries* (True green Frog), *Gigaratorina golath* (Goliath Frog), *Xenopus tropicalis* (Clawed toe frog) and *Hyperclius sp* (Tree frog). The common amphibians in the area include *Bufo regularis* (Common African Toad), *Bufo latiformis* (Toad), *Rana temporaries* (True green Frog), *Gigaratorina golath* (Goliath Frog), *Xenopus tropicalis* (Clawed toe frog) and *Hyperclius sp* (Tree frog).

Reptiles

The reptiles of the area include Tortoises (*Kinixys spp*), small lizards *Agama agama,* common garden skinks (*Mabuya affinis* and *Lampropholis guichenoti*), forest gecko (*Hoplodactylus granulatus*), and chameleon (*Chamaeleo sp*). The Large lizards include *Crocodylus tetraspsis* and *Varanus niloticu* which are endangered. There was a consensus opinion among the hunters that snakes are preponderant throughout the study area, and include the king cobra (*Ophiophagus hannah*), Emerald green snake, (*Gastropyxis smaradgina*), the green mamba, (*Dendoaspis jamesoni*), Gabon viper (*Bitis gabonica*), and the pythons (*Python reguis* and *P. sebae*) which inhabit the humid forests areas.

Plate 4.23: West African black mud turtle (*Pelusios castaneus*)

Plate 4.24: Lampropholis guichenoti (common garden skink)


***Plate 4.25: Agama agama* (Female Agama Lizard) and *Agama agama* (Male Agama Lizard)**

Plate 4.26: Varanus niloticus (Monitor Lizard)

Plate 4.27: A chameleon (*Chamaeleo sp*)

Plate 4.28: King cobra (*Ophiophagus hannah*)

Plate 4.29: A python (*Python reguis*).

Mollusks

African giant snail *Archachatina marginata*, was the prominent mollusk found in the proposed project area. Others may include: *Achatina spp.* and *Limicolaria aurora.*

The result of the molluscs is presented in Table 4.36, while the reading of the parameter from the five different stations from Aamassoma River and pond is shown in Table 4.37. These parameters were commonly used as indicator for water quality.

Table 4.36: Checklist of molluscs in Amassoma Kingdom

Taxon

Class	**Family**	**Scientific name**	**Common name**
Bivalvia	Ostreidae	*Crassostrea sp.*	Oyster
Gastropoda	Viviparidae	*Cipangopaludina chinensis malleata*	Chinese mystery snail
	Achatinidae	*Achatina faulica*	Giant African land Snail.
		Achatina marginata	Giant African land Snail.
		Achatina achatina	Giant African land Snail.

Limicolaria aurora

Achatina marginate

Achatina faulica

Insects

A total of 6547 individual species comprising 8 Orders, 25 Families and 40 species were encountered during this study. The most dominant Orders in this study were Lipidoptera and Diptera and they were represented by six (6) families each, the families include; Noctuidae, Nolidae, Geometridae, Erebidae, Nymphalidae, and Pieridae for Lipidoptera, while the families for Diptera include; Culicidae, Muscidae, Psychodoidae, Chrysopidae, Tabanoidae, Formicidae. The Order Lipidoptera was represented by eight (8) species where Diptera was represented by seven (7) species.

These Orders were followed by Coleoptera and was represented by four (4) families and eight (8) species. This was followed by Orthoptera and was represented by three (3) families with seven (7) species. This Order was jointly followed by Hymenoptera and Odonata and were represented by two (2) families each. But Hymeoptera had seven (7) species while Odonata had four (4) species. The least dominant Order in this research work were Hemiptera and Blattodea, they were represented by one (1) family each, with one species respectively (see Table 4.37).

Table 4.37: Summary of the composition of insect Order, Family and species encountered in the study Area

ORDER	FAMILY	SPECIES	COMMON NAMES
Blattodea	Blattidae	*Periplaneta americana*	Cockroach
Coleoptera	Carobidae	*Brachinus favicollis*	Bombardier beetle
		Brachinus sp.	Bombardier beetle
	Tenebrionoidae	*Alphitabius sp.*	Darkling beetle
	Coccinellidea	*Coccinella sp.*	Ladybird beetle
	Chrysomelidae	*Labidomera clivicollis*	Leaf beetle
		Charidotella sexpunctata	Golden tortoise beetle
Diptera	Culicidae	*Known*	Mosquito
		Anopheles sp.	Mosquito
	Muscidae	*Musca domestica*	House fly
	Psychodoidae	*Clogmia sp.*	Filter fly
	Chrysopidae	*Chrysoperla carnea*	Lace wing

	Tabanoidae	*Hybomitra micans*	Fly
Hymenoptera	Formicidae	*Darylus sp.*	African army ant
		Camponotus pennsylvanicus	Black carpenter ant
		Monomerium pharaonis	Pharaoh ant
		Camponotus floridanus	Carpenter ant
		Formica ligniperda	Carpenter ant (worker)
		Camponotus gigas	Carpenter ant
	Apidae	*Apis mellifera*	Honey bee
Lepidoptera	Noctuidae	*Spodoptera exampta*	African armyworm moth
	Nolidae	*Nola cucullatella*	
	Geometridae	*Lomographa sp.*	Moth
	Erebidae	*Hypenas cabra*	Moth
		Caenurgina erechtea	Forage looper moth
	Nymphalidae	*Danaus plexippus*	Monarch butterfly
		Limenitis archippus	Viceroy butterfly
	Pieridae	*Pieris rapae*	Cabbage white butterfly
Odonata	Caenagrionidae	*Ischnura elegaus*	Blue-tail damsel fly
	Libellulidea	*Libellula pulchella*	Twelve spotted skimmer
		Brachymesia furcate	Red-tail dragon fly
Orthoptera	Gryllidae	*Gryllus bimaculatu*	Field cricket
		Acheta domestica	House cricket
	Gryllotalpidae	*Gryllotalpa brachyptera*	Mole cricket
	Acrididae	*Dendrotettis quercus*	Short-horn grasshopper
		Schistocerca americana	
		Melanoplus differentialis	
		Melanoplus scudderi	
Hemiptera	Pentatomidae	*Nezara viridula*	Sting bug

The Green Cloverworm (moth).

Periplaneta Americana Hypeno scabra (Cockroach)

Darylus sp.(African Army Ants).

Libellula sp. (Skimmer)

Libellula pulchella (Twelve spotted skimmer)

Apismellifera(Honey bee).

Charidotellasexpunctata (Golden Tortoise Beetle)

A Species of Beetle

Acheta domestica (House cricket)

Nezara viridula (Sting bug)

Some of the wildlife species are endangered while others are threatened and their status area presented in **Table 4.38.**

Table 4.38: Status of some wildlife in the study area

Species Group and Names	Status		
	IUCN A (2000 Red List)	Nationally	Niger Delta
MAMMALS			
Primates			
Anngwantibo	LR/nt	I	Cmn
Red capped Mangabey	LR/nt	I	*
Sclaters Guenon	EN		Cmn
White throated Genon	EN		*
Delta Red Colobus	EN	I	*
Olive Colobus	LR/nt	I	**
Chimpanzee	EN	I	
Carnivoresb			
Leopard	CR	I	**
Cape Clawless Otter	-	I	
Speckle Throated Otter	-	I	
Crested Genet	EN	cmn	
Cetacea			
Atlantic Humphacked Whale	DD	I	
Manatee	V	I	Cmn
Elephant D	EN	I	**
Ungulates			
Heslops Pygm Hippo	/CR	I	***

Water Chevrotain	DD	I	*
Sitatunga	LR/nt	I, E	Cmn
Ogilby's Dulker	LR/nt	E	**
Yellow Backed Duiker	LR/nt	I	**
Bates's Poygmy Antelope	LR/nt	I	*
P***angolins***			
Long Tailed Pangolin	-	I	*
Tree Pangolin	-	I	
Rodents			
Rufous-noised Rat	DD		
Brush Tailed Porcupine	-	I	Cmn
Birds			
Anambral Waxbill	V		
Falcons, Kites, Eagles etc.		I	
All Parrots		I	
REPTILES			
Nile Monitor Lizard	-	I	Cmn
Royal	-	I	*
Python	-	I	*
Rock Python Serrate Hinge Back Tortoise	DD		*
Home's Hinge Back Tortiose	DD		*
Nile Crocodile		I	
African Slander-snout crocodile West African Dwarf Crocodile	DD V	I	Cmn
Reptiles (Marine)			
Oliver Ridley Turtle	EN		
Hawksbill Turtile	CR		
Leatherback Turtle	CR		

NOTES

CR = Critically Endangered, LR = Lower Risk, ***** = Reduced to small part of original rang in Delta, En = Endangered DD = Insufficient Data, ****** = Reduced to relict population in Delta, V = Vulnerable, E Nationally endanger, *** = Probably extinct in Delta. nt = Near Threatened as listed in Anadu and Green, cmn = Relatively common in suitable habitat in Delta

Reptiles (Marine)			
Oliver Ridley Turtle	EN		
Hawksbill Turtile	CR		
Leatherback Turtle	CR		
NOTES CR = Critically Endangered, LR = Lower Risk, * = Reduced to small part of original rang in Delta, En = Endangered DD = Insufficient Data, ** = Reduced to relict population in Delta, V = Vulnerable, E Nationally endanger, *** = Probably extinct in Delta. nt = Near Threatened as listed in Anadu and Green, cmn = Relatively common in suitable habitat in Delta			

A substantial part of the site is a mangrove swamp. Mixtures of vegetation types characterize the proposed project site. It also consisted of a freshwater swamp forest. The commonest plants within the proposed site *Avicennia germinans* (Black mangroves), and *Avicennia marina* of the Family Avicenniaceae; *Laguncularia racemosa* (White mangrove) of the family Family Combrataceae; *Rhizophora mangle* (Red mangroves); *Rhizophora racemose, Rhizophora Africana*, *Rhizophora mucronata* (Loop- root mangrove), *Rhizophora stylosa* (Stilted mangrove), and *Ceriops tagal* of the family Family Rhizophoracea; *Avicennia germinans* (Black mangrove) of the family Family Acanthaceae, *Calamus sp* (Rattan palm), *Elaeis guineensis* (oil palm), and *Cocos nucifera* (coconut palm) of the family Family Arecaceae; *Acrostichum speciosum* (Mangrove fern) and *Acrostichum aureum* (Golden leather fern) of the family Family Pteridaceae; and *Spartina alterniflora* or *Sporobolus alterniflora* (salt mash cord grass or salt- water cord grass) of the family Family poaceae. *Asplenium bulbiferum* (fern) of the Family Aspleniaceae were also seen attached to the stems of *Elieas guineensis* in some parts of the fringes of the Brass River estuary. *Prunus dulcis* (red almond) of the family Family Rosaceae were also seen on the fringes of the estuary. *Eichhornia crassipes* (Water hyacinth) of the family Family Pontederiaceae were also seen on the fringes of the estuary and were also floating in the estuary. The locale depends on the forest for fuel wood and sawed timbers for building construction. Evidence of timber expoitation were seen by the shoreline in Okpoma waterside during the field data gathering exercises that took place on the 20th and 21st September, 2021.

In conclusion it’s important to note that animals are integral components of the stable environment and serve the needs of the human population in various ways such as providing food and materials for medicines. Some animals such as mosquitoes and house flies are vectors of diseases and they pose a serious danger to human health. Several pools of water and ponds were found within the study area. They serve as sources of waters for animals as well as breed grounds for toads, frogs and other amphibians, especially in the dry season.

Geology and Geomorphology

The project area being part of the Coastal Plans of the Niger Delta (Adegoke 2000; Adewoye & Adegoke, 2000; Allen, 1965; Burke 1969; Short & Stauble, 1976). Tertiary and Quaternary Formations underlie the area. The sequence, the Sub-divisions and the lithological units are shown below, in the geology sequence; the superficial quaternary deposits are the most susceptible to environmental impacts arising from site development project activities.

The Geologic Sequence in the Niger Delta

Geologic Unit	Sub Division	Composition
Quaternary	Upper and Lower Deltaic Plain Sands	Fine-medium-course grained unconsolidated sands forming lenticular beds with intercalation's of peat and lenses of soft/ plastic, silty clay and shale's. Gravelly beds of up to 10m thick have been reported.
Tertiary	Benin Formation	Mainly sandstones with tin shale intercalations. It is coarse grained, gravelly, locally fine grained, poorly sorted, sub-angular to well-rounded and bears lignite streaks and wood fragments. The thickness is variable but generally exceeds 2000m.
	Agbada	It is an alternating sequence of sand and shale's. It is predominantly sandy, very close to the base of the Benin formation. It is over 3000m thick. Major hydrocarbon accumulations are fund in this formation.
	Akata Formation	This formation is composed of marine shale with gray sandy. Silty shale with plants remains. The thickness is not known.

Land Use/Cover

Human use of land resources gives rise to "land use" which varies with the purpose it serves, whether they be food production, provision of shelter, recreation, extraction and processing of materials and so on, as well as the bio-physical characteristics of land itself. Hence, land use is being shaped under the influence of two broad set of forces- human needs and environmental features and processes. None of these forces stays still; they are in a constant state of flux as change in the quintessence of life.

Changes in land use are a large extent, a reflection of how society responds to socio-economic, institutional and management practices (Adeniyi, 1980. UNECE 2004) defines land use as the manner in which land is used, including the nature of vegetation upon it surface. Land use can therefore include activities that takes place upon land such a cultivation, grazing of domestic animals, building (such as schools), and animal migration, among other activities.

Land cover and Land use Identified within the Spatial Boundary

S/N	Land Cover	Land Use
1	Built-up area	Residential, Commercial, Institutional/ Public (Schools, meeting halls, Churches, markets and clinics etc)
2	Agriculture	Subsistence farming (small holder Rainfed agriculture)
3	Forest	Forested freshwater Swamp
4	Water Body	River, stream and pounds

Built-up Land Cover

Built-up area comprised of the land covered by building structures. Included in this category are human settlements, strip development along roads, farm steads, fishing camps, palm mill and local gin production camp. Also included are infrastructures and amenities such as jetty, power distribution facilities and telecommunication communication facilities, and area such as those occupied by cottage industries, dredging sites and institution that may, in some instance, be isolated from human settlement areas.

Institutions/ Commercial Land use

The proposed project is aim at establishing the **NCDMB Brass Island Shipyard**. As at the time of study the host communities could be classified as a semi-urban area comprises of about 27% of the surrounding environment.

Forest Land Cover

Although forest is a term of common parlance, there is no universal recognized precise definition, with more than 800 definitions of forest used around the world. Although a forest is usually defined by the presence of trees, under man definitions an area completely lacking trees may still be considered a forest if it grew trees in the past, will grow trees in the future, or was legally designated as forest regardless of vegetation type.

Expected environmental impacts of the ship yard project

Significant amount of crude oil is expected to be discharged into the mangrove ecosystem around the proposed site of the ship yard and these mangroves are extremely responsive to contamination by oil and industrial waste. Oil exploration in or near mangrove shorelines has significant adverse impacts, even on the marine ecosystem (US Fish and Wildlife Services, 2013). Crude oil and their by-products can destroy mangroves by coating aerial and submerged roots and from direct absorption. Oil deposits as marine tar residues are susceptible to mangroves which affects soil chemistry and permeability, leading to death and several sub-lethal impacts (Duke, 2016). Once oil and marine tar residues are deposited on or around the mangroves, they particularly stick themselves to the plant surfaces, adsorbing to oleophilic surfaces of both flora and fauna. Oil coats breathing surfaces of roots, stems, seedlings, and it contaminates surrounding sediments and their sessile intertidal or burrowing fauna (Zhang *et al.*, 2019). Also, coatings of oil on the leaves and submerged roots of the mangrove can hinder salt exchange responsible for mediation of salt tolerance (Hoff, 2010). Crude oil is linked with toxic heavy metals most of which contaminate the soil through underground deposits, especially Lead and Chromium. Iron is present in abundance in tropical and subtropical aquifers and is also linked with crude oil deposits (Enujiugha and Nwanna, 2004).

Furthermore, the clearing of the forest in the proposed project site will lead to loss of the habitat and breading grounds of some animals. This could cause some animals to migrate from the area and could even lead to the death of some. The noise that will be produced during the repairs of ships will also scare the animals and cause them to flee from the habitats.

Cultural effects

The activities in the proposed ship yard will result in a multitude of cultural problems. These include occupational dislocation, rural-urban drift, unemployment and poor human health (Dauda, 2017; Mugisa, 2016; Matemilola *et al.*, 2018).

Health effects

Human health impact can be direct effect from changes in ecological processes (e.g., consumption of seafood with bio-accumulated oil toxins), economic stressors that can alter intermediary processes (e.g., psychological effects of community decline), loss of major subsistence or export industries (such as through loss of fisheries), and effects of the spill causing human harm outright (e.g., inhalation of aromatic hydrocarbons and other vaporous compounds) (Webler and Lord, 2010).

Oil pollution gives rise to the occurrence of certain ailments in areas that have suffered from oil pollution in Nigeria (Bello, 2017). Direct contact with, or exposure to oil spill material, as well as inhalation of volatile compounds, or physical contact with crude including consumption of water and oil-contaminated seafood can have serious hazardous health effects on humans, ranging from nausea and dizziness to carcinogenic effects, central nervous system inhibition and disruption, and several long-term reproductive, developmental, and carcinogenic effects (Aguilera *et al.*, 2010; Chang *et al.*, 2014).

Economic effect

Given that the local economy of many coastal communities is dependent on fishing and farming, an impact on mangroves should have economic implications on such communities. Degraded mangroves affect local fisher men and women whose economic wellbeing is dependent on a clean rivers and alluvial soil fertile soil (Zabbey et al., 2017; Ehirim *et al.*, 2018). Low catch from fishing expedition as a result of polluted rivers could lead to economic loss and affects peasant families whose entire livelihood are dependent on fishing.

4.12 Socio –Economic Studies

4.12.1 Background Information

Nigeria Content Development & Monitoring Board (NCDMB) proposes to embark on Shipyard project at Brass, in Brass Local Government Area of Bayelsa State. The Agency therefore, proposes to carry out an Impact Assessment as a pre-requisite for obtaining permit to carry on with her planned petroleum product tank farm project. NCDMB recognizes the importance of comprehensive Environmental Planning and Management to the success of any developmental project and is committed to the required studies to understand the environmental system of its planned project and her environs in order to address areas where significant environmental impacts (biological, physical and social) may be experienced.

In compliance with the Nigerian's environmental and social regulatory requirements (FMENV EIA Act No. 86 of 1992 and DPR's EGASPIN, 2018), as well as NCDMB corporate HSE Policies and international best practice/requirements (World Bank EIA Guidelines, 1991, WB/IFC ESIA, 2012), the Company commissioned a competent and independent consulting company in the name of Lympson Leosentino Limited (LLL) to carry out the Environmental Impact Assessment study for the Shipyard project activities to assist with proper project planning. This document presents a draft report of the (impact assessment) human/social environment (socioeconomic). Acceptable procedures and methodologies were employed for data collection (socioeconomic) in order to characterize the human environment as well as evaluate impacts of proposed shipyard on proximate populations of the area.

4.12.2 Scope of Work for Socio-economic

Project influences and receptor exposure are felt by the human population. Consequently, data requirement, generic in nature were detailed in the Scope of Work (SoW) to include but not limited to the following data needs:

Table 4.39: Socioeconomic Variables

	Social Features	Variables
1	Demography	Population size and distribution (age, gender, ethnic groupings, population density, dependency and sex ratio), marital status, educational attainment, primary and secondary school drop-out rates, history and trend of migration, net enrolment ratios for primary and secondary schools, etc.
2	Livelihood	Income distribution and consumption patterns, employment status, occupation, occupational mobility and adjustment, poverty profile, land use and tenure system, and other economic activities.
3	Social Infrastructure	Major means of transportation; educational institutions, water supply, electricity, communication, recreational facilities, waste management facilities, housing (type, pattern and quality) etc.
4	Cultural Properties	Value system, social norms, location and spatial distribution of historical sites, archaeological artefacts, shrines, sacred forests/scenic areas; religion, plants/animal species of cultural value, festivals, marriage practices, cultural calendar etc.

5	Natural Resources and Land Use	Values and use of natural resources including rights over private, rental, common ownership and access to resources – especially with respect to women; local conservation practices (closed seasons/closed locations) etc.
6	Perception of the project	Perception of associated project risks and impacts on quality of life, rating of relationship with the CLIENT, pleasure/displeasure with proposed project, expectations etc.
7	The role of women and children	Rights and privileges, contribution to socio-economic development; activity systems and political organisation, women trafficking, child labour etc.
8	Physically Challenged	Rights and privileges, contribution to socio-economic development; activity systems, social exclusion etc.
9	Social Structure and Organization	Settlement history, ethnic groups, social organization and traditional governance – power and authority structure; history of conflicts and their resolution including the role of women
10	Sex Trade	Population, Frequency, Nature, types, origin, and socio-economic aspects etc.

4.12.3 Study Approach, Data Gathering & Analysis

The socio-economic data gathering involve the use of some techniques like interview schedule, survey question administration, key informant interview (KII) and focus group discussion (FGD). These techniques are found to be useful in participatory rural and learning appraisal techniques. The field survey study was carried out across the identified project affected community and also facilitated by the community's representative who attended the pre-field mobilization meeting as well as members of the community who are familiar with data gathering exercise.

In the study both qualitative and quantitative techniques were utilized for data collection and as a primary techniques of data gathering, community consultation and focus group discussions were used as well as community leaders and other participant. In the process, probing questions on crucial socio-economic issues were raised and answers ask for from the participants in relation to their positions in community and level of knowledge (***See plate 4.30***). Visitations were also carried out on the existing social infrastructural facilities and services, e.g., education and health care for necessary information on education and health. As a survey instrument and primary data gathering method, the questionnaire was structured such that binary, optional and open-ended questions were raised to solicit the necessary answers to questions from the community members.

Meanwhile, random sampling technique was used in selecting respondents from the surveyed community during the community gathering (focus group discussion) as well as during the cross session of respondent within the community with the adult population as the target. At the end of the focus group discussion (FGD) sessions/community-wide interaction meetings, structured questionnaires were administered to a cross section of each of the community with the aid of the community's leadership and facilitator. As a survey instrument and primary data collection method, the questionnaire was structured such that binary, optional and open-ended questions were asked to solicit the necessary answers to questions from the householder. two hundred and forty (240) questionnaires were administered at the community and out of which one hundred and sixty nine (169) questionnaires were adequately completed for analysis, giving a response rate of 70.4% (**Plate 4.30**). Below are some sampled pictures during focus group discussion (FGD) with the stakeholder community.

Table 4.40: Focus Group Discussion (FGD) Venue, Questionnaire administered and Retrieved

S/no	Community	FGD Venue	GPS Coordinates	Questionnaire administered	Questionnaire retrieved
1	Okpoama Kingdom	CDC Chairman's Place	$4^0$17'57.244''N $6^0$17'37.499''E	120	87
	Twon-Brass	Town Hall	$4^0$18'43.516''N $6^0$14'41.028''E	120	82
	Total			**240**	**169 (70.4%)**

4.12.4 Socio-economic Data Analysis and Presentation

In analyzing the primary and secondary data, simple descriptive methods and summary statistics like mean, range, mode and percentage were used. Some of the data were presented in table and graph…and also six key levels of aggregation and analysis were used. These are national, regional, state, local government area, community, household and individual respondent. Meanwhile, the population of the host community was projected using result of the 2006 national census released by the National Population Census (NPC). The linear extrapolation and exponential growth model of population projection method are often used in estimating population. While the linear extrapolation model assumes population growth to occur in constant increment over time, the exponential model assumes rate of population growth as not constant but rather changes with time, growing faster as the population size increases. Put differently, population more often than not grows exponentially rather than linearly. Population sizes and relevant distributions were determined using the following formulae:

i. Population projection using the exponential model

$P_n = P_o (1 + r)^n$; P_o is population in the base year, r is the estimated annual growth rate of population, and n is time lapse in years.

ii. Sex Ratio = $\frac{\text{Number of males in the LGA} \times 100}{\text{Number of females in the LGA}}$

iii. Dependency Ratio = $\frac{\text{Population} \leq 14\text{years} + \text{population} \geq 65\text{years} \times 100}{\text{Population aged 15-64years}}$

iv. Crude Birth Rate (CBR) = $\frac{\text{Number of births in the community in one-year} \times 100}{\text{Mid-year population}}$

v. Crude Death Rate (CDR) =
$\frac{\text{Number of deaths in the community in one-year} \times 100}{\text{Mid-year population}}$

Plate4.30a: ESIA team kick-off meeting with regulators @Parkis Suite Hotel, Yenagoa

Plate 1: ***Middle & bottom photos* @Okpoama Kingdom and Twon-Brass community-wide meetings and interactions at proposed NCDMB Brass Shipyard stakeholder community for socioeconomic data collection @CDC Chairman’s place - 4^{0}17’57.244’N, 6^{0}17’37.499’E & Twon-Brass Town Hall - 4^{0}18’43.56’N, 6^{0}14’41.028’E**

4.12.5 Social Profile

Project influences and receptor exposure are felt by the human population. This section of the Impact Assessment (IA) focuses on the Socio-Economic parameters such as settlement history, population characteristics, educational status, occupation, employment, income, expenditure, land and, water resource ownership, housing, infrastructure, social structure, religion, customs, belief, power and governance, conflicts, conflict resolution and inhabitants perception of the proposed NCDMB Brass Shipyard project.

4.12.6 Study Communities

The identified stakeholder’s communities in the proposed NCDMB Brass Shipyard are Okpoama and Twon-Brass. The communities are of Ijaw ethnic nationality. Okpoama and Twon-Brass is a Kingdom on their own with other constituent villages and fishing camps that make-up the Kingdoms. Okpoama and Twon-Brass town is under the local government jurisdiction of Brass Local Government Area of Bayelsa State. The communities are predominantly inhabited by the Ijaw ethnic group of Bayelsa State with other ethnic nationalities living with them; like Ilajes, Efiks, and Hausas etc. Brass Local Government headquarters is in Twon-Brass town with an area of 1,342km², a Density of 183.4/km² and a population of 184,127 based on the 2006 National Population Census figures, projected at 246,100 in 2016 and current year 2021 projected at 288,076 using 3.2% annual growth rate. However, the Brass LGA's male-female population ratio in 2006 was 94,359(51.2%) and 89,768(48.8%), *See Fig. 4.23a*.

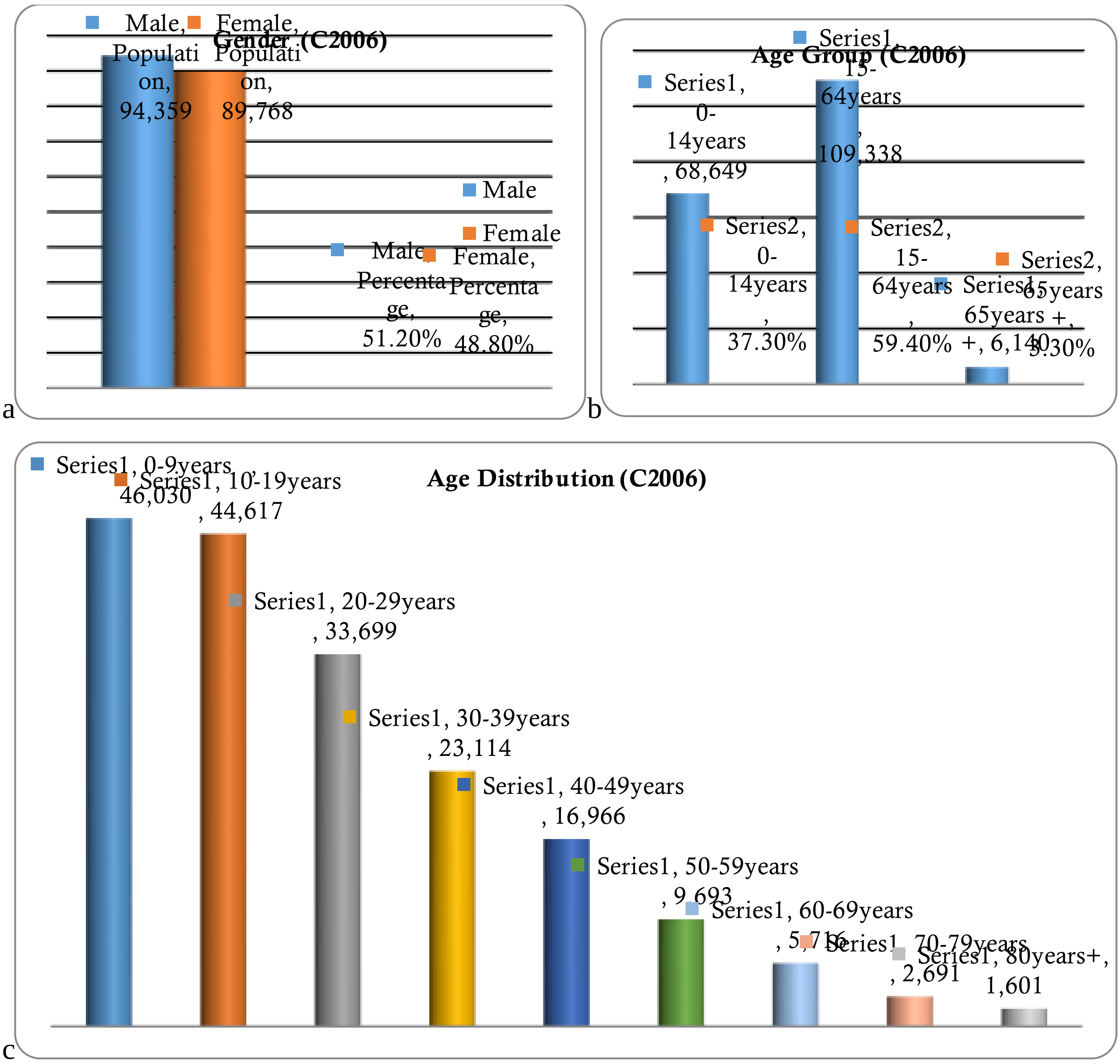


Fig. 4.23abc: Gender, Age group and Age Distribution of Brass LGA (C2006)
Source: NPC

The Ijaws are one of the most dynamic and enterprising people in Nigeria. Their aquatic skill, coupled with their ability to adapt enabled them to conquer their harsh geographical environment and turn it to their advantage. The most prominent means of livelihood is fishing, as the majority of the people are mostly fishermen and women who utilize the rivers and creek. They are also involved in fish processing, fish marketing and other agricultural practices. The large-scale fishing attracts traders and consumers from the nooks and crannies of the country. Boat making is a viable craft of the traditional industry, providing a source or means of livelihood for, though relatively few members of the community.

Bayelsa State: Bayelsa State is one of the nine states created in 1991, excised from the present Rivers State. At its inception, it had eight (8) Local Government Areas (LGAs). Bayelsa State as revealed in 2006 census had a population of *1,704,515*, comprises of *874,083* males and *830,432* females, distributed into about *352,025* households. It also encompasses a landmass or area of over *9,415.76* km^2…and this shows an average density of *181.0* persons per km^2 (NPC 2006). According to the 2006 census, Bayelsa State, like the nation Nigeria, has witnessed much increase in her population…with a total population of *1,704,515*. Meanwhile, with this population figure, Bayelsa State now ranks the 36th most populous State in the country…and the 9th most inhabited among the nine (9) oil producing States that comprises the Niger Delta Region. The population is being estimated to be growing at an annual growth rate of 3.2 just as that of the entire country (FGN, Official Gazette, 2007; ***See Fig 4.23b***.

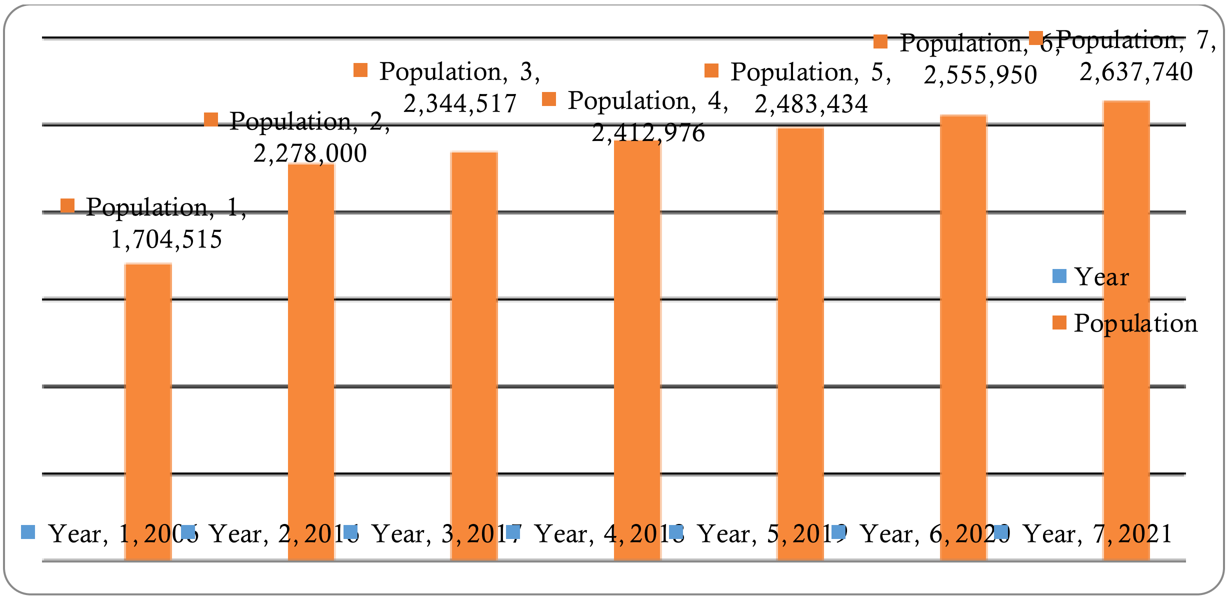


Fig 4.23b: Bayelsa State population projection
Source: GTZ projections (2006) based on NPC Data

Nigeria: Nigeria, one of Africa's largest countries and its most populous, is located in West Africa. The country covers an area of about 923,768 km2, with an estimated 4,049 km of land boundaries, shared with Cameroon in the east, the Republic of Niger in the north, Chad in the north-east and Benin in the west. In the south, Nigeria's 853-km long coastline opens onto the Atlantic Ocean. The southern lowlands join into the central hills and plateaus, with mountains in the south-east and plains in the north. The country's largest river is the Niger, which joins with the River Benue to form a confluence at Lokoja.

***Niger Delta*:** The Niger Delta, situated in the southernmost part of Nigeria and covering an area of about 70,000 km2, is the largest river delta in Africa and the third largest in the world. From a coastal belt of swamps, stretching northwards the land becomes a continuous rainforest which gradually joins with woodland and savanna grasslands in central Nigeria. The swamp, forest and woodland areas occupy about 12 per cent of the delta's land surface. Nigeria gained independence from the United Kingdom in 1960. With a population in excess of 158 million people, Nigeria is a multi-ethnic federation divided into 36 states and the Federal Capital Territory, within which lies the capital city of Abuja. More than 250 ethnolinguistic groups are spread across the country; however, the three dominant groups are the Hausas in the north, the Igbos in the south-east and the Yoruba mainly living in the south-west. Nigeria is rich in natural resources, including natural gas, petroleum, tin, iron ore, coal, limestone, niobium, lead, zinc, timber and extensive arable land. Prior to the discovery of oil in the 1950s, agriculture was the mainstay of the economy, with agricultural produce exported to the more developed parts of the world. By 1971 there had been a shift from agriculture to petroleum production, such that between 1973 and 1981 the value of agricultural exports declined from more than USD 1.5 billion to about USD 0.3 billion. Currently, oil and gas provide 80% of budget revenues and 95% of forex earnings.

Meanwhile, stakeholder's communities of the proposed NCDMB Brass Shipyard project are permanent communities and rural-urban settlements. The housing pattern, type and structure of the settlements reveal a typical rural-urban setting of the project environment. Houses, it is said, are built according to family/lineage ties, including transportation and communication routes. Land before the discovery of oil in 1977, was not that of an issue and so the major influence on the pattern of settlements was basically the kinship/lineage ties and land ownership right. The stakeholder's communities are rural-urban, though their cultural affinities to family ties still play a major role on how houses are built. In most Bayelsa State communities, housing patterns are both nucleated and linear ***(Plate 4.30)***.

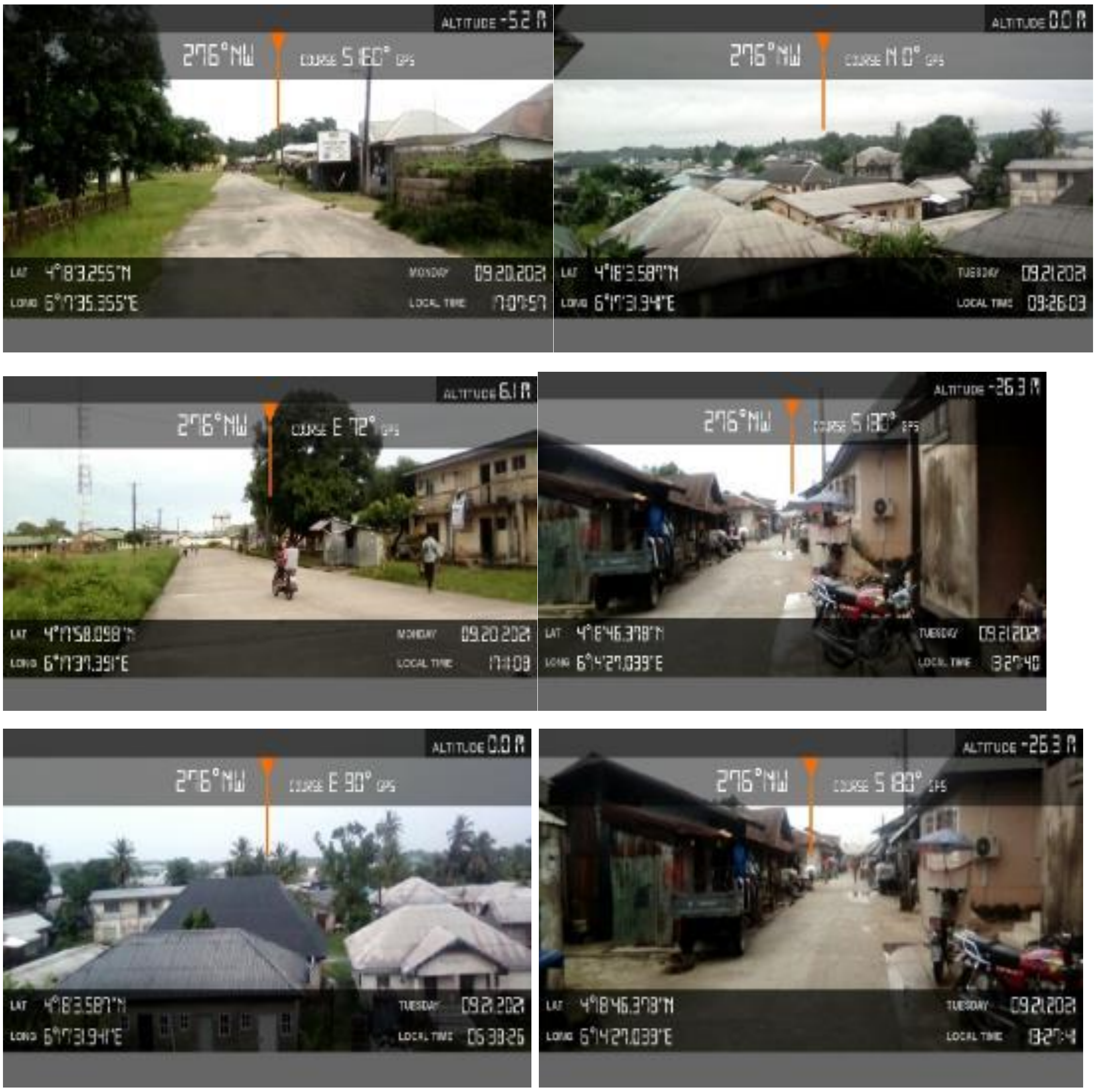


Plate 30: Showing the proposed NCDMB Brass Shipyard communities (Okpoama & Twon-Brass) traversed by concrete tarred roads with internal streets/quarters; also the housing type/quality, showing a typical rural-urban environment

4.12.7 Political Structure/ Governance

4.12.7.1 Community Power Structure and Governance

The internal structures of a small community living in a single settlement and the structures of the community belonging to a larger community spread out over several hamlets are the same. The men of a community are subdivided into the youth (young men able to work) and the elders, the latter being committed persons who have actively contributed to the development of the community and have to be recommended by other elders or the chiefs/traditional ruler. The women of a community are organized in the same way. Also, there is the young group, married women of working age and the group of the 'elder women. The "elders" (women and men) have a high status in the community. Why? It is because of their experience and often makes the final decisions regarding important activities at the community level. Be that as it may, for over a decade now, many youth groups and movements have hijacked this position due to the perceived inaction of the elders to exploitation.

Even though, a more dynamic indigenous political system based on representative participation and fair sharing of power and responsibilities among the community members and age-grade associations have emerged…many of the independent villages of the Ijaw ethnic group are still being governed on the principles of gerontocracy; executive, legislative and judicial functions are still vested in the hands of the oldest man and his cohorts. As a result, majority, if not all of the Ijaw communities, the traditional governance and power structure is organized into hierarchies from the clan level to the individual village/community down to the quarters that constitute each settlement.

Traditionally, the proposed NCDMB Brass Shipyard project stakeholder's communities have kings that rules over the land. He is known as the 'Amanyanabo'. The Amanyanabo as paramount ruler has members of his traditional ruler's council. The leadership structure is as follows: Amanyanabo (His Royal Majesty), Alepu (the Council of Chiefs), Elders (Traditional ruler in Council), Youth group/leader and Women group/leader respectively constitute the local and traditional administrative structures of the proposed NCDMB Brass Shipyard stakeholder's communities; *Fig. 4.24***.**

Meanwhile, depending on the clan and the system of administration, the King or village head is called the Amanyanabo and such title may be hereditary in some clans. Although, it was revealed that it is rotational in the studied area and usually shift to the next person after the death of the existing one. In other word, the existing Amanyanabo remains as long as he lives. While the kingship system maintained a highly centralized type of government with the Amanyanabo (King) assisted by council of chiefs, the village elders (Traditional rulers in council) is assisted in the day-to-day administration of the polity by titled officers selected from the various age grades recognized in the clan. Due to political expediency and the King in modern day Nigeria, the number of Ijaw clans adopting the Kingship system has increased. Today, the traditional political system operates side by side with the Western system.

In the same vein, the Amanyanabo oversees his kingdom, while the Village Heads in each of the villages that makes up the communities takes charge of the community and report to the Amanyanabo. Meanwhile, the CDC Chairmen (Development Association) takes charge of the developmental issues and daily running of the community with his cabinet. The Amanyanabo as the general overseer of the communities usually has his Council of Chiefs attached to him. The Council of Chiefs takes decision collectively with him. Meanwhile, in the formal traditional power structures, there are several organizations, including those representing social and business interests…like the fishing, trading and co-operative societies for men, women and youth respectively.

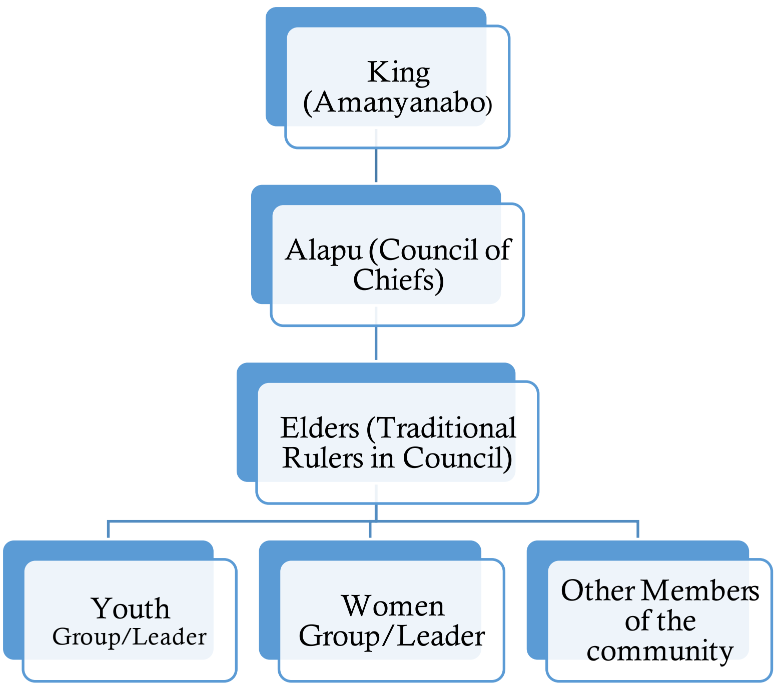


Fig. 4.24: Traditional Administrative Structure in Okpoama & Twon-Brass Kingdom

On the other hand, at the formal level of modern governance system, apart from the roles of the Federal and State Governments in fostering development and security of lives and properties, the Local Government Area (LGA) administration is overseen by an elected Executive Chairman. There is also the legislative arm of the LGA administration made up of Counselors elected from the political wards in the LGA. Communities in each LGA are grouped into political wards for purposes of representation and administration. Political participation is very keen in the community and the main political parties with offices in the community studied in Bayelsa State are: All Progressive Congress (APC), Peoples Democratic Party (PDP) and others.

4.12.8 Population and Socio-Demographic Characteristics

4.12.8.1 Population Size, Growth and Distribution

Bayelsa State is one of the nine states created in 1991, excised from the present Rivers State. At its inception, it had eight (8) Local Government Areas (LGAs). Bayelsa State as revealed in 2006 census had a population of *1,704,515*, comprises of *874,083* males and *830,432* females, distributed into about *352,025* households. It also encompasses a landmass or area of over *9,415.76* km^2…and this shows an average density of *181.0* persons per km^2 (NPC 2006). According to the 2006 census, Bayelsa State, like the nation Nigeria, has witnessed much increase in her population…with a total population of *1,704,515*. Meanwhile, with this population figure, Bayelsa State now ranks the 36th most populous State in the country…and the 9th most inhabited among the nine (9) oil producing States that comprises the Niger Delta Region. The population was further projected at 2,278,000 in 2016 and current year 2021 projected at 2,666,563 using 3.2% annual growth rate. However, the Bayelsa State's male-female population ratio in 2006 was 874,083 (51.3%) and 830,432 (48.7%). The population is being estimated to be growing at an annual growth rate of 3.2 just as that of the entire country (FGN, Official Gazette, 2007.

Knowledgeable individuals and key informants whose views were sought as to what their community estimated population might be as at the time of the study have near an exaggerated estimate of how many persons may be inhabiting the community as follows: Okpoama 45,000 and Twon-Brass 40,000. Although, the figures appear very bogus even if the number of houses, physical size and internal migration and pull-factors (growth-inducing factors) are considered. However, according to 1996 National Population Census (NPC), Okpoama population was put at 17,707 and Twon-Brass at 15,554 and when projected to the current year (2021), Okpoama population is about 38,904 and Twon-Brass 36,751.

Natural increases, like excess of births over deaths and migration are the two most known determining factors of population growth. The population growth may have been influenced by the oil exploration activities and entitlements given to community leaders. In addition, population projection using the exponential model reveal practically that rather than population growth occurring in constant increments over time, i.e., linearly, the rate of growth changes over time, growing faster as the population size increases. It is therefore, to be expected, why the project stakeholder community has actually witnessed an increase over the years.

4.12.8.2 Population Growth Rate

Population growth is determined by the demographic processes of fertility, mortality and migration. Considering the impact of these demographic processes, NPC has estimated annual population growth across Nigeria at 3.2% (NDHS, 2008). Fertility rates are influenced by a number of factors in the study community, which include early procreation and the practice of polygamy. The most commonly used measures of fertility in Nigeria are the Total Fertility Rate (TFR) and the Crude Birth Rate (CBR). The TFR provides an indication of the total number of children a woman will have in her reproductive life time. There were no available TFR values for the community and LGAs, but the National Bureau of Statistics (NBS) in its Annual Abstract of Statistics (ABS), 2010 provides a TFR value of 4.6 for the South-South geo-political region and 5.9 for the nation. The implication of these values is that the rate of fertility in the South-South states, including Bayelsa is lower than the national average. Another measure of fertility, the Crude Birth Rate (CBR) describes the relationship between the number of life births per 1000 of the population and the midyear population in an area. Expressing the CBR in percentage, the NBS estimates the national CBR at 13.65% and in Bayelsa State at 16.09% (ABS, 2010). Bayelsa State has a higher CBR of 2.59 % than the national average of 1.78%. A major factor that has influenced mortality in the communities is the non-availability of adequately staffed and equipped medical facilities.

Migration is another factor that is responsible for population growth rate in Nigeria. This has been mostly characterized by a rural to urban movement of individuals and families. Overall, results obtained from the survey of the community indicate that about 85% of respondents across the study area were non-migrants and 15% were migrants. Specifically, the figure was 85% non-migrants to 15% migrants across proposed NCDMB Brass Shipyard stakeholder's communities. Thus, there has been slightly increased ethnic mix arising from migration by non-indigenous population in search of services for the oil and gas operations in the area.

4.12.8.4 Age Distribution of Respondents

The age distribution of respondent is dominated by youth ranging between 20–49years (58.9%). About 38.4% were found to fall within the age bracket of 50–69 year while above 70 years accounted for only 2.7% and respondents less than 20years account for 2.6% as depicted in (***Fig. 4.25a &b).*** This result suggests that the population of the proposed project area has great potentials for future growth. The age range is in conformity with the local and state government age group where the bulk of the population falls within 15-64years of age.

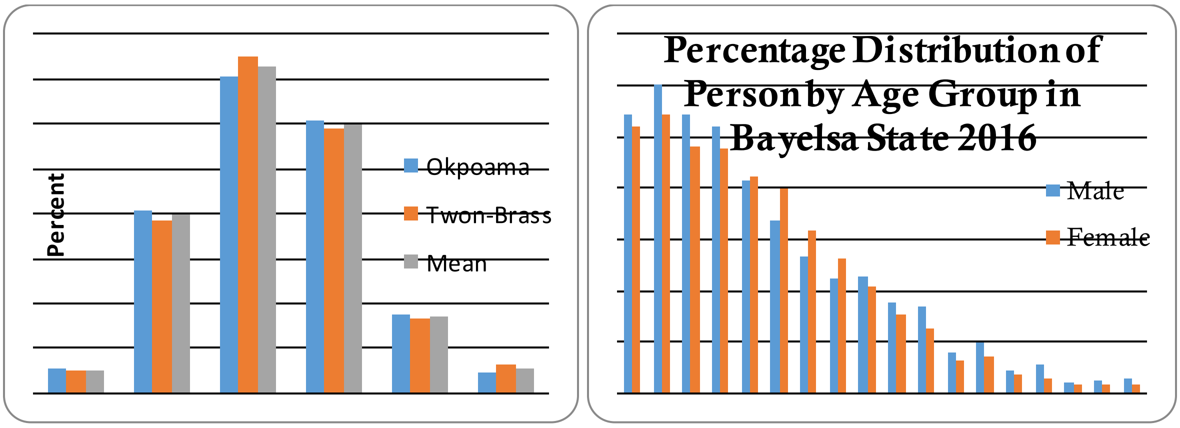


Fig. 4.25a &b: Age range of respondents & Percentage Distribution of Person by Age Group

Source: NBS/CBN/NCC Social-Economic Survey on Nigeria, 2016

4.12.8.5 Household Size and Marital Status of Sampled Population

Information on household composition is critical for understanding family size, household headship, and for implementing meaningful population-based policies and programmes. Household composition is also a determinant of health status and well-being (NPC and ICF Macro, 2014). These characteristics are important because they are associated with household welfare. Female-headed households are, for example, typically poorer than male-headed households. Economic resources are often more limited in larger households. Moreover, where the size of the household is large, crowding also can lead to health problems (NPC and ICF Macro, 2009).

The household structure in the proposed NCDMB Brass Shipyard stakeholder's communities' parallels the patriarchal leadership structure of most Nigerian ethnic groups. The majority (82%) of households in Nigeria are headed by men, with only 18% headed by women. The proportion of female-headed households has remained almost the same in the last five years (i.e., between 2008 and 2013) (NPC and ICF Macro, 2014). The three different types of male-headed household structures are traditional (one husband and one spouse), polygamous, and single male (male with no spouse, including widowers and males that have never been married). Traditionally, the male is responsible for all the major household decisions.

Returned responses from administered questionnaires of the surveyed communities revealed on average some 34.7% to be of single marital status while over one half (52.5%) were married persons ***(Fig. 4.26a).*** The percentage of respondents divorced/separated from their spouses and those widowed amounted to some 12.8%, implying that the vulnerable proportion is comparatively low. The proportion of married persons tallied with the age of the respondents. There are two obvious implications; higher proportions of the population were of the marital age and there was also a wide range of matured representation of opinions during the field study. Less than 11.8% of the respondents were aged less than 30 years.

More so, according to the survey, married males were found to have an average of one wife, with few of the older genre or folks having more than a wife. This implies that polygamy is either no longer fashionable or common in the study area. Sizes of families vary from community to community and this is influenced greatly by the cultural attitude of the people. Another critical determinant of household size and marital status is economy of the settlement as well as educational status/awareness of the resident population. Specifically, the average household size in the proposed NCDMB Brass Shipyard stakeholder communities was 5.3 according to number of households and total population in (NPC 2006); socioeconomic survey of the sampled community revealed however, that household sizes had since increased beyond this level.

Women have an average of 5 children and average household size approximates to 5.3. If other dependants living in the households are added, (a minimum of 2 and maximum of 5 was reported within the communities), household size now comes to 10. This trend of large household sizes can be attributed to several reasons in the study communities in particular and the South-South (Niger Delta) region as a whole. For instance, people marry at a relatively early age thereby extending their period of child bearing. On the other hand, the men marry more than one wife (i.e polygamy) as well as keep other concubines. On the average, about 52.5% of the sampled respondents are married while about 34.7% are single. Widows' people account for about 9%, Divorced/Separated 3.8%. This is in conformity with the Bayelsa State marital status where the married and single are higher with 27.8% and 63.6% respectively as depicted in ***(Fig 4.26a & b).***

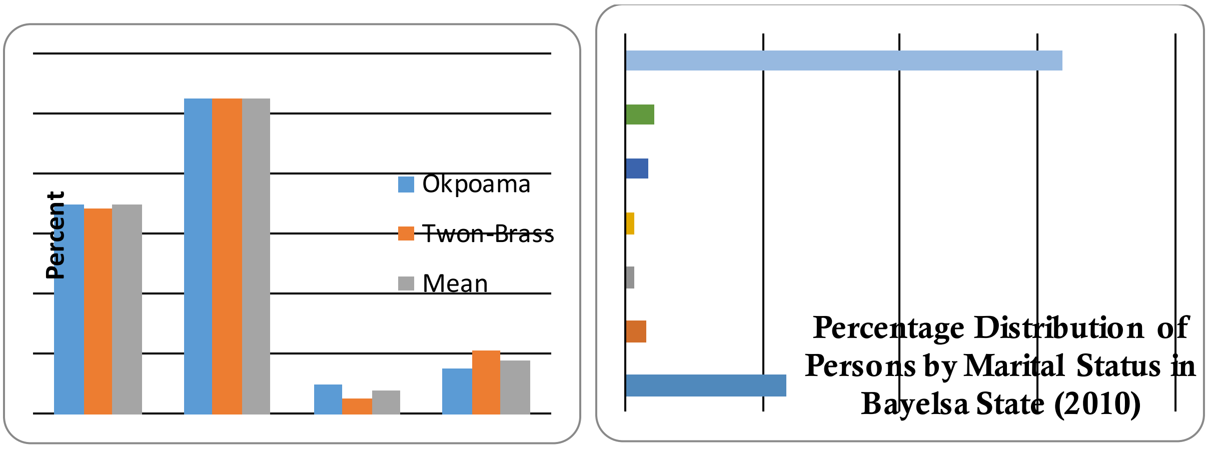
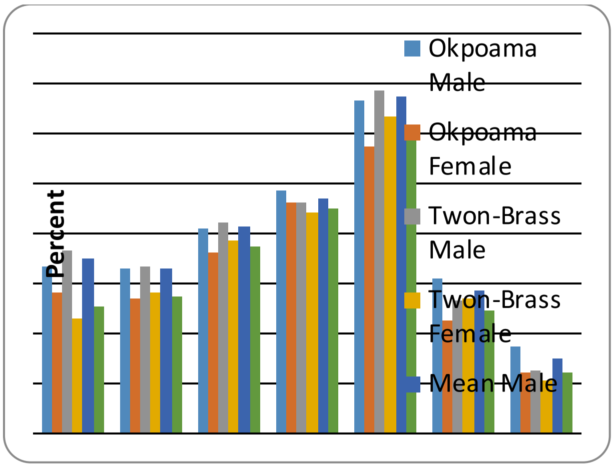


Fig 4.26ab: Marital Status of Sampled Respondents (a); Bayelsa State marital status (b)
Source: National Bureau of Statistics (NBS)

4.12.9 Household and Population Structure (Age/Sex Distribution and Ratio*)*

4.12.9.1 Age and Age-Sex Structure

Age and sex are important demographic classification variables. As high as 24.2% of the household population is aged 0-12 years while 15.8% is within the 13-18 years age bracket. Together therefore, children make up 37% of total household population. Also 44% of the household members are within the productive workforce age cohort of 19-59 years. Household members aged 60 years and above are few, constituting only 16% (***Fig.4.275a & b****)*.



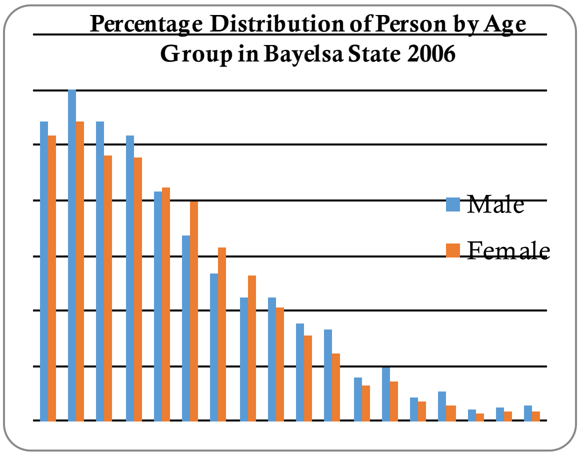
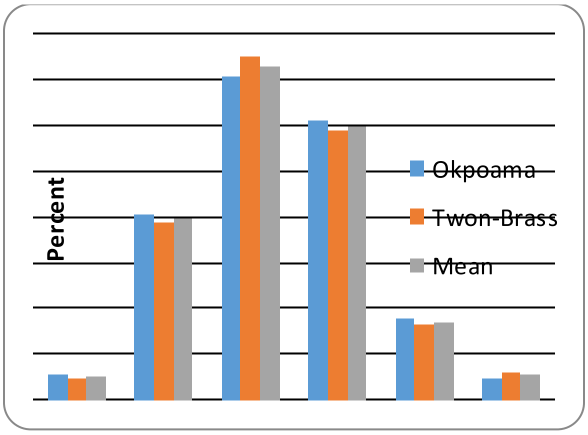


Fig 4.27ab: Age and Sex Structure of Sampled Households; Distribution of population by 5years age Group and Sex in Bayelsa State
Source: NPC 2006

This household Age-Sex composition conforms to what was found in Bayelsa State, and indeed Nigeria's population age-sex structure (National Population Commission, 2006). By this structure, the population is overwhelmingly loaded from the lower age-cohorts with the bulk of the population made up of persons below 18 years, and descriptively classified as children (NPC, 2002). As a result, communities in Bayelsa State have high dependency ratio with child dependency ratio (for age group of 0-12 years) of 22.7%, disaggregated into 13.7% for males and 9% for females. The implications of this age profile are that the population is young and growing and places heavy burden of dependence on the workforce population especially with regards to provision of education and health care services for the young and medical care for the aged. The household structure of the proposed NCDMB Brass Shipyard stakeholder's communities' shows that there are more male (53.5%) heads of households than females (46.5%). The three (3) different type of male-headed household structures are as follows; (one husband and one spouse), polygamous, and single male (male with no spouse, including widowers and males that have never been married). Traditionally, the male is responsible for all the major household decisions.

The socioeconomic survey of the communities also showed that households' structural composition is typically pyramidal; i.e., broad-based with the younger ones predominant and the aged fewest in proportion. On the average, children aged 0-4 years (infants) is about 12.1% of the household members and children aged 5-12 years (primary school age) makes-up about

12.1% of the population. The age range of 13-18 years (Secondary school age) is about 15.8% while 19-25years (Tertiary education) made up of 18.4%. Also 25.6% make up 26-59 years (active working proportion) and the aged (60 years and above) make up 16% of the household composition. The socio-economic data also indicates that most of those surveyed are adults of at least 20 years old (2.6%). On the average, about 22.4% and 66.4% of the communities' respondents were respectively in the 20-39 and 40-59 years age brackets, 36.5% were aged 40-49; 29.9% (50-59) while 11.2% were aged 60+ years and above *(Fig 4.26)*. Sex distribution of the population in the communities shows the males are more in number constituting approximately 66.6% to the females' 33.4% of the population (*Fig.4.28ab*). According to the 2006 census, the males outnumbered the females. At the State level, the male-female ratio is almost equal at 51.3% males to 48.7% females.



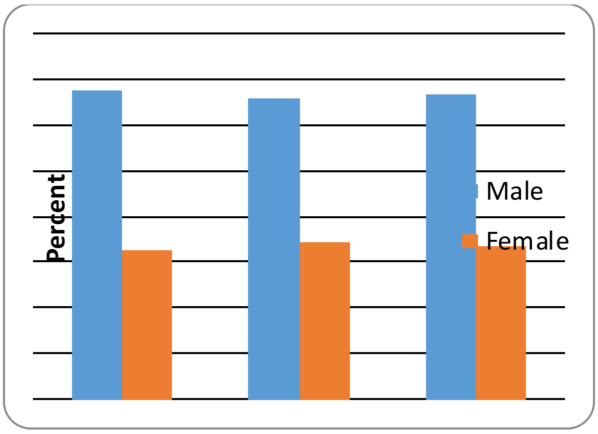


Fig. 4.28ab: Age Range of Respondents; Sex Respondents

Dependency ratio:

The dependency ratio relates the number of children (0-14 years old) and older persons (65 years or over) to the working-age population (15-64 years old). The unit of measurement is per hundred persons aged 15-64. The policy relevance and purpose of the Dependency ratios is to indicate the potential effects of changes in population age structures for social and economic development, pointing out broad trends in social support needs.

Relevance to Sustainable/ Unsustainable Development*:* By relating the group of the population most likely to be economically dependent (net consumers) to the group most likely to be economically active (net producers), changes in the dependency ratio provide an indication of the potential social support requirements resulting from changes in population age structures. In addition, the ratio highlights the potential dependency burden on workers and indicates the shifts in dependency from a situation in which children are dominant to one in which older persons outnumber children as the demographic transition advances (that is, the transition from high mortality and high fertility, to low mortality and low fertility). A high dependency ratio indicates that the economically active population and the overall economy face a greater burden to support and provide the social services needed by children and by older persons who are often economically dependent. A high youth dependency ratio, for instance, implies that higher investments need to be made in schooling and child-care.

The need to ensure access to basic services, such as education and health, as well as to ensure the economic security of children and older persons has been emphasized in many international conferences and summits, including the World Summit for Children (1990), the International Conference on Population and Development (1994), the World Summit for Social Development (1995), The United Nations Millennium Declaration and the World Assembly on Ageing (2002). Methodologically, the dependency ratio refers to the number of children aged 0 to 14 years plus the number of persons aged 65 years or over per 100 persons aged 15 to 64 years:

Dependency Ratio =100 x (Population (0-14) + Population (65+)) / Population (15-64).

The dependency ratio can be disaggregated into: 1. the youth dependency ratio, which is the number of children, aged 0-14 per 100 persons aged 15-64, and (2) the old-age dependency ratio, which is the number of persons aged 65 or over per 100 persons aged 15-64. The dependency ratio, also referred to as total dependency ratio, is the sum of the youth and old-age dependency ratios. Some studies employ other age groups in calculating dependency ratios, for instance 0-19 years to represent the population of children or the population aged 60 or over to represent the population of older persons.

Limitations of the Indicators: The dependency ratio is an approximation to the ratio of net consumers to net producers. As a proxy for that ratio, the dependency ratio suggests that children under age 15 as well as persons aged 65 or over are economically dependent. In many populations, however, people do not stop being economically active at age 65, nor is it true that all persons aged 15-64 are economically active. Although older persons often require economic support from others, in many societies they have economic resources of their own and provide support to their adult children. Furthermore, as the period of training for a productive life increase, most adolescents and young adults remain in school and out of the labour force, effectively extending the period of young-age dependency well beyond age 15. Whenever available, direct estimates of net producers and net consumers can be used for a more precise assessment and analysis of economic dependency.

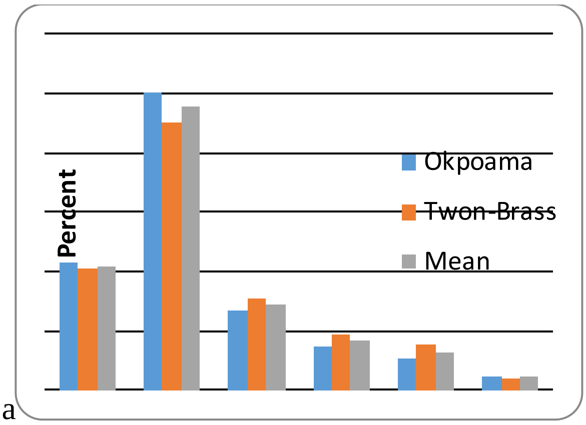
(i) Data needed to compile the indicator: The information on population classified by age that is necessary to calculate the dependency ratio is usually derived from censuses or demographic surveys. The United Nations recommends that countries undertake population censuses every 10 years. Since the last census of 2006, no other has been conducted in Nigeria. Even the 2006 Census had no complete release of relevant data such as those related to dependency ratios.

The communities have a high dependency ratio typical of the Bayelsa State relatively high dependency pattern. The total overall dependency ratio for the study communities was calculated to stand at 59.2. So, in theory, about 40.8%, below half of the population is of the working age (15-59 years) and supporting the other half of the population, who were either children or retired/old. In practice, the over-reliance on fishing as occupation in the study environment, the oil exploration which may have resulted in environmental pollution of the area (a major complaint identified amongst the respondents) and the rearing of large family sizes (high average household size) makes higher dependency ratio inevitable. The overall implications of the age profile are that the population is young and growing and places a heavy burden on the adult population, as well as a huge unemployed human number. There is therefore the need to provide more training, including vocational education and educational facilities to accommodate this young population.

At the State level (Bayelsa), child dependency ratio (age group of 0-14 years) was found to be 31.23%, disaggregated into 16.37% (males) and 14.86% (females). The same source reported old age dependency (60 years and above) for both sex at 5.06% (Bayelsa State Household Survey, 2006). The overall implication of the age profile is that the population is young and growing and places a heavy burden on the adult population. More importantly, the State Government need to commit more resources in the provision of socioeconomic infrastructure, particularly in the area of educational facilities as well as employment opportunities and other social welfare scheme required for the preparation of the dependent young population to become productive when they move into the productive age group.

4.12.10 Educational Status of Respondents

Education is a key determinant of lifestyle and social status among individuals. Studies have consistently shown that educational attainment is highly correlated with socio economic wellbeing, health behaviours and attitudes. A large proportion of the sampled population has formal education indicating a literate society. The common classes of educational attainment among the sampled population are the tertiary, post primary and primary education. On the average, 8.4% of the respondents had tertiary education training. Those with post primary (secondary) and primary education accounted for 47.6% and 20.9% respectively. The possession of vocational/technical education among the sampled population is quite high (14.3%) and this is good on occupational skill needed for prospective employment positions that may be offered to members of the communities. Those of NFE constitute 6.5% and 2.3% others *(Fig 4.29a)*. The educational attainment of the study communities is in conformity with the Bayelsa State educational attainment where the bulk of attainment is in secondary educational level *(Fig. 4.29b)*.



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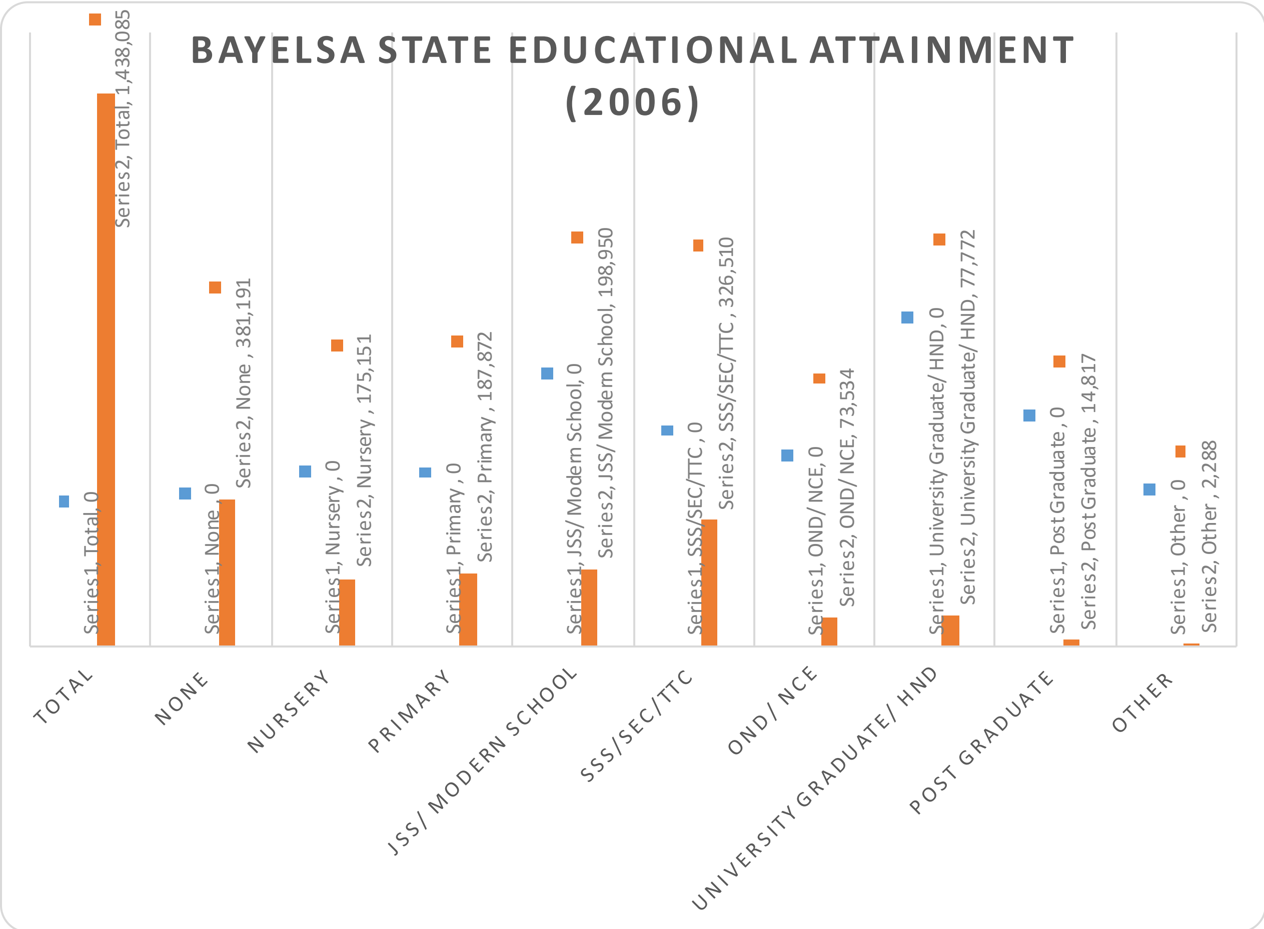


Fig. 4.29a&b: Education attainment of respondents & Bayelsa State Education Attainment

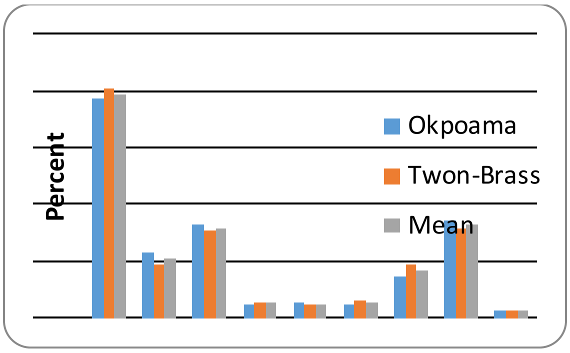
4.12.11 Livelihood and Micro-economy

4.12.11.1: Occupation, Employment and Income Generating Activities

Economic conditions have a vital role to play in people's experience and perceptions of place. A person or a household's socioeconomic status influences the range of opportunities and constraints that people face. In fact, socioeconomic status affects almost all aspects of life. It affects nutrition levels and health, geographic mobility, educational attainment, and overall quality of life.

The livelihood of the communities in the study area depends much on their natural resource-based traditional occupations. Fishing is obviously the major occupation practiced, supplemented with other agriculture-based enterprises such as fish farming and fish smoking (Plate 4.31). Most of these activities are carried out at subsistence level. Apart from the traditional occupation, other income generating activities identified include petty trading, contracting, boat transportation/driving, and technical and artisan works (tailoring, welding, electrical works, and carpentry). In addition, there are few company workers and civil servants as well as teachers in local schools in the area. All of these other economic engagements have affected traditional fishing. As a consequence, and contrary to expectations, the percentage of people currently depending on fishing appears to be dwindling as the years pass on.

Responses from administered questionnaires and focus group discussions (FGDs) confirm the above assertions. On the average, those found to be engaged in fishing amounted to 38.5 percent and 0% take to farming, so that together less than one half (39.4%) are into fishing ***(Fig. 4.30a).*** Trading and artisanship/technicians 15.9% and 10.5% respectively are the other occupations with some significance in the surveyed communities. Unemployed population amounted to some 16.4%; students/apprenticeship (8.4%) and small percentage of 2.6% are into business and contracting. More of the population are into trading as a secondary economic activity (41.8%), which in fact is more representative of the economic landscape of the study environment. Those in the informal sector of the economy, e.g. technical and artisan activities assumed higher percentage of response (23.5%) as a secondary occupation. Unemployed numbers (16.4%) in the communities is below 33.3% national unemployment rate published on August 2020 by the National Bureau of Statistics. It could infer therefore that unemployment rate in the study communities conforms with the national unemployment rate ***(Fig. 4.30b).***



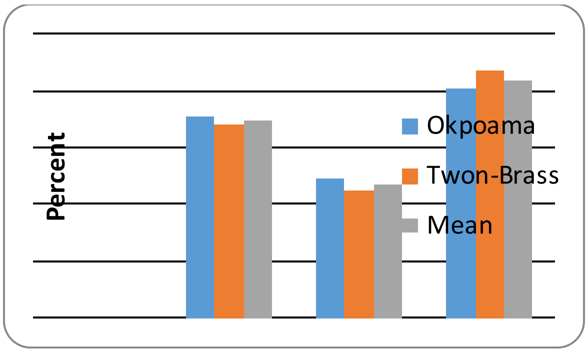


Fig 4.30a&b: Primary and Secondary Occupation of Respondents in the Study Communities

Although a higher proportion of the resident population in the study environment are engaged in fishing activities, responses revealed a gradual withdrawal adduced to several reasons chiefly because of the disproportionate harvests resulting from the continued efforts invested. Many claimed to have had their environment and livelihoods affected over the years. Over one half (50.3%) on average claimed have experienced a reduced fish catch over the past few years, over a third (39.1%) also claimed to have had increased fish catch and a tenth (10.3%) also thought the fish catch had remained the same over the years. Over a third (39.6%) also claimed to have had increased fish catch. The reasons adduced by those who thought fish harvest have continuously declined over the years varied from, 'oil pollution/spillages', 'gas flaring', and 'environmental degradation' to ''changes in climate'', ''youth leaving fishing and its associated farms to engage in other more productive activities, including oil/gas'', according to a very knowledgeable key informant in the study communities. These varied reasons have resulted in 'loss of polluted fish catch area', in addition to the perennial ''oil spillage'', that inundates the rivers/creeks resulting in loss of fish.

The principal constraints being experienced in fishing on the proposed NCDMB Brass Shipyard study area include ''inadequate/lack of capital (55.4%)'', a characteristic of rural poverty, ''occupational shift'' to engage in other economic activities considers more rewarding (16.5%), because younger ones no longer take to fishing. The ''use of poor technology/local tools and methods'' (22.2%), and 5.9% others was also mentioned as a principal constraint to improved fishing activities/harvest ***(Plate 4.31).***

Plate 4.31a: Fishers encountered in the Creeks carrying normal daily fishing expedition

Plate 4.31b: Fish processing, including smoking/drying using local method in study area

***Trading Activities*:** Although the livelihood system in the study area appears predominantly subsistent, excess fish catch from the fishing efforts are taken to the markets for sale to earn incomes. The trading system in the area is such that individuals in the communities display their goods along street shops for sale. Smoked fish are usually taken to Yenagoa and Port Harcourt where they are perceived to have higher market value. Proceeds from sale of fish are used to buy other goods in turn for sale in the community.

4.12.12 Employment Status in the Stakeholder Communities

Residents of the communities experience employment and unemployment. The employed are engaged in one or more of the identified livelihood activities as identified in the preceding section. The Unemployed here refers to those who are ready and willing to work but are unable to secure one. During discussion and interview sessions, community sources indicate that several households among them had one or two unemployed members. They estimate the rate of unemployment among residents at between 20% and 30%. Sources at proposed NCDMB Brass Shipyard stakeholder’s community estimated the higher figure at 30%. These figures conform to the unemployment situation in Nigeria. For instance, in its 2011 Annual Socio-Economic Report, the National Bureau of Statistics (NBS) estimated the level of unemployment among rural residents in the country as follows: Among the uneducated, the rate of unemployment was 22.8%, among primary school levers it was 22.7%, among JSS graduates it was 36.9% and among SSS graduates it was 22.5%. The age distribution showed that among 18-24 year olds, unemployment rate was 38.2% in the rural areas, among 25-44 year olds it was 24.1% while for those aged 45-59 years it was 19.65% and among those aged 60-64 years it was 22.1%. The sex distribution of unemployment was 25.1% among males and 26.1% among females. This would suggest that the rate of unemployment across these communities is highest among females aged between 15 and 24 years whose only qualification is Junior Secondary School Certificate (NBS, 2011). The International Labour Organization (ILO), however, estimated that unemployment rate across Nigeria in 2014 was 10%. It also indicated that the main employment problem in the country was underemployment rather than unemployment (This Day Newspaper, 23 July 2014). The proposed NCDMB Brass Shipyard obviously will provide more employment for some residents of the stakeholder community.

4.12.13 Income Levels and Distribution

Income is an important variable that influences socio-economic status of individuals and its distribution pattern has the potential of influencing other demographic variables. However, personal income levels of self-employed rural households is always difficult to assess because many local people do not keep records and are therefore uncertain of the gross or net amount actually earned from self-endeavors. Household members are engaged in several income-generating activities and their respective contributions to the overall household income most times are difficult to calculate. The consequence is that presented incomes of rural households are often less reliable.

For the proposed NCDMB Brass Shipyard study area, income estimation extracted from the administered structured copies of the questionnaire, revealed a spread of monthly income across the income brackets. The modal income bracket is the N30, 001 – N35,000; some 33.7% of the respondents earn this much. Other relatively significant income brackets are the N25,001-N30,000; N35,001-N40,000 and N40,001-N45,000 respectively. Some 16.5%, 14.1% and 8.9% earn these monthly incomes while 12% reported earning less than N25, 000 and 14.8% earn N45,001 and above ***(Fig. 4.31).*** Interactions at FGDs revealed that residents, who are into business and contracting earn better incomes that averaged about N100, 000/month. However, the frequency of getting such businesses was unpredictable. Studies across the Niger Delta communities (UNDP, 2006, NDDC, 2006) have confirmed that except for those employed in oil and gas related activities, income of majority of the people in the rural communities are generally low and highly variable.

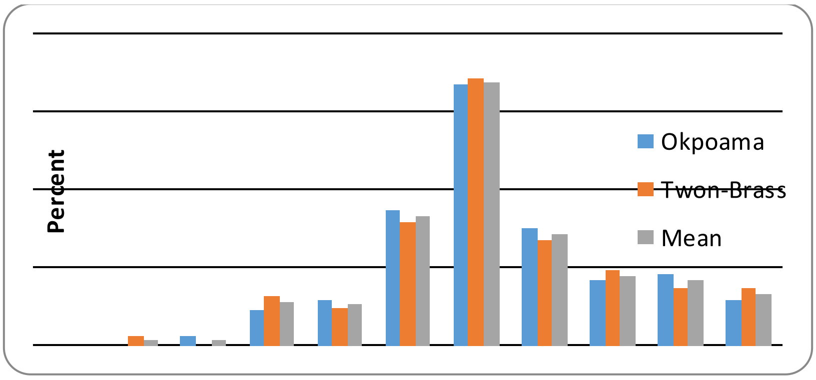


Fig. 4.31 Monthly income level of respondents at study environment

Monthly income levels from primary and secondary livelihood activities in the proposed NCDMB Brass Shipyard stakeholder communities are further presented in *Table 4.41*.

Table 4.41 Monthly Income Levels in the Study Communities

Income Range and Midpoint (N)	Community/Frequency		Total of Study Communities			
	Okpoama Kingdom		Twon-Brass		(No)	%
	(No.)	Total Income (N'000)	(No.)	Total Income (N'000)		
1,000-5,000 (2,500)	0	0	0	0	0	0
6,000-10,000 (7,500)	0	0	1	7.5	1	0.7
10,001-15,000 (12,500)	1	12.5	0	0	1	0.7
15,001-20,000 (17,500)	4	70.0	5	87.5	9	5.3
20,001-25,000 (22,500)	5	112.5	4	90.0	9	5.3
25,001-30,000 (27,500)	15	412.5	13	357.5	28	16.5
30,001-35,000 (32,500)	29	942.5	28	910.0	57	33.7
35,001-40,000 (37,500)	13	487.5	11	412.5	24	14.2
40,001-45,000 (42,500)	7	297.5	8	340.0	15	8.8
45,001-50,000 (47,500)	8	380.0	6	285.0	14	8.3
Above 50,000 (52,500)	5	262.5	6	315.0	11	6.5
Total	**87**	**2,977,500**	**82**	**2,805,000**	**169**	**100**

<table>
<tr><td rowspan="3">Income Range and Midpoint (N)</td><td colspan="2">Community/Frequency</td><td colspan="4">Total of Study Communities</td></tr>
<tr><td colspan="2">Okpoama Kingdom</td><td colspan="2">Twon-Brass</td><td>(No)</td><td>%</td></tr>
<tr><td>(No.)</td><td>Total Income (N’000)</td><td>(No.)</td><td>Total Income (N’000)</td><td></td><td></td></tr>
<tr><td>Community Average Income (N)</td><td colspan="2">34,224.14</td><td colspan="2">34,207.32</td><td></td><td></td></tr>
</table>

Source: Field Data 2021

The mean monthly incomes within Okpoama Kingdom is N34,224.14 and Twon-Brass N34,207.32. The modal income bracket across the community is N30,000.00-N35,000.00. Given the mean income values and assuming naira to United States of America dollar (USD) conversion rate of N480: 1USD and 30 days in a month, the daily individual incomes will be N1,140.80 or 2.40USD in Okpoama Kingdom and N1,140.24 or 2.40USD. Using the midpoint of the modal income range (i.e., N32, 500) individual daily incomes in the communities will be N1, 083.33 or 2.25USD. Daily incomes in the communities are higher than the World Bank extreme poverty income of 1.9USD.

Household Expenditure/Consumption Patterns & Ownership of Household Items

A ranking in order of concern on issues for household expenditure during FGDs indicates that *food* was listed by 75.0% of heads of households as the most important spending priority, with *entertainment* ranked the least in priority in the community. Spending on *Education* was ranked the second most important household expenditure item by the respondents. Healthcare, energy, and transportation were rated low in their expenditure priority lists. It was however, difficult for the discussants to estimate accurately how much individual households spent on these priority items per month.

The availability of durable consumer goods is a good indicator of a household’s socioeconomic status. Moreover, particular goods have specific benefits. For instance, having access to a radio or a television exposes household members to innovative ideas; a refrigerator prolongs food storage; and a means of transport allows greater access to several services away from the local area. As a measure of the overall quality of life apart from incomes and available community-wide basic infrastructures, the proportion of the population with or without the requisite amenities in their dwellings indicates a satisfactory situation. Generally, many households were found with basic household amenities; approximately 85 percent on the average reported having one of the many amenities like telephone (mobile/GSM), electric fan, radio, television and generator as opposed to 15 percent without basic household amenities/properties.

The 2008 NDHS report revealed that 74% of households in Nigeria own a radio (84 percent in urban areas and 69% in rural areas), and 39% own a television (69% in urban areas and 23% in rural areas). A mobile telephone is owned by 50% of households (76% in urban areas and 35% in rural areas), while 16% of households own a refrigerator (NPC and ICF Macro, 2009).

4.12.14 Religion, Customs, Belief System and Heritage

4.12.14.1 Religious Affiliations, Customs, Belief Systems, and Heritage

Despite the remote location of the proposed NCDMB Brass Shipyard environment and communities, inhabitants practice the Christian religion. However, respondents agreed that their community were largely ‘’Christian settlements’’, as revealed by key informants and during our FGDs that the religious persuasions of the inhabitants was better described as ‘’mixed’’. Consequently, though there was a 100% affirmation by respondents claiming ‘’Christianity’’ as main religion, it is to be expected that there is a handful of inhabitants who practice the ‘’African traditional religion (ATR)’’ and Islam. The multiplicity of several religious Christian denominational sects in the study environment, with the dominance of orthodox and spiritual Churches (First Baptist Church, Celestial Church of Christ, Cherubim and Seraphim) testifies to the Christian claim of respondents. Modern Pentecostal sects were also confirmed to have their adherents in the community, e.g. the Redeem Christian Church of God.

Culturally, the community have their festivals which relate to either the fertility of the land and waters or the blessings of the ‘’gods’’. The FGD and KII session revealed that as Ijaw (Izon) community, several of the cultural traits recognized for the Izon ethnic group also applies sometimes with slight differences. The ‘’Apanpan’’, the ‘’Akiye’’,‘’Ayoegele’’ and the ‘’Idualaba’’ are four important sacred grounds with attached festivals. These sacred areas can only be accessed after the necessary appeasement of the gods residing in such areas. As Christian community, the Easter and the Christmas celebrations are part of their cultural heritage.

The social structure of the proposed NCDMB Brass Shipyard stakeholder’s communities reflects most traditional African community, composed of the nuclear families, the extended family units and the lineage wards, a conglomeration of which make up a settlement. An amalgam of three to eight nuclear families of common descent constitutes an extended family unit, and these have residential locations that are easily distinguished. Four to six of these extended families make a lineage ward, all sharing a common ancestry. Polygamy is a practiced form of matrimony; in fact, the men pride themselves by how many wives one is married to. Households are partrilineal and patrilocal, both serving as basic residential and economic units and inheritance of land and property is evidently patrilineal. The marriage custom of bride price payment on nubile and marriageable girls is widely practiced within the study area. Adultery, bringing in the police to arrest an indigene, raping of girls, wanton and illegal pregnancies and stealing are strong taboos in the proposed Tank Farm project affected community.

Festivals, Calendars, cultural Groups, and Value System, Taboos and Social Norms

The most cultural heritage of the people remains their festivals, which are tied to their way of life and livelihood, i.e., the seasons. Culturally therefore, the subsisting festivals relate to either the fertility of the land and waters or the blessings of the ''gods''. As Christian community, the Easter and the Christmas celebrations are part of their cultural heritage. There is a wide variety but same commonality of festivals still celebrated by the proposed NCDMB Brass Shipyard stakeholder communities in the area, with marked periods of celebrations and some have serious strictures attached to them (e.g., some masquerade cults require all and sundry to keep off the streets when it is to be celebrated at night, though prior notices are given to this effect). These annual festivals are considered important for warding off evil, promoting fertility in marriages and profitable enterprise with fishing and other activities. The reality on ground however, is that traditional worship is rooted in the culture of the community and even acclaimed Christians participate in the festivals at different levels of commitment.

Every society is guided by some value systems which attempt to regulate or guide the way of living, otherwise there could be anarchy with disastrous results. The inhabitants of the study environment with cultural allegiance to the Ijaw ethnic group have its value system, taboos and social norms as well. Other belief systems revolve around the communal social life of the inhabitants in the proposed project affected community. Social maladies such as incest, adultery, stealing fighting with cutlass, bottles or gun and in the bush or mating with a woman in the bush are amongst the customs and beliefs, which are seriously frowned at. Violators are dealt with by either being physically beaten up and subjected to some punishment or asked to pay some fine, including the appeasement of the offended deity and/or ancestors.

Social capital:

Community service and exemplary behaviour are rewarded with membership in social clubs or chieftaincy titles. Religious groups, traditionalist groups, cults, community based organizations and thrift clubs provide strong social networks that unite members through a common set of shared values.

Taboos

Shrine mentioned in the study area are Apanpan, Akiye, Ayoegele, Etima, and Iduolala, Alasoha, Isselabiri, and festival attached to them. The people observed some taboos and they are:

- Having sexual intercourse with a woman in the bush/forest,
- A woman under menstruation is not allowed to enter the shrine,
- Sleeping with another man's wife (adultery)
- Picking and selling of periwinko (Isam) and
- Killing of python snake etc.

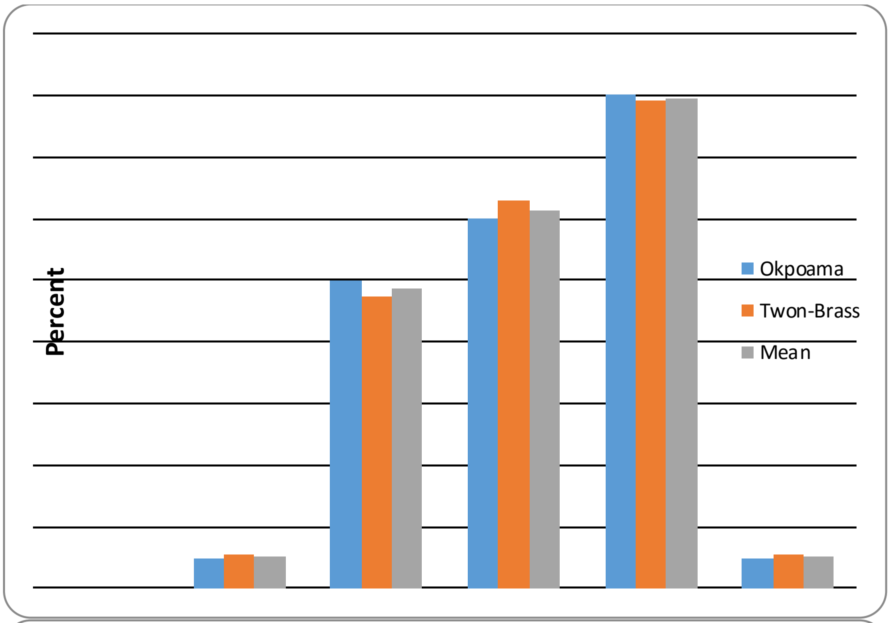
It is a general belief of the traditional worshippers that these shrines and forbidden forests provide their respective community spiritual protection against external aggression and promote progress. As a result, these shrines and forest are held in high esteem and ensure that nothing is done to desecrate them.

4.12.15 Housing

4.12.15.1 House Types

Housing is a basic social need and an integral part of the human environment and the physical structure of settlements. Housing has been defined by WHO as "residential environment which includes in addition to the physical structure that man uses for shelter, all necessary services, facilities, equipment and devices needed or desired for the physical and mental health and social well-being of the family and individual" (WHO cited in Owei O. et. al., 2002). Housing in the community is a mixture of modern and traditional designs and construction materials. A few houses have modern designs and they are built with utilities like kitchen, toilet and bathroom. Most houses in the community are also constructed with stable and permanent materials like cement blocks and roofed with corrugated iron sheets.

Some houses across the proposed NCDMB Brass Shipyard project stakeholder communities are bungalows and flats. The bungalows are built with many rooms and are mostly multi tenanted. However, most houses are built with single rooms or as self-contained units of room and parlour. Bungalows account for quite number of houses in the community. Residents in the project community believe that the proposed project would encourage the building of more flats in the community for rental purposes. Some of the houses are owner occupied houses; some, especially the flats, have toilets and baths located in-house; but most are not provided with these utilities. Some also have kitchens in-house. However, the survey analysis revealed 0% of the housing type in the stakeholder's communities to be mud with thatch roof, mud houses with zinc roof 2.6%, wood/plank with zinc roof 24.3%, zinc with zinc roof 30.7%, while concrete houses with zinc roof are more in the community with 39.8% and those others houses account to about 2.6% (Fig. 4.32a&b). See also ***plate 4.30*** depicting the housing type/quality, showing a typical rural-urban environment.



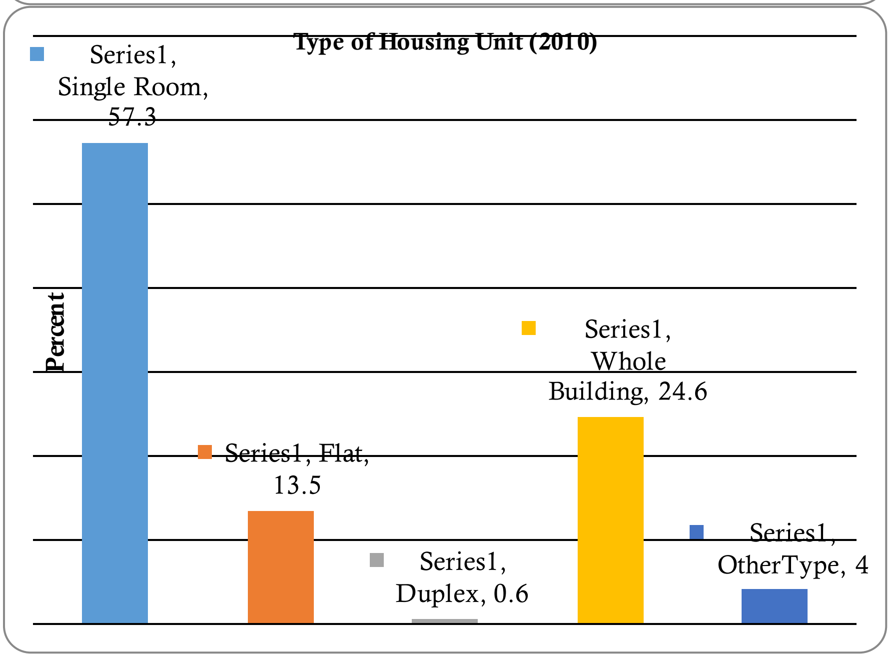


Fig. 4.32a & b: Housing type & Housing unit
Source: NBS/CBN/NCC Social-Economic Survey on Nigeria, 2010

Availability and Cost of Rental Accommodation

Rental accommodation is available in the Okpuama and Twon-Brass community. A number of residents, including indigenous members of the community, live in rented accommodation. Value of house rent in the community varies according to the construction material. A room in a house built with plank/wood walls and roofed with zinc attracts N2500 per month across the community while a one room accommodation in cement block house costs N3500 monthly while a room and parlour in a similar house costs N5, 000. Flats, two and three bed rooms, cost between N10, 000 –N15, 000 in the community.

Available Housing Utilities

Houses in the communities are built with limited utilities. For instance, as a result of the unstable power supply by Agip, residents now use alternative sources like private electricity generators, kerosene lamps, torches and candles to light up their houses. Common sources of energy for cooking household meals are firewood and kerosene. About 75% of households across the community cook with firewood. The proposed project stakeholder communities' drinks and cook from river/stream water around them as well as hand-dug well. In addition to the hand-dug wells, residents use water from rain water. Fortunately for the Okpoama residents, their public borehole is now functional as it has been reactivated by Atlantic Refinery.

4.12.16 Existing Businesses in Communities

Existing businesses in the communities are small scale. They comprise primary production activities as represented in the two traditional occupations of fishing and commercial activities represented in trading, in shops and markets. Okpoama and Twon-Brass have major provision store and drug stores. Apart from these there are also business centers, welding shops, carpentry and furniture making shops, electrical and electronic repair shops, motorcycle repair and tire vulcanizing shops. Another existing business is transportation by commercial boat driving, open back Keke NAPEP for carrying of heavy luggage. Available businesses in the study communities are all in the informal sector.

Banking and Informal Credit Institutions

Residents do their banking transactions mainly at the state capital, Yenagoa and POS stands located in the communities. Existing informal credit practices among residents are the traditional contribution and Osusu. Contribution entails a group, usually made up of friends and acquaintances, who commit themselves to a fixed monthly contribution over a number of months, usually determined by the number of members of the group. A member takes each monthly contribution, and this is done in rotation until every member has had an opportunity. For participants, this represents a source of funds for business investments, payment of fees and bills and purchase of various items, among others. Osusu, on the other hand is organized by an individual who collects money from participants in the scheme. The sum collected is agreed with the participant, the duration is varied but mostly daily or weekly. The total sum collected, less an agreed amount (usually one daily or weekly collection, depending on agreed frequency of collection) is returned to the participant at the end of the month. Osusu is common among petty traders and artisans and it provides some savings which is used at month end to pay salaries of their assistants and purchase essential materials for their trade. Usually the person who organizes the 'Osusu' deploys the funds collected as short-term credit to micro and small scale businesses and charges an interest.

4.12.17 Land Use and Resource Harvesting

4.12.17.1 Available Resources

The proposed NCDMB Brass Shipyard stakeholder communities are endowed with a lot of natural resources. These resources have been exploited by generations of residents, and have kept and sustained the continuous human settlements in the entire area. The resources are the water bodies, the forest and the limited land mass. Water bodies in the study area include the rivers, ponds and wetlands. Ponds and wetlands are situated in bushes and forests around the community. These water bodies yield the fishes on which the community depends for food and livelihood. The forests are home to a number of resources including timber, firewood, economic trees like the raffia and bush mango (Ogbono). The timber is useful in building houses and supports canoe repairs activities. The land provides for the physical development of the community including housing and infrastructure. It is a major resource that supports the growing of a variety of cash crops like plantain, coconut, mango tree, and palm trees etc.

Land Ownership and Tenure

The Land Use Act of 1978 provides the framework for land ownership and payment of compensation for land acquisition for development purposes in Nigeria. However, some of its provisions like the ownership of all lands by the Government have not been well received, especially in southern Nigeria (including Bayelsa State and the proposed Tank Farm stakeholder community). The rejection stems mostly from the socio-cultural significance of lands. Therefore, in spite of the law, communities and families still assert their ownership rights over lands. Lands in the community are primarily owned by extended families, compounds and the community. In the community, families and compounds own lands. Ownership rights over lands are handed down from one generation to another within the extended family, compound and community. Such inherited land is put to any use as desired by the owners. These are the lands on which family, compound and community members build their houses. They are also allocated to members for use as farm lands and for other economic purposes. These lands revert back to the families and compounds at the end of its use. Lands can be leased by non-family and compound members. Such lands similarly revert back to the owners after the period of lease. Lands are managed by males within the extended families and compounds. ***Fig. 4.33*** shows that 66.2% of lands are owned through family inheritance, 16.4% bought it, 15.1% rented/lease it, while 0% sharecropping and 2.3% others.

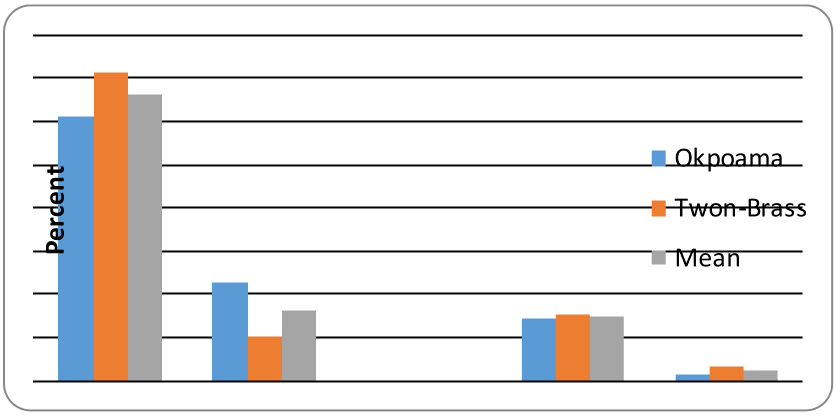


Fig. 4.33: Land ownership system

Classification of Land Use

Land in the proposed Brass Island Shipyard project stakeholder communities have an invaluable resource. Traditionally, these have been used over the years for housing, and in more recent times there have been additional uses for infrastructural development and industrial purposes. Residents were conscious of a further decrease of the limited lands in the community over the years. Their perceptions and estimates of the proportion of lands put to various uses and lands lost to natural factors are presented in ***Table 4.42a***. Most of the lands have been left fallow over the years due to the terrain. Lands put to industrial use mainly could be the one on the proposed Brass Island Shipyard and occupied by oil exploration companies in the area. Land loss has also mostly been attributed to the natural factors of coaster erosion from the river and rain fall.

Table 4.42a: Land Use Structure in the Proposed NCDMB Brass Shipyard Study Communities

Land Classification	Community/Frequencies (%)	
	Okpoama	Twon-Brass
Agricultural	0.0	0.0
Industrial	5.0	10.0
Housing Development	70.0	70.0
Institutional (Infrastructure)	5.0	5.0
Loss from natural factors	20.0	15.0
Total	100.0	100.0

Source: Field Survey, 2021

Land use Tenure System and natural Resources

Land use and ownership system in any society is generally governed by a tenure system evolved over time and determined by the perceived demand as well as the potential and actual social pressure associated with its supply and use (Powell, 1995, Swallow and Kamaro, 2000). Land use pattern visible in all societies include public land use, commercial land use, industrial land use, recreational land use and social land use. As in the case in most communities in the Niger Delta area, land ownership is rested in individual, families as well as communities.

As shown in *Table 4.42b*, the predominant land tenure system practiced in the proposed Brass Island Shipyard project stakeholder communities was individual ownership (60.5%), family ownership (20.5%); communal (12.4%); while rented/leased was 6.6%. FGDs discussions conducted with members of the surveyed community confirmed the arrangement. They also agreed that access to land was through inheritance while control is left in the hands of the individual families and community that owned bush land. In most cases community's lands are used for developmental projects such as schools, health care service.

Table 4.42b: Natural Resources Assessment of Proposed Brass Island Shipyard communities

Community	Tenure Right			Access to land rent inheritance	Access to forest free (yes/no)	Access to water (yes/no)	Presence of forest reserved (yes/no)	Land control	Land used/
	Land individual/ family/	Forest individual/ family/	Water/ Lake Community						
Okpoama	C F	F C	C	Inheritance	Yes	Yes	No	F C	✓
Twon-Brass	C F	F C	C	Inheritance	Yes	Yes	No	F C	✓

Source: Field survey, 2021

C = Community, **F** = Family, **I** = Individual

4.12.18 Infrastructure

4.12.18.1 Functional Status of Available Infrastructure

The infrastructural framework in the proposed Brass Island Shipyard study communities are made up of a few physical and social amenities. Some of the available amenities are functional while some are not. Most of the amenities have been provided by governments, development agencies. The physical amenities include paved access roads, internal roads, community halls and telecommunication services. Social amenities consist mainly of education, health, water supply and electrification facilities.

The proposed project communities are accessed by water. They also have some paved internal streets of varying lengths. The communities (Okpoama and Twon-Brass) are accessible from Nembe Jetty as well as Yenagoa Jetty through Twon-Brass. Internal transportation in the communities is by commercial motorcycles which cost N100-N300 per passenger depending on the distance. From Okpoama to Twon-Brass is N300 and vice versa. Okpoama to Ewoama is N200 and vice versa. Another major physical infrastructure in the communities is Telecommunication services. Telecommunication services from GSM service providers

(MTN, Airtel and Glo) are received in the communities, though depending on your network and position.

The Okpoama has two public primary schools and two public secondary schools while Twon-Brass has 8 primary schools and 2 secondary schools. The primary schools run classes 1-6 and the secondary schools have JSS 1-3 and SSS 1-3 classes. Health centers are located in the Okpoama community (one health center and a cottage hospital); same applies to Twon-Brass The communities has electrification facilities and connected on the Agip Turbine. However, the people like other part of the country have power once in awhile and depend more on their individual generating set ever since the supply by Agip turbine become irregular. The youth organize themselves into vigilante groups. The community has public recreation facilities – sport complex. Residents recreate by playing football in the school football fields or swimming in the river. Some stay at home and watch television for few who have television and can afford running cost of generator in absence of regular power supply.

Available Social Infrastructures and Services

The development, availability and access to basic social infrastructure (see Table 4.43), in addition to employment were the greatest concerns of the resident community population in the proposed NCDMB Brass Shipyard study environment. Complaints were rife that both the Bayelsa State Government and the Brass LGA Council have had minimal intervention in the area in terms of amenity provision. The oil and gas company on the other hand of having better impact was greatly appreciated by many in their efforts so far. The NDDC (and its predecessor, OMPADEC) had sponsored some welfare-enhancing projects, but the benefits derivable from some of such basic social amenities were not sustainable. Some of the facilities have been left uncompleted or un-maintained, leading to depreciation and non-functionality of some. There are public primary schools in the community, access to primary health care services; electricity and accessible internal roads within the community are available although in different functional status.

Table 4.43: Available Social Infrastructural facilities in the proposed NCDMB Brass Shipyard project stakeholder communities and its provider/donors and state

S/ no	Community	Type of infrastructure	Provider/Donor	Functional
1	Okpoama	Water Board	NDDC	Functional
		Health center	By Brass LGA	Functional
		Cottage Hospital	Community self effort	Functional
		Market		Yes, functional
		Primary and Secondary School	By Bayelsa State Government and other private owned schools	Yes, functional
		Energy/Electricity	By NAOC	Functional, though not regular
		Sports complex	By Presidency (Border Communities Development Agency – courtesy Senator Biobarakuma W. Degi-Eremienyo	Functional
	Twon-Brass	Water supply	NDDC	Functional
		Health center	By Brass LGA	Functional
		General Hospital	By State Government	Fuctional
		Primary and Secondary schools	By State Government	Fuctional
		Energy/Electricity	By NAOC	Functional

Educational Institutions

The proposed NCDMB Brass Shipyard project stakeholder's communities owned public primary and two secondary schools within their immediate domains. Okpoama own two primary school with two secondary school while Twon-Brass own 4 primary school and 2 secondary schools. There are also private school, however, notably is the Kingdom Heritage own and managed by Winners Chapel. The schools on ground had relatively adequate capacities in terms of structures (some need rehabilitation/renovation) and pupils/students enrolments were adequate but the number of teachers in the schools was a cause for concern. Teachers are inadequate compared to the number of pupils/students in the schools. ***See Plate 4.32.***

Plate 4.32: Typical of Primary and Secondary School at the proposed NCDMB Brass Shipyard project stakeholder communities

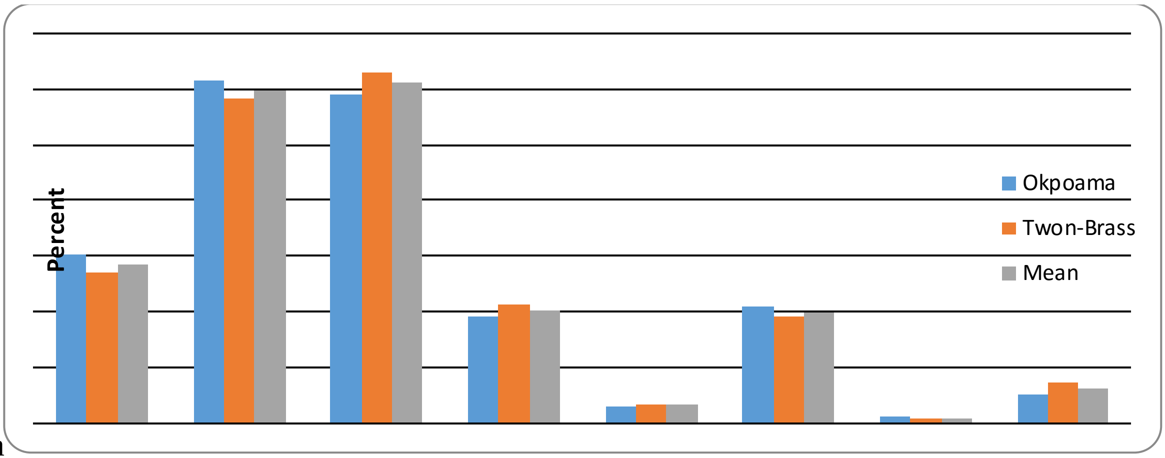
Electricity Supply

The electricity power supply in the communities is through gas turbine by Agip. It was regular power supply at inception but supply had since dropped due to reasons according the community members best known to Agip. Regular power supply has therefore formed one the expectation of the people. The people currently depend on generator as alternative supply to gas turbine supply. Some respondents claim to spend between N5000.00- N10000.00 on fueling of their gen set on monthly basis, particularly the artisans like hairdressers, welders, barbing salons etc..

Water Supply Facilities

Available data from the Federal Office of Statistics (National Bureau of Statistics) reveals that water in the majority of South-South states comes from unsafe supply facilities. These include rivers, lakes or ponds, unprotected wells and boreholes. The Bureau however, classifies available sources of potable water for household use as pipe borne, untreated pipe, borehole, protected well, unprotected well, river/lake/pond, vendor trucks and other categories.

There are few public borehole water facilities in the communities but unfortunately some are functional while some are not. The functional ones are not drinkable due to high concentration of iron. The water is usually 'clean' at point of fetching, however, will change to yellowish color after some time. The people rely also on river/stream, hand dug well and sachet water (pure water)/bottle water as source of water supply. However, from the survey analysis 14.3% rely on rain water for source of domestic water, 29.9% depends on rivers/stream, 30.5% uses own hand dug well, 10.1% (public piped/tap), 1.6% (private piped water), 10% (community borehole), 0.5% vendor/buy and 3.1% others (fig. 4.24a). However, when compared with Bayelsa State distribution of households by source of water for drinking and cooking, the use of rainwater appears to be contrary to the study communities but conform to the use of other source of water in the communities. The use of stream/river/creek water, hand-dug well, borehole water is high in the study communities which affirm the NBS data. Again, according to NBS data 18.5% uses borehole and this appears to be true with the study communities, while 43.5% rely on borehole water in the communities. Again 19.2% rely on well water according NBS and this is also conforms to the study community with 22.5% reliance on hand-dug well water *(See fig 4.34).*



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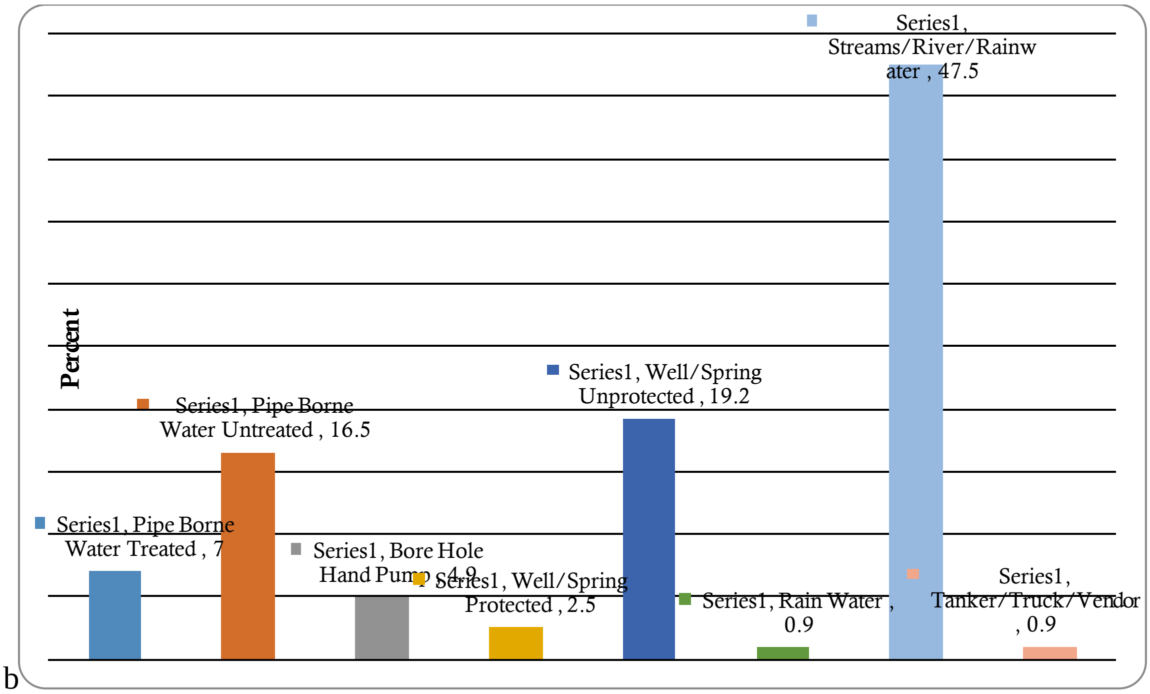

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Fig 4.34: (a) Source of water supply (b) % Bayelsa State Distribution of Households **Source of Water NBS (2010)**

Plate 4.33: Okpoama and Twon-Brass Water board respectively and typical of hand-dug well as source of water supply in the proposed NCDMB Brass Shipyard project stakeholder communities.

Transportation and Communication Facilities

The proposed Brass Island Shipyard project study environment has physical conditions and constraints to road construction since it is riverine communities. The communities can only be accessed by water. Access to Okpoama Kingdom and Twon-Brass is either through Nembe jetty or Yenagoa jetty through Twon Brass. On the other hand, access is through road from Yenogoa to Nembe where speed boat can be boarded. Yenogoa to Nembe by road is N1500 while from Nembe jetty by speed boat is N2500 ie N4000 and N8000 to and from. Access to public communication facilities like the telephone in the study communities was also found to be greatly enhanced. In fact, the new mode of telephony, the GSM has made telecommunications quite easy in the area; there is hardly any part within the area where the population does not have access to one of the networks, as base stations and masts are located in the communities.

Conflicts and Conflict Resolution

Conflict can be resolved in the study communities through dialogue in special meetings summoned by the most elderly person and his cabinet. Traditionally, issues are discussed at the lower levels of family, age grade and women or taken directly to the community leadership. In addition, appeals and summons are common processes utilized at community level. Issues are referred to the police and courts, when they are criminal offences that are mandatory to be reported and when the resolution of the conflict overwhelms community leadership. Conflict resolution at community level could attract penalties such as fines, seizures of assets and ostracizing.

4.12.19 Community Health Environment and Related Issues

(i)Water Supply Facilities

Increasing access to improved drinking water was part of Millennium Development Goal (MDG) 7 (ensuring environmental sustainability), adopted by Nigeria and other nations globally (United Nations General Assembly, 2002). The goal in Nigeria was for 77% of the country's residents to have access to an improved drinking water source by 2015 (Federal Republic of Nigeria, 2010a). Nigeria met the MDG target; the proportion of the 2015 population that gained access to water since 1990 amounted to 48% (UNICEF and WHO, 2015). The statistics however, showed that while some 69% have access to improved sources of water, only 2% have piped water on premises, some 21% depend on 'other' improved sources while 10% still sources water from ''surface water'' susceptible to contamination.

A number of indicators are useful in monitoring household access to improved drinking water. The source of drinking water is an indicator of whether it is suitable for drinking. Sources that are likely to provide water suitable for drinking are identified as improved sources. These include a piped source within the dwelling, yard, or plot; a public tap/stand pipe or a borehole; a protected well or spring; and rainwater (WHO and UNICEF, 2010). Lack of easy access to a water source may limit the quantity of suitable drinking water available to a household, even if the water is obtained from an improved source. Water that must be fetched from a source that is not immediately accessible to the household may become contaminated during transport or storage. Especially in such situations, home water treatment can be effective in improving the quality of household drinking water.

According to the Nigerian Demographic Household Survey, 2013, some 61% of the households in Nigeria have access to an improved source of drinking water, with a much higher proportion among urban households (76%) than among rural households (49%). The results show an overall improvement in the quality of sources of water in Nigeria since the 2008 NDHS (when the figure was 56%). This improvement was higher in rural areas (45-49%) than in urban areas (75-76%). The most common source of improved drinking water in Nigeria is tube well or borehole water, used by 44% of urban and 32% of rural households. Thirteen percent of urban households and 10% of rural households have access to drinking water from a protected well.

Use of sachet water, which is included under non-improved sources, is common in Nigeria, with 6 percent of households using it as their main source of drinking water. It is used more in urban areas than in rural areas (12% versus 1%). In the 2013 NDHS, only 20% of households reported having water on their premises, as compared with 25% in the 2008 NDHS. Households not having water on their premises were asked how long it takes to fetch water. About a quarter of households (24%) travel 30 minutes or longer to obtain their drinking water (20% in urban areas and 28% in rural areas).

In the 2013 NDHS, all households also were asked whether they treat their water prior to drinking. An overwhelming majority, 88%, do not treat their drinking water. Urban households (8%) are somewhat more likely than rural households (3%) to use an appropriate treatment method to ensure that their water is safe for drinking. The statistics indicates that many households in some of Nigeria's states have no access to improved source of drinking water. More than any other amenity, water facilities are present in most communities across the Niger Delta region but more often than not, water never flows from the facilities for the population (Ojile, 2010). The availability of social infrastructures in the proposed NCDMB Brass Shipyard stakeholder communities, including those of potable drinking water presents a disproportionate access to potable water supplies for the resident population thus a challenge to human health and well-being. The stakeholder communities have access to potable water supplies. The people depend more on public borehole, hand-dug well and insignificant number of the population have private owned borehole.

(ii) Access to sanitation facility

About 25% of communities' members do not have a toilet facility within the ideal 50m distance from their houses, even though most of the facilities were of pit toilet, and some excrete directly in the surrounding water, a practice that often contaminate surface water, and are not technically considered a toilet facility. The use of these toilet facilities is really a threat to the community member's health as admitted by the respondents since the water body can be contaminated with raw faeces, like one of the respondents asked, 'what will they do', since some of the community members can't afford an ideal toilet facility in their individual household.

(iii) Energy for cooking

The use of firewood and charcoal was observed from some members of the communities as a source of fuel for domestic cooking as well as the predominant method of roasting plantain (bole) and smoking of fish, which is preservation in the communities notwithstanding the health implications.

(iv) Waste management

Waste generated in the communities was mainly garbage and other domestic wastes. These wastes were usually dumped near residential buildings at the backyard. These wastes can become a source of contamination of the water body yet this is what is commonly practiced in the communities.

(v) Alcohol usage and cigarette smoking

Smoking was common in the communities; a significant number of the young males in the communities are said to smoke cigarette...but an average smoker smoke at most three sticks of cigarette a day. Women in the communities rarely smoke cigarette, but female smokers could be found in the communities mostly at night smoking by the commercial sex workers.

(vi) Sexual behaviour

Sexual behaviour is directly related to the incidence of sexually transmissible infections and diseases, including HIV/AIDS. The two key behaviours useful in public health action are number of sexual partners and condom use. Majority at the proposed NCDMB Brass Shipyard project study community members claimed to have only one sexual partner while a few admitted to having more than one. The uptake of condoms from the drug stores was used as proxy indicator to measure the behaviour of the people with regards to preventive measures relating to unwanted pregnancies and sexually transmitted infections. Condom uptake was relatively low.

The knowledge of the existence of HIV/AIDS and recent COVID-19 is high in the communities. The methods of STIs transmission (needles, razor blade and sexual contact) is also well known in the community. The 2003 NDHS reported that 70.6% of female youths in the South-South reported having high risk (unprotected) sex in past one year (higher than the national averages of 29.4%). However, the HIV/AIDS Reproductive Health Survey showed figures for South West females and males to be 69.3% and 68.6% respectively (FMOH, Nigeria 2005). This shows a slight decline but is still higher than the National average of 67% for females and 63% for males from the same report.

This risky sexual behavior increases vulnerability to both STIs and HIV/AIDS. HIV sero-prevalence in Nigeria has not been increasing but the level is still worrisome. The factors that drive increase in HIV/AIDS prevalence such as industrialization, promiscuity; low condom use is prevalent in the study area. The high prevalence rate of HIV/AIDS in an area is sustained by several factors including; project-induced influx of workers who have a higher income level than locals, migration of commercial sex workers due to the economic attraction of workers, risky sexual behaviours, high sexual activities, early sexual exposures.

(vii) Housing

The provision of good housing is an important aspect of environmental health. It represents a significant part of man's environment; shelter from the elements; workshop (the kitchen for the housewife, the playroom for the children and tool-shed for the adult males); and home (the residence of the family), where this social institution carries out some of its major functions. Consequently, good housing should minimize physical and biological hazards in the environment, provide a good social environment and promote the health of the inhabitants.

The housing pattern, type and structure within any given community or communities and study area are more often than not, a reflection of the settlement pattern itself. As a consequence, the housing pattern, type and structure within the proposed NCDMB Brass Shipyard study communities are a reflection of its generally and predominantly rural environmental setting; old housing stocks are generally intermixed with emergent modern types. The bigger and more populated the community, the better the quality of housing stock with housing patterns depending on the status of a family/compound. Majority of the houses are of the rooming type, with modal walling and roofing materials being constructed of concrete block with corrugated iron sheets (zinc/aluminium) for roofing. A sizeable proportion of the housing stock are also of the wattle and daub (mud-wall) type, some of which have been rendered (plastered with cement) and have both corrugated iron zinc and thatched roofing.

The quality of housing in the communities measured by the walling, flooring and roofing materials used indicates that majority of the respondents (39.8%) live in houses constructed of concrete block or cement walls and with zinc roofing. On average, 30.7% of the respondents live in houses constructed of zinc wall with corrugated iron roofing sheets (zinc) and plank/wood wall with zinc roofing accounting for 24.3%. Smaller fractions (2.6%) of the population live in varied other types of housing in the area.

(viii) Knowledge of HIV/AIDS

Most respondents during the focus group discussion in the communities have heard of HIV/AIDS but knowing how it’s usually contacted was observed to be very low. There is need to carry out awareness campaign to educate members of the community on HIV/AIDS. And most recent is the deadly coronavirus codenamed Covid-19, although this is being widely publicized worldwide but few still claim ignorance of it and don’t seem to believe its existence. There is a need to keep educating the public on the preventive measure of these deadly diseases.

(ix) Household Food

Common foods eating by the proposed NCDMB Brass Shipyard project communities include garri, plantain, loiloi, rice, and yam. Others eaten at lesser levels include fish, vegetables, beans, milk, eggs and meat. Malnutrition is a major health problem in Nigeria and provides an overall picture of the health status of the population. Children who are malnourished are at a greater risk of falling sick and dying than children who are not malnourished.

Three standard indices of child growth are used to describe nutritional status, Height-For-Age (stunting), Weight-For-Height (wasting) and Weight-For-Age (underweight). To ensure that the results obtained in this study are comparable on an international scale, they are expressed in terms of Z scores. The Z score gives indication in units of standard deviation how far from the reference value a given value lies. The standard used here is based on the National Canter for Health Statistics (NCHS) growth references as recommended by the World Health Organisation (WHO).

An assessment of the nutritional status of 190 children in the surveyed communities, aged 0-5 years, was carried out Table 4.44. The indices of malnutrition recorded showed that 26.7% were underweight, 32% were stunted and 13.4% were wasted. A child with a significantly low height-for-age ratio is considered to be stunted or short for his age. This is generally the result of a failure to receive adequate nutrition over an extended period of time and is also affected by recurrent episodes of chronic illness. Children whose Weight-For-Height (W/H) ratio is significantly low are defined as wasted or thin for their age. One in ten surveyed children was classed as wasted. Stunting and wasting are both most severe in the second year of life. This pattern is likely to be due to poor weaning diets (with breast milk offering significant protection in the first year) and infected sources of water resulting in acute illnesses from diarrhoea mainly in the second, third and fourth years of life.

Table 4.44: Weight and height for age of pre-school children in the study communities

Age (months)	Mean Weight (kg)	Mean Height (m)	Weight for age (Normal range) kg
0 – 11	6.73	0.54	3.5 – 9.4
12 – 23	9.17	0.76	9.5 – 12.4
24 – 35	11.45	0.91	12.5 – 14.4
36 – 47	12.60	0.94	14.5 – 17.4
48 – 60	13.98	1.02	17.5 – 19.4

(x) Mortality Rate

The mortality figures from questionnaire survey are grossly unreliable. The indigenes tend to give exaggerated values when asked about mortality cases may be to lend credence for their demand for more government presence. Inadequate records on mortality rates from the local government level where cases of death are supposed to be registered were also noted. The common causes of mortality in the project area especially in children includes; diarrhoea, malnutrition, malaria, respiratory tract infections, and measles as well as other vaccine preventable diseases. These illnesses were prevalent in the area from the hospital record.

(xi) Morbidity Rate

Mortality rates between the ages of 0-5 and maternal mortality rates are said to be low in the proposed NCDMB Brass Shipyard project communities. This was observed during the focus group discussion with the communities. It was said that women die during pregnancy and childbirth, and that this doesn't happen often but at most once in five years in the communities. The causes of the maternal death that happened in the communities in the last five years according to the respondents are attributed to prolonged labour, and abortion.

(xii) Health system

The resident population in the proposed NCDMB Brass Shipyard project study communities have access to functional primary health care services. Functional and effective public (government health care facilities) primary healthcare (PHC) facilities and services are available. There is health center and a cottage hospital in the communities.


Plate 4.35: Typical of Cottage Hospital and Primary Health Center in Brass Island Shipyard project study communities

(xiii) Traditional and Herbal Medicine Practices

Traditional medical practice is available in the communities. Their practice commonly involves the use of herbs derived from medicinal plants. Several medicinal plants abound in the area. Some of the medicinal plants used in the traditional medical practice in this study area and their uses are given in Table 4.45.

Table 4.45: Common Medicinal Plants and their Uses in the Area

Common/local names	Botanical Names	Medicinal Uses
Pawpaw leaves	Carica papaya	Treatment of malaria
Lemon orange	Citrus aurantium	Abdominal upset, and as a base for other herbs in treatment of malaria
Cashew fruit, leaf and bark	Anarcadium occidentale	Treatment of diarrhoea and menstrual problems
Mango leaves and bark	Mangifera indica	Treatment of malaria
Banana plant	Musa spp	Treatment of fever
Guava tree leaves and bark	Psidium guajava	Treatment of malaria, diarrhoea and menstrual disorders

4.12.20 Community Expectations and Suggestions to Mitigate & Enhance Socioeconomic Impacts

Naturally, community members in the study environment entertained high expectations regarding the proposed Brass Island Shipyard project activities with particular reference to the benefits and/or positive effects. Overall social issues, including increased and more permanent employment opportunities for the indigenes at the skilled, semi-skilled and unskilled levels are paramount. Unemployment was particularly mentioned as the most troubling social problem in the proposed project study communities, as is the case across Nigeria in general, while youth delinquency and disputes over land and prostitution were ranked highly by respondents as disturbing social problems in the area ***(Fig. 4.35a).*** The associated opportunities with regard to economic empowerment of youth and women groups through skills training/acquisition and micro-credit programs; vendor services/minor supplies (contracts), compensation for resource losses (particularly on land take), scholarships and provision of infrastructures, are expectations of the stakeholder communities.

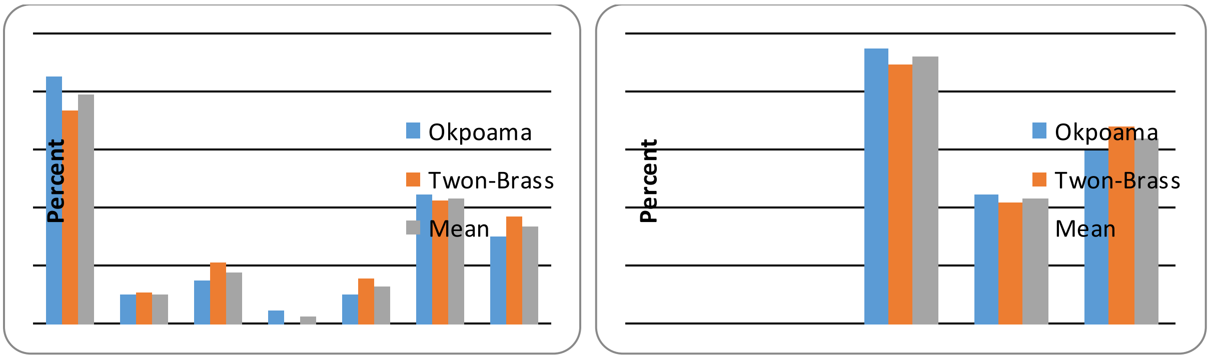

Fig. 4.35a&b: Social & Environmental problems in the proposed NCDMB Brass Shipyard project stakeholder communities

These twin problems of flooding and coaster erosion are serious environmental challenge with close to one quarter (67.9%) mention from the respondents ***(Fig. 14b).*** Oil pollution is mentioned as the third most important environmental problem in the communities with a 32.1% mention. Even with the best industry practice, human and engineering errors are possible causes of pollution. Utmost care and due diligence must therefore, be exercised by NCDMB and her contractors as proposed activities come on-stream to avoid negative throwbacks and effects.

The primary concerns of the people focused on negative activities during the project construction period as well as potential negative impacts on livelihood, health and environment as the project proponent embark on Shipyard construction and its operational activities. They made suggestions on how best to improve their socio-economic conditions and reduce the negative impacts on their livelihoods. Community members want the project to bring about improvements in employment, education facilities and services, equip the existing health centre and improve access to health care, and access to potable water in line with their infrastructure needs. Social issues, including employment opportunities for skilled, semi-skilled and unskilled indigenes at various levels as the proposed project and operations commence are expected. They also want economic empowerment of youths and women groups through skills training/acquisition and micro-credit programs; vendor services/minor supplies (contractor), compensation for resource losses, scholarships and provision of infrastructures, e.g., educational, health, electricity, water, among others are expectations of the community. Pooled responses of these positive expectations put employment opportunities ahead of all expected benefits while a boost in education through awards of scholarships to children and wards, and the expansion of primary healthcare facilities were recognized equally by respondents.

CHAPTER FIVE

POTENTIAL ENVIRONMENTAL IMPACTS

5.1 Introduction

There are a number of approaches for the prediction and evaluation of impacts. The ISO 14001 method is simple to apply and provides a high level of detail and also relies on limited data, unlike the other methods that require the availability of large historical data. The ISO 14001 method, is therefore selected for the identification and evaluation of impacts for this proposed Shipyard project at Brass Island.

5.2 Impact Identification and Evaluation

In line with general guidelines for an Environmental Impact Assessment (EIA) process, the following were the basic steps adopted for identification and evaluation of impacts:

- ✓ Impact identification
- ✓ Impact qualification
- ✓ Impact rating
- ✓ Impact description

5.2.1 Impact Identification

The aim of impact identification is to account for the entire potential and associated bio-physical, social and health impacts making sure that both significant and insignificant impacts are accounted for. The anticipated impacts were determined based on the interaction between project activities and environmental sensitivities. The identified potential impacts during the different phases of the proposed Shipyard project are listed in Table 5.1.

5.2.2 Impact Qualification

The identified impacts of the project were qualified based on the following four criteria:

- Positive or negative
- Short-term or long-term
- Reversible or irreversible
- Direct or indirect

Positive impacts are those which enhance the biophysical, health, and social environment while the negative impacts adversely affect the biophysical, health, and social environments. However, 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 mean whether the environment can either revert to previous conditions or remain permanent when the activities causing the impact is terminated.

Table 5.1: Identified Project Impacts of The Proposed Brass Island Shipyard Project

Impacts	Phase		
	Pre- Construction	Construction	Decommissioning /Abandonment
Acceleration of erosion	√	√	
Acidification of soil and water		√	
Alteration of local hydrology and drainage patterns		√	
Alteration of local topography			
Alteration of natural drainage pattern	√	√	
Alteration of river bed bathymetry		√	
Alteration of soil profile		√	
Availability of fuel wood	√		
Blockage of waterways		√	
Change in local topography		√	
Contamination of groundwater	√	√	√
Contamination of surface water/ soil and sediment	√	√	√
Disruption of fishing activities	√	√	√
Disturbance of spawning ground for fish and shrimps	√	√	√
Exposure of workers to wildlife attack	√	√	√
Impairment of air quality	√	√	√
Increase in incidence of STI's including HIV	√	√	√
Increase in social vices	√	√	√
Increase in surface water turbidity	√	√	√
Increased opportunity for business and employment	√	√	√
Influx of migrant workers and camp-followers	√	√	√
Injuries and death from blowouts	√	√	√
Interference with water transportation	√	√	√
Legacy issues	√		
Light trespass and sky glow			
Loss of biodiversity	√	√	√
Loss of employment/ income			√
Noise and vibration nuisance	√	√	√
Opportunities for business and employment	√	√	√
Pirate attacks and kidnappings	√	√	√
Pollution from drill cuttings and mud			
Reduction of access to land and its resources	√		
Surface water contamination	√	√	√
Third party agitations	√	√	√
Visual obstruction		√	
Land and water traffic accidents	√	√	√
Work site accidents	√	√	√

5.2.3 Impact Rating

This stage involves evaluation of the impact to determine whether or not it is significant. The quantification scale of 0, 1, 3 and 5 was used. The ratings are as described below and are adapted from The International Organization for Standardization ISO 14001– Environmental Management System Approach. The criteria and weighting scale used in evaluating significance 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).

5.2.3.1 Legal /Regulatory Requirements (L)

This asks the question ‘is there a legal/regulatory requirement or a permit required?’ The scoring is as follows:

0= There is no legal/regulatory requirement

3= There is legal/regulatory requirement

5= There is a legal/regulatory requirement and permit required

The legal/regulatory requirements were identified based on national laws/guidelines/standards (DPR and FMENV) relating to the project activity.

5.2.3.2 Risk (R)

This uses a matrix based on the interaction of the probability of occurrence of the impact (Table 5.2) against consequences (Table 5.3). The matrix (Figure 5.1) is referred to as the Risk Assessment Matrix (RAM). Five probability categories are interacted against four groups of consequences. The resultant outcomes are given scores with colour-coding. High-risk categories are red; intermediate risks, yellow and low risks, green as follows:

1=Low risk (green)

3=Intermediate risk (yellow)

5=High risk (red)

Table 5.2: Probability of Occurrence

Probability Category	Definition
A	Possibility of Repeated Incidents
B	Possibility of Isolated Incidents
C	Possibility of Occurring Sometime
D	Not Likely to Occur
E	Practically Impossible

Table 5.3: Consequence Categories

Consequence Category	Considerations			
	Safety / Health	**Public Disruption**	**Environmental Aspects**	**Financial Implications**
I	Fatalities / Serious Impact on Public	Large Community	Major/Extended Duration/Full Scale Response	High
II	Serious Injury to Personnel / Limited Impact on Public	Small Community	Serious / Significant Resource Commitment	Medium
III	Medical Treatment for Personnel / No Impact on Public	Minor	Moderate / Limited Response of Short Duration	Low
IV	Minor Impact on Personnel	Minimal to None	Minor / Little or No Response Needed	None

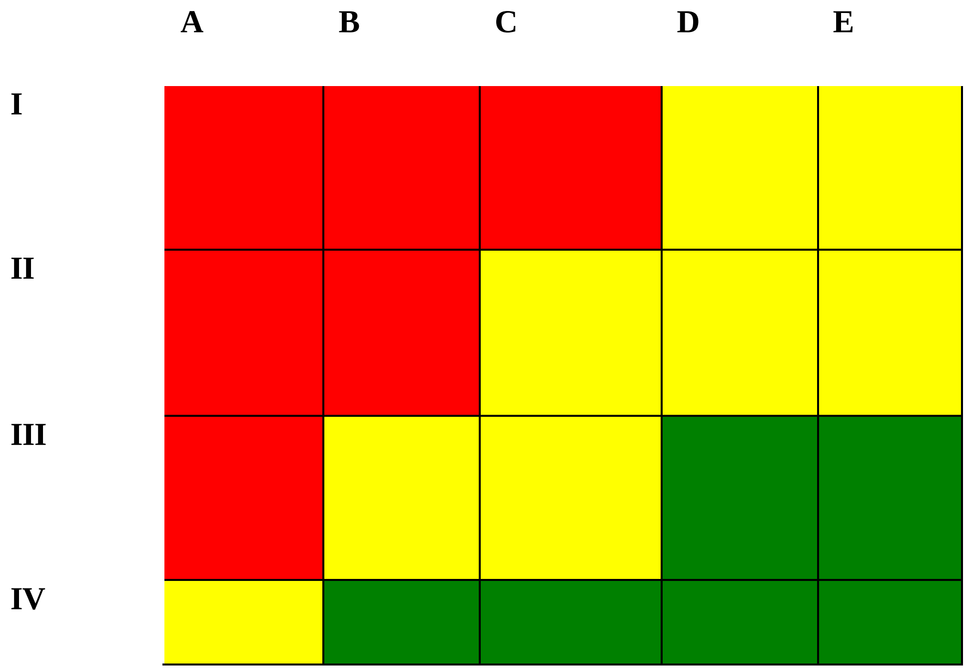

Figure 5.1: Risk Assessment Matrix

5.2.3.3 Frequency of Impact (F)

Frequency of impact refers to the number of occurrence of impacts. The frequency of impact was determined using historical records of occurrence of impacts, and consultation with experts and local communities. The criteria for rating the frequency of impacts are outlined in Table 5.4.

Table 5.4: Frequency Rating and Criteria

Frequency	Rating	Criteria
Low	1	Rare, not likely to happen within project lifespan
Medium	3	Likely to happen ≥ 5 years
High	5	Very likely to happen throughout the project lifespan

5.2.3.4 Importance of Affected Environmental Component and Impact (I)

The importance of the affected environmental components was determined through consultation and consensus of opinions. This was also further facilitated by information on experiences on the impacts of already existing facilities in the proposed project area. The rating of the importance of impacts is shown in Table 5.5.

Table 5.5: Importance Criteria

Importance	Rating	Criteria
Low	1	• Imperceptible outcome • Insignificant alteration in value, function or service of impacted resource • Within compliance, no controls required
Medium	3	• Negative outcome • Measurable reduction or disruption in value, function or service of impacted resource • Potential for non-compliance
High	5	• Highly undesirable outcome (e.g., impairment of endangered species and protected habitat) • Detrimental, extended animal behavioural change (breeding, spawning, moulting) • Major reduction or disruption in value, function or service of impacted valued ecosystem resource • Impact during environmentally sensitive period • Continuous non-compliance with existing statutes

5.2.3.5 Public Perception (P)

The consensus of opinions among the project stakeholders were used to determine the public perception on the potential impacts and the following criteria were applied (**Table 5.6**). The combination of the five impact rating weights forms the basis for judging the level of significance of each impact. A matrix displaying the combination based on the ISO 14001 tool is shown in Figure 5.1. The final ratings of the existing and identified impacts are presented in **Tables 5.7 - 5.9**. In this report, medium and high significant negative impacts were judged to require mitigation, and all positive impacts required enhancement.

Table 5.6: Public Perception Criteria

Public Perception	Rating	Criteria
Low	1	• No risk to human health, acute and/or chronic • No possibility of life endangerment for residents, associated communities • Minor reduction in social, cultural, economic values • Unlikely adverse perception among population
Medium	3	• Limited incremental risk to human health, acute and/or chronic • Unlikely life endangerment for residents, abutting communities • Some reduction in social, cultural, economic value • Possibility of adverse perception among population. • Potential for non-compliance
High	5	• Elevated incremental risk to human health, acute and/or chronic • Possibility of life endangerment to residents, abutting communities • Major reduction in social, cultural, economic value • Continuous non-compliance with statute • Any major public concern among population in study area

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**

Figure 5.2: Impact Value and Rating Colour Code

Table 5.7: Potential and Associated Impacts of the Proposed Shipyard Project at Brass Island (Pre-Operational Phase)

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
Land acquisition and survey	Exposure of workers to wildlife attack		√	√			√	√	√	0	5	1	1	1	9	2	M
	Legacy issues		√		√		√	√		3	5	5	5	5	23	10	H
	Opportunity for income generation	√			√	√		√		-	-	-	-	-	-	-	P
	Reduction of access to land and its resources		√	√			√	√		3	5	3	3	5	19	6	H
	Third party agitations		√		√		√	√		3	5	5	5	5	23	10	H
	Disruption of fishing activities		√	√		√		√		3	3	3	3	5	17	6	H

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
Mobilization of equipment& personnel to site	Impairment of air quality from emission of air pollutants including greenhouse gases		√	√		√		√		3	1	1	5	5	15	6	H
	Increase in incidence of STI's including HIV		√		√	√	√	√	√	0	3	3	5	5	16	8	H
	Increase in noise and vibration/levels		√	√			√	√		3	1	3	1	3	11	4	M
	Interference with land and water transport		√	√		√		√		5	3	1	1	3	13	2	M
	Pirate attacks and kidnappings		√		√	√	√	√	√	3	5	3	5	5	21	8	H
	Surface water contamination		√	√		√		√		3	1	1	1	1	7	4	L
	Water and land traffic accidents		√	√		√	√	√	√	3	5	3	5	5	21	8	H

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
Site Preparation (Vegetation clearing)	Acceleration of erosion		√	√			√		√	0	1	1	1	1	4	2	L
	Availability of fuelwood	√		√		√		√		-	-	-	-	-	-		P
	Exposure of workers to wildlife attack		√	√		√		√		3	5	1	3	3	15	4	H
	Habitat Fragmentation		√	√		√		√		0	3	3	1	1	8	4	L
	Impairment of air quality by emission of air pollutants including greenhouse gases		√	√		√		√		3	1	3	3	3	13	6	M
	Increase in access for poaching and illegal lumbering		√	√			√		√	0	1	1	3	1	6	4	L
	Increase in social vices		√		√		√	√	√	3	3	3	3	5	17	6	H

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
	Increased opportunity for business and employment	√		√		√		√		-	-	-	-	-	-		P
	Influx of migrant workers and camp-followers pressure on existing infrastructure		√	√		√		√		0	3	3	1	1	8	4	M
	Loss of biodiversity		√	√			√	√		3	1	3	1	1	9	4	M
	Work site accidents		√	√		√	√	√	√	3	5	1	3	3	15	4	H
Dredging of Access Routes	Alteration of local hydrology and drainage patterns		√	√			√	√		3	3	1	3	3	13	4	L
	Alteration of local topography		√	√			√		√	0	1	1	1	1	4	2	L
	Contamination of surface water		√	√		√		√		0	3	3	3	3	12	6	M

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
	Disruption of fishing activities		√	√		√		√		3	3	3	3	5	17	6	H
	Disturbance of spawning ground for fish and shrimps		√	√		√		√		0	1	1	1	1	4	2	L
	Increased in surface water turbidity		√	√		√		√		3	3	3	3	5	17	6	H
	Interference with water transport		√	√		√		√		3	3	3	3	3	15	5	H
	Smothering of flora and fauna by dredge spoils		√	√		√		√		0	3	1	1	1	6	2	L
Movement of construction	Impairment of air quality by emission of air pollutants including greenhouse gases		√	√		√		√		3	1	1	1	1	7	2	L

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
equipment to Site	Increase in noise and vibration levels		√	√		√		√		3	1	1	1	1	7	2	L
	Interference with land and water transport		√	√		√		√		5	3	3	3	3	17	6	H
	Pirate attacks and kidnappings		√		√	√	√		√	0	5	3	5	5	18	8	H
	Surface water contamination		√	√		√		√		3	3	1	1	1	9	2	M
Site Construction Equipment / Facility Set-Up	Impairment of air quality by emission of air pollutants including greenhouse gases		√	√		√		√		3	1	1	1	1	7	2	L
	Noise and vibration nuisance		√	√		√		√		3	1	3	1	3	11	4	M

Table 5.8: Potential and Associated Impacts of the Proposed Shipyard Project at Brass Island (Operational phase)

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
OPERATION AND MAINTENANCE	Increase in concentrations of NO_2 and SO_2 in the air due to incomplete combustion from power generating plant, heavy machinery, and vehicular activities		√	√			√	√		3	3	5	3	5	19	8	H
	Increase in particulate matter concentration in the air due to incomplete combustion from power generating plant, heavy machinery, and vehicular activities		√	√			√	√		3	3	3	3	3	15	6	H
	Increase in salinization (salt water intrusion) of surface and		√	√			√		√	5	3	5	5	5	23	10	H

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
	groundwater as a result of dredging and channelization																
	Changes in species composition of phytoplankton and benthic macroinvertebrates due to salt water intrusion		√	√			√		√	0	1	1	1	1	4	2	L
	Successional changes in the plant cover due to dumping of dredge spoils along the shoreline and slots		√	√			√		√	0	5	5	5	5	20	10	H
	Increased levels of heavy metals in plant tissues.		√	√			√		√	0	3	3	5	3	14	8	H
	Decrease in wildlife as a result of increased hunting and habitat loss		√	√			√	√		3	3	3	5	3	18	8	H

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
	Increased access to forest resources as a result of channelization and pipeline right of way (RoW), leading to deforestation		√	√			√		√	3	3	3	5	3	18	8	H
	Nominal increase in income of members of the community as a result of employment generating activities from the Tank Farm activities	√		√			√	√									P
	Occupational shift from fishing to crop farming and hunting due to availability of fertile lands associated with the dumping of dredge spoils	√		√			√		√								P

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
	Decrease in access to potable water as a result of communal crises		√		√	√		√		0	3	3	5	5	16	8	H
	Increase in numbers and access to health facilities	√		√			√		√								P
	Decrease in child and maternal mortality	√		√		√		√									P
	Increase in non-communicable diseases		√		√		√	√		0	3	3	3	3	12	6	M
	Increase in levels of alcohol and cigarette consumption		√		√		√	√		0	3	5	3	3	14	6	M
	Third party agitation		√	√		√		√		3	1	1	5	5	15	6	H

Table 5.9: Potential and Associated Impacts of the Proposed Shipyard Project at Brass Island Decommissioning/Abandonment Phase)

Project Activity	Description of Impact	Impact Qualification								Impact Quantification							
		Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	Impact
Dismantling of Equipment/facility and site clean-up	Contamination of surface water/ soil and sediment		√	√		√		√		3	3	3	1	1	11	4	L
	Disruption of fishing activities		√	√		√		√		0	1	3	1	1	6	4	L
	Impairment of air quality by emissions of air pollutants including greenhouse gases		√	√		√		√		3	3	1	1	3	11	2	M
	Increase in noise and vibration level		√	√		√		√		3	3	3	5	5	19	8	H
	Increase in surface water turbidity		√	√		√		√		3	3	3	1	1	11	4	L
	Increased opportunity for business and employment.	√		√		√		√		-	-	-	-	-	-	-	P

	Loss of employment/ income		√	√		√		√		3	1	5	5	5	19	10	H
Movement of personnel and equipment out of site	Disruption of fishing activity		√	√		√		√		3	3	3	3	5	17	6	H
	Disturbance of spawning ground for fish and shrimps		√	√		√		√		0	3	3	3	3	12	6	M
	Impairment of air quality by emissions of air pollutants including greenhouse gases		√	√		√		√		3	1	1	3	3	11	4	M
	Increase in incidence of STI's including HIV		√	√		√		√		0	3	3	5	5	16	8	H
	Increased noise and vibration levels		√	√		√		√		3	1	3	1	3	11	4	M
	Interference with water transport		√	√		√		√		3	3	1	1	3	11	2	M
	Pirate attacks and kidnappings		√		√	√	√		√	0	5	3	5	5	18	8	H
	Surface water contamination		√	√		√		√		3	3	1	1	1	9	2	M
	Water and land traffic accidents		√	√		√	√	√	√	3	5	3	5	5	21	8	H

Rehabilitation of site	Employment and income generating opportunities	√		√		√		√		-	-	-	-	-	-	-	P
	Restoration of aesthetic value of the environment	√		√		√		√		-	-	-	-	-	-	-	P

5.3: Impact Discussion from Proposed Project Activities

The likely impacts of the proposed project on the biophysical and socio-cultural components in the study area are as follows:

Land use: Land aquisation for shipyard project area are some of the activities that will impact on land use. These activities involve some level of significant land take, which would have otherwise been used for settlement and agriculture purposes or fishing camp. This impact will be most significant at the acquired area. The impact would be direct, irreversible and of long-term duration.

Vegetation: During vegetation clearing, trees, shrubs and herbs will be permanently removed. Habitats of some species of plant and animal wildlife will also be lost. These impacts will however, be restricted to the acquired area. The impact would be direct and of long-term duration.

Biodiversity: The impact on plant biodiversity will be direct and adverse as species will be lost permanently as a result of site clearing. The impact will also be limited to the acquired area. The impact would be direct and of long-term duration.

Soil: Soil will be exposed to direct sunlight rays due to removal of vegetation. This may elicit erosion, high temperature and changes in soil moistures regimes. This will lead to changes in soil physical and chemical characteristics and subsequent death of soil organisms; promotion of run-off and may impact nearby water body. These impacts will be direct and long term but localized.

Air Quality: Heavy machinery used during pre-operational and operational phase in loading and offloading of equipment, construction materials, and petroleum products may serve as mobile sources of noxious gases that could lead to atmospheric pollution. Some of these air pollutants are carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM), and sulphur dioxide (SO_2). These pollutants, which are air toxics are known to degrade air quality. The particulate matters that would be released into the air could reduce visibility. The particles may settle on the surface of leaves thereby blocking the stomatal pores through which gaseous exchange occur during respiratory/photosynthetic activities. The impact would be direct, reversible and of short-term duration.

Increase noise level/vibration: The noise during the various project phase may come mainly from power generating plants, heavy machinery/vehicular activities, loading and offloading processes. This combined effect will likely lead to annoyance and irritation. Also, the noise and vibration could adversely affect the fishes and other noise sensitive animals. This will have some short-term impact on people living within the project area.

Socio-Economics: The likely effects of the planned project and related activities on the communities and its total environment are enumerated below:

- **Demographic Changes**

The proposed project activities, which will involve movement of job seekers, could lead to a temporary net increase in population and moderately affect the demographic pattern. This impact is expected to be direct and indirect, reversible, of short-term duration and rated low.

- **Increase in social vices**

The job opportunities created by the project activities and the expected monetary gains could encourage some social vices such as drunkenness, violence and drug abuse. It could also attract commercial sex workers (CSW) and teenage girls to the area. The influx of these categories of people to the area has the potential to increase teenage pregnancies. The impact would be direct, irreversible/reversible, long-term, and rated high.

- **Pressure on existing infrastructure**

The relatively large labour force required for project activities could lead to an increase in overall population of the communities. Population increase due to the labour force and migrants could lead to overcrowding and its consequent pressure on existing housing, educational and recreational facilities. The impact would be direct, reversible, short-term, and rated medium.

- **Community Agitation**

Land acquisition, destruction of farmlands and other areas of interest and supply of labour could attract third party agitation involving inter- and intra-communal conflicts and human rights issues. The impact would be direct, reversible, short-term, and rated high.

- **Increase in cost of living/inflation**

The increase in population which is likely to occur as a result of the movement of people to the project site could overstretch available food supplies, healthcare and other social facilities such as housing, water and power supply. The shortage of these goods and services could result in increase in cost of living and attendant inflation. This impact would be direct, reversible, short-term, and rated medium.

- **Emergence of new communicable diseases**

The movement of a large number of people (workers and job) into the hitherto isolated, discrete communities could introduce new diseases in the communities if good hygiene is not ensured. This impact would be direct, reversible, of short-term duration and rated medium.

- **Sexually transmitted infections (STIs), skin and respiratory diseases**

There could be an increase in STIs (including HIV/AIDS), due to anticipated movement of commercial sex workers and increase in sexual risk behaviours. Skin and respiratory diseases could also occur from overcrowding and poor ventilation (poor housing conditions) due to anticipated marginal increase in population. This impact would be direct, irreversible, of long-term duration and rated high.

- **Soft tissue injury and poisoning**

There could be an increase in soft tissue injuries and poisoning from exposure of field workers and community members to poisonous plants and dangerous animals (snakes, bees, etc.) that have been displaced from their habitats. This impact would be direct, reversible, of short-term duration and rated medium.

- **Trauma and deaths**

This could result from work-related accidents involving field workers. This impact would be direct, irreversible, of long-term duration and rated high.

- **Respiratory disorders**

Gaseous discharges and dust particles from vegetation clearing, excavation and heavy machinery/vehicles used during construction, could impair lung functions could lead to or aggravate respiratory disorders such as bronchitis and asthma. This impact would be direct, irreversible, of long-term duration and rated high.

- **Improvement in Local Economy**

Positively, the proposed project is expected to benefit the local economy of the host community employment opportunities, the opportunities for contract works and welfare improvements in the host community. All these are capable of having a beneficial multiplier effect on the local economy.

CHAPTER SIX

MITIGATION MEASURES

6.1 Introduction

The actions and measures that NCDMB intends to take to reduce (or eliminate) negative impact and promote positive Environmental, Social and Health impacts of the existing and proposed Project are presented in this chapter. In these mitigation measures, emphases are placed on those negative impacts rated as significant. These 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. Significant negative impacts are expected to be mitigated through effective implementation of Health, Safety Security Social and Environment (HSSSE) policies put in place during the different phases of the project.

The mitigation measures proposed are in consonance with the following:

- Department of Petroleum Resources guidelines and standards;
- Environmental laws at national, regional and internal levels
- FMENV (formerly FEPA, 1991) regulations on oil and gas exploration and waste management.
- Bayelsa State Ministry of Environment policies;
- Best Available Technology for Sustainable Development;
- Social wellbeing; and
- Concerns of stakeholders.

6.2 Approaches to Impact Mitigation Measures

The selected approaches include enhancement (for the positive impacts), prevention, reduction, avoidance and compensation (for the significant negative impacts). Furthermore, the mitigation measures for each (significant and adverse) impact of the proposed project activities were generally identified, based on the associated effect to the environment and human health and safety. The significance of the impact, probability that the impact would occur and the severities of its consequence (as determined from the risk assessment matrix) were indices used for determining the mitigation requirements as illustrated in Figure 6.1. Subsequently, the specific mitigation measures satisfying the mitigation requirement were established putting into consideration available resources and competencies, on-site conditions, public concerns and technology.

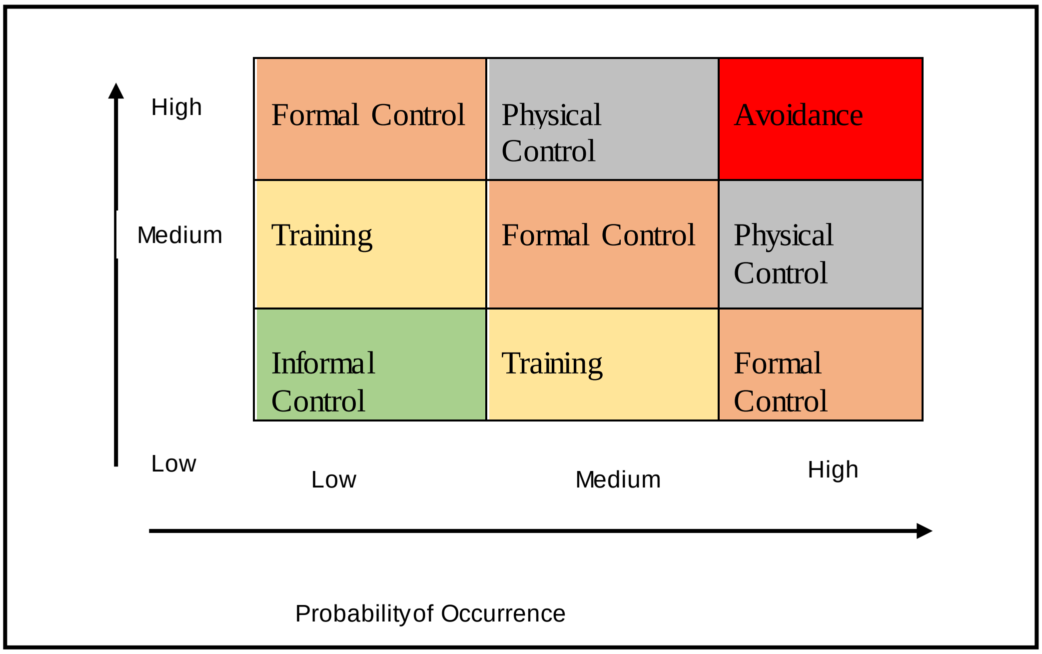

Figure 6.1: Matrix for determination of mitigation measures

The various approaches to impact mitigation considered are presented below.

Enhancement: These are measures proffered to ensure that significant beneficial impacts of the existing facilities and proposed project are encouraged.

Prevention: These are measures proffered to ensure that significant and adverse potential impacts and risks do not occur.

Reduction: These are measures proffered to ensure that the effects or consequences of those significant associated and potential impacts that cannot be prevented are reduced to a level as low as reasonably practicable.

Formal control: This involves the application of documented policy, process or procedure in mitigating the impacts of the project activities.

Informal Control: This involves the application of sound judgment and best practice in mitigating the impacts of project activities.

Physical control: This involves the physical application of physical processes or instruments (such as sign post/caution signs, flags, pegs, etc.), which may not necessarily require any special technology, in order to mitigate the impacts of a project or impacts.

Avoidance: This involves the modification of plans, designs or schedules in order to prevent the occurrence of an impact.

Training: This involves personnel awareness in specific or specialized areas of operation.

6.3 Management Procedure for Mitigation Measures

The management procedures employed for the establishment of mitigation measures for the identified impacts is presented in **Figure 6.2**. Mitigation measures were subsequently proffered for adverse significant potential impacts. These measures (prevention, reduction, control strategies) were developed for the adverse impacts through review of industry experience (past project experience), consultations and expert discussions with multi-disciplinary team of engineers and scientists.

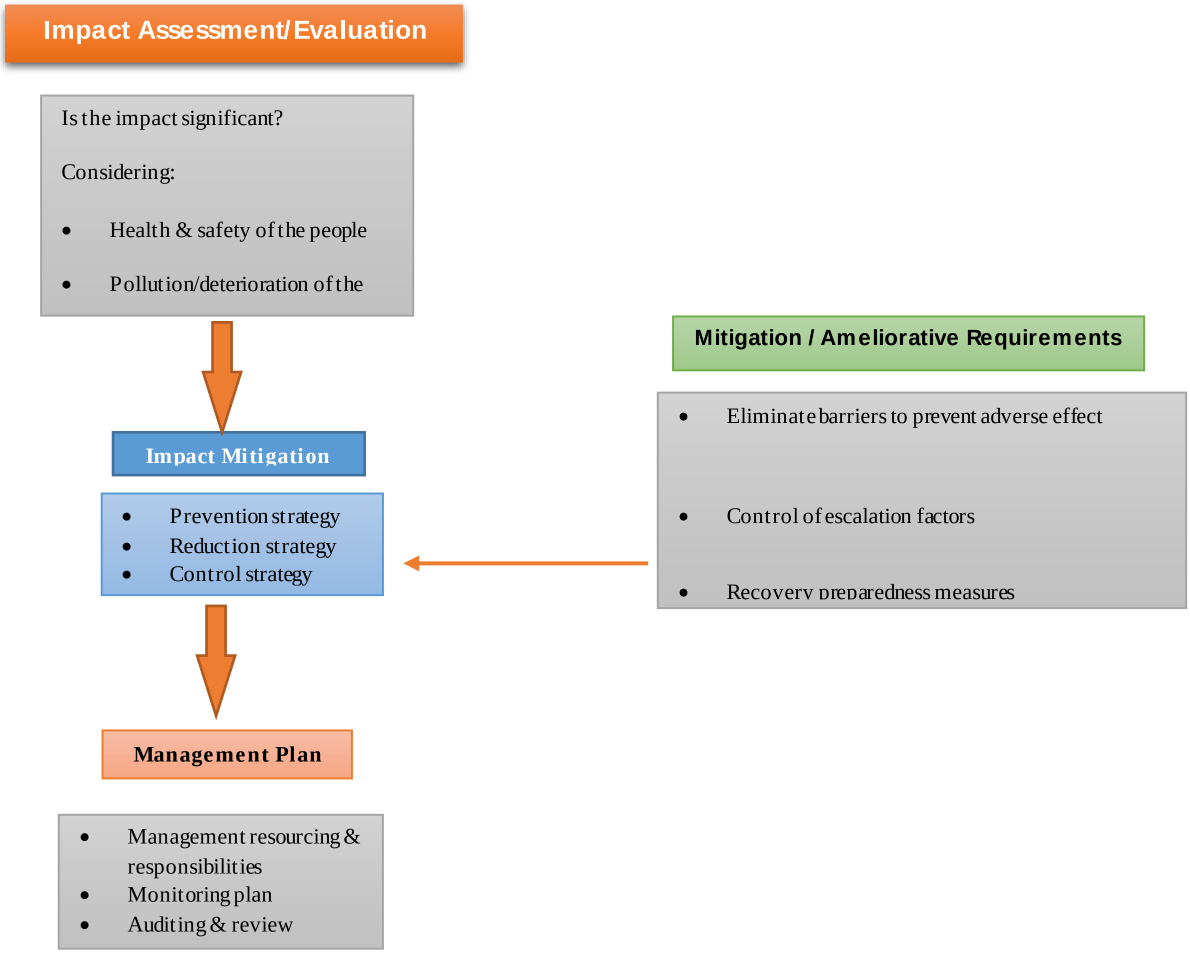

Figure 6.2: Management Procedure for Mitigation Measures

6.4 Proffered Mitigation Measures

This section presents the mitigation measures proffered for the significant (medium and high) adverse impacts of the proposed development projects. These cost-effective measures have been proffered with reference to best industry practice and HSSSE considerations.

Based on the impact assessment matrix in the previous section, the overall ratings of impact significance **High** or **Medium** or **Low** was established for each identified impact. The proffered mitigation measures and the expected final residual impact rating for the identified potential significant impacts are presented in the **Table 6.1.**

Table 6.1: Impact Mitigation Measures for Proposed Shipyard Project at Brass Island (Pre-Operational Phase)

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
Land acquisition and survey	Exposure of workers to wildlife attack	M	• NCDMB shall provide and enforce usage of PPE by field workers. • NCDMB shall provide First aid/Anti venom and insect repellant on site. • NCDMB shall create awareness among site workers and nearby communities on the likelihood of exposure to wildlife	L
	Legacy issues	H	• NCDMB shall identify and settle all outstanding legacy issues within the project area	M
	Reduction of access to the acquired land and its resources	H	• NCDMB shall ensure: • minimization of land take by following existing RoW • thorough assessment of land requirements before additional land take • Proper consultation to be carried out. • appropriate compensation is paid for any additional land take • Provision of alternative means of livelihood e.g. micro credit scheme.	L
	Third party agitation	H	• NCDMB shall ensure: • management of public expectations by engaging NGOs and CBOs • regular/periodic dialogue sessions with active NGOs and CBOs • adoption of appropriate community entry strategies;	M

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
			• Commitment to transparent adherence to G-MoU programmes and projects. • improvement of company-media relation	
Movement of personnel and equipment to site	Disruption of fishing activities	H	NCDMB shall: • Issue timely information to stakeholders particularly fisher folk on the nature and timing of activities that may interfere with fishing operations • Ensure proper signposting and mapping of any sub-sea structures to exclude trawling and avoid damage to fishing gear. • Make provision for fishing gears and fingerlings. • Scheduling of project activities to minimize disruption of fisheries activities.	L
	Impairment of air quality by emissions of air pollutants including greenhouse gases	H	• NCDMB shall use only pre-mobbed vehicles and boats • NCDMB shall ensure that there is controlled use of all vessels and vehicles that their engines are turned off when not in use.	L
	Increase in incidence of STI's including HIV	H	NCDMB shall ensure: • regular medical check-ups are conducted for project work force • condoms are provided for workers • restriction of workers to the camp	M
	Increase in noise and vibration levels	M	NCDMB shall ensure: • regular maintenance of vessels and vehicles	L

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
			• Vessels and vehicles are turned off when not in use • Vessel and vehicles engines are fitted with effective silencers.	
	Interference with land and water transport	M	• NCDMB shall minimize movement at the peak hours of water transportation • NCDMB shall notify the community of the movement on the waterways	L
	Pirate attacks and kidnappings	H	• NCDMB shall make adequate security arrangements. • NCDMB shall ensure that members of staff are sensitized on the peculiarity of the project environment.	M
	Water and land traffic accidents	H	NCDMB shall ensure: • the creation of awareness amongst local communities on the potential of increase in traffic on land and water, and the need for extra precautions through public enlightenment • Compliance with NCDMB journey management policy for land and water transport • Marine boat quarter master training for boat drivers • Vehicles and water borne crafts are pre-mobbed and pre-mobilization/compliance certificate issued. • that all personnel for water related operations shall have certificate of swimming proficiency • the provision of First Aid facilities in all water borne crafts & at sites • the use of PPE at sites • daily pep talks	L

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
			• carry out job hazard analyses	
	Impairment of air quality by emission of air pollutants including greenhouse gases	M	• NCDMB shall use only pre-mobbed equipment. • NCDMB shall ensure that there is controlled use of all equipment and that the engines are turned off when not in use.	L
Site Preparation (vegetation clearing)	Increase in Social vices	H	▪ NCDMB shall ensure: ▪ intensive enlightenment campaign and health education for the abatement of abuse of drugs, alcohol and sexual promiscuity in the community and among workers ▪ that contractor enforces the alcohol and drug policy for its staff ▪ regular medical check-ups are conducted for project work force ▪ condoms are provided for workers	L
	Influx of migrant workers and camp-followers	M	NCDMB shall: • provide accommodation with necessary amenities at the base camp for its workers to reduce pressure on the pr-existing facilities • ensure that there is site and camp base clinics/first aid and personnel • ensure that local workforce be employed from the project communities in line with Nigerian Content Development (NCD) directives	L
	Loss of biodiversity	M	NCDMB shall limit clearing and all earth digging activities to necessary areas • NCDMB shall carry out the re-vegetation of cleared area.	L

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
	Work site accidents	M	NCDMB shall ensure: • the creation of awareness amongst local communities on the potential of increase in traffic on land and water • compliance with NCDMB journey management policy for land and water transport • Marine boat quarter master training for boat drivers • That all water borne crafts are pre-mobbed and pre-mobilization/compliance certificate issued. • that all personnel for water related operations shall have certificate of swimming proficiency • the provision of First Aid facilities in all water borne crafts at sites • compensation for proven project-induced injuries, accidents and fatalities • enforcement of the use of PPE at sites • daily pep talks are conducted • shall carry out job hazard analyses	L
	Contamination of surface water	M	NCDMB shall: • ensure that all water vessels used in the mobilization of equipment and personnel are pre-mobbed according to NCDMB policy • activate the spill emergency response as soon as any spills are noticed	L

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
	Disruption of fishing activities	H	NCDMB shall: • issue timely information to stakeholders particularly fisher folk on the nature and timing of activities that may interfere with fishing operations • ensure proper signposting and mapping of any sub-sea structures to exclude trawling and avoid damage to fishing gear • make provision for fishing gear and fingerlings • schedule project activities to minimize disruption of fishing activities	L
Movement of construction equipment to Site	Interference with land and water transport	H	NCDMB shall • minimize river crossing time • proactively engage the community prior to any blockages of the waterways	L
	Pirate attacks and kidnappings	H	• NCDMB shall make adequate security arrangements • NCDMB shall ensure that members of staff are sensitized on the peculiarity of the project environment.	M
	Surface water Contamination	M	• NCDMB shall treat all effluents to regulatory limits before discharging into the environment.	L
Site Construction	Increase in noise and vibration levels	M	NCDMB shall ensure: • regular maintenance of dredgers • dredgers are turned off when not in use	L

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
Equipment / Facility Set-Up			• dredger engines are fitted with effective silencers	

Table 6.2: Summary of Existing Impacts and Mitigation Measures during operation and Maintenace Phase

Project Activity	Description of Impact	Rating Before Mitigation	Mitigation Measures	Rating After Mitigation
OPERATION AND MAINTENANCE	Increase in concentrations of NO_2 and SO_2 in the air due to incomplete combustion from power generating plant, heavy machinery, and vehicular activities	H	Upgrade to high efficiency flare nozzle	L
	Acidification of soil in Proposed project area	H	Upgrade high efficiency flare nozzle	L
	Increase in salinization (salt water intrusion) of surface and groundwater as a result of dredging and channelization	H	Limit channelization to as low as possible	M
	Successional changes in the plant cover due to dumping of dredge spoils along the shoreline and slots	H	Re-use of dredge spoil for reclamation purposes	

Project Activity	Description of Impact	Rating Before Mitigation	Mitigation Measures	Rating After Mitigation
	Increased levels of heavy metals in plant tissues	H	Immediate clean-up of crude oil spill (likely source of heavy metals) by physical processes Remediation (bioremediation) of contaminated soil	M
	Decrease in wildlife as a result of increased hunting and habitat loss	H	Limit land take to proposed project Increase surveillance to reduce poaching and lumbering activities Create alternative source of income generation	L
	Increased access to forest resources as a result of channelization and pipeline right of way (RoW), leading to deforestation	H	Limit land take to proposed project Increase surveillance to reduce poaching and lumbering activities Create alternative source of income generation	L
	Nominal increase in income of members of the community as a result of employment generating activities from the Tank Farm activities	P	Positive Impact	
	Occupational shift from fishing to crop farming and hunting due to availability of fertile lands associated with the dumping of dredge spoils	P	Positive Impact	
	Decrease in access to potable water as a result of communal crises	H	Proactive engagement with communities Implementation of PGMoU	L
	Increase in numbers and access to health facilities	P	Positive Impact	
	Decrease in child and maternal mortality	P	Positive Impact	

Project Activity	Description of Impact	Rating Before Mitigation	Mitigation Measures	Rating After Mitigation
	Increase in non-communicable diseases	M	Step-up health education and sensitisation activities prior commencing construction activities and support condom donation initiatives. NCDMB shall organise awareness session on communicable diseases related to water and sexual behaviour. Step-up HIV/AIDS awareness programmes. Augment the supply and issue of condoms to workers on the project and possibly extend to commercial sex workers in the vicinity if identified.	L
	Increase in levels of alcohol and cigarette consumption	M	Step-up health education and sensitisation activities prior commencing construction activities	L
	Third party agitation	H	NCDMB shall: ensure effective consultation with stakeholders Ensure commitment and transparent adherence to PGMoU programmes and projects. Identify and address legacy issues	M

Table 6.3: Impact Mitigation Measures for Proposed Shipyard Project at Brass Island (Decommissioning/Abandonment Phase)

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
Dismantling of Equipment/facility and site clean-up	Impairment of air quality by emission of air pollutants including greenhouse gases	M	• NCDMB shall use only pre-mobbed equipment • NCDMB shall ensure that there is controlled use of all equipment and that equipment engines are turned off when not in use.	L
	Increase in noise and vibration levels	M	NCDMB shall ensure: • regular maintenance of vessels and vehicles • Vessels and vehicles are turned off when not in use • combustion engines are fitted with effective silencers • regular maintenance of machines and equipment • machinery covers and panels are closed and well fitted at all times • equipment with low noise level is used • NCDMB shall provide appropriate PPE	L
	Loss of income/employment	H	• NCDMB shall support entrepreneurial skill development and opportunities for community members to cushion the effect of reduction in economic/income generating activities.	L
Movement of personnel and equipment from site	Interference with land and water transport	M	• NCDMB shall minimize movement during peak hours • NCDMB shall notify the community of the movement on the waterways	L
	Pirate attacks and kidnappings	H	• NCDMB shall make adequate security arrangements	M

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation
			• NCDMB shall ensure that members of staff are sensitized on the peculiarity of the project environment	
	Surface water contamination	L	• NCDMB shall use only pre-mobbed boats • NCDMB shall ensure that there is controlled use of all vessels and that their engines are turned off when not in use.	L
	Land and water traffic accidents	H	NCDMB shall ensure: • the creation of awareness amongst local communities on the potential of increase in traffic on land and water and the need for extra precautions through public enlightenment • compliance with NCDMB journey management policy for land and water transport • Marine boat quarter master training for boat drivers • water borne crafts are pre-mobbed and pre-mobilization/compliance certificate issued • that all personnel for water related operations shall have certificate of swimming proficiency • the provision of First Aid facilities in all water borne crafts & at sites • the use of PPE at sites • daily pep talk • carry out job hazard analyses	L

CHAPTER SEVEN

ENVIRONMENTAL MANAGEMENT PLAN

7.1 General

Environmental management is concerned with a planned and integrated programme aimed at ensuring that adverse impacts of a proposed project are contained and brought to acceptable minimum levels, while the positive impacts are enhanced to optimize the benefits. Environmental management provides confidence on the part of project planners that a reliable scheme has been put in place to deal with any contingency that may arise during all phases of the project development, from from feasibility study to abandonment.

In keeping with NCDMB policy on the environment, considerations of environmental implications of this project began from feasibility study, conceptual design and will continue throughout the project life cycle. This Environmental Impact Assessment report, is part of the environmental management programme, and is intended to provide an environmental input into the planning and execution of the project.

Environmental management will be carried out in accordance with the provisions of ISO 14001 sections 4.3.2 to 4.3.4, DPR and FMEnv.

7.1 Objectives of EMP

The EMP has the following specific objectives:

- The adoption of a systematic procedure to ensure that the Project activities are executed in compliance with all applicable legislations and NCDMB HSSSE (and other) policies and guidelines;
- Demonstration that mitigation measures for all impacts and effects have been put in place and that the measures shall be adhered to throughout the project development life cycle;
- Demonstration that effective recovery measures for managing ‘lost control’ situations throughout the Project life cycle;
- Establishment of a structure that will ensure compliance by NCDMB and its Contractors with the EMP.

In order to accomplish the above targets, the EMP has considered each environmental, social and health impact from the point of view of the Valued Ecosystem and Social Component(s) (VEC/VSC) to be monitored, as well as the parameters for their monitoring (**Table 7.1- 7.3**). It also specifies the responsible party/parties for each action.

In developing this EMP, NCDMB recognizes that sound environmental management of the proposed project can only be guaranteed through the integration of the provisions of the plan as an integral part of business quality management. To this end NCDMB shall put in place measures to enforce compliance by the project team on a daily basis throughout the duration of the project.

Table 7.1: Environmental Management Plan (EMP) of Brass Island Proposed Shipyard Project (Pre-Operational Phase)

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
Land acquisition and survey	Exposure of workers to wildlife attack	M	• NCDMB shall provide and enforce usage of PPE by field workers. • NCDMB shall provide First aid/Anti venom and insect repellant on site. • NCDMB shall create awareness among site workers and nearby communities on the likelihood of exposure to wildlife	L	• Evidence of provision of PPE/first aid facility • Awareness campaign records	Daily	NCDMB /FMEnv/DPR
	Legacy issues	H	▪ NCDMB shall identify and settle all outstanding legacy issues within the project area	M	• Records of legacy issues identified/resolved	Quarterly	NCDMB /FMEnv/DPR
	Reduction of access to land and its resources	H	NCDMB shall ensure: ▪ thorough assessment of land requirements before additional land take; ▪ appropriate compensation is paid for any additional land take; ▪ provision of encouragement for the adoption of alternative means of livelihood e.g. a micro credit scheme	M	• Site inspection report • Map of Project Site • Post-construction dimensions • Evidence of disbursement of compensation	Once before, during and after construction	NCDMB /FMEnv/DPR

					• Evidence of provision of alternative means of livelihood.		
	Third party agitations	H	NCDMB shall ensure: ▪ management of public expectations by engaging the communities ▪ regular/periodic dialogue sessions with the communities ▪ adoption of appropriate community entry strategies; ▪ commitment to transparent adherence to GMoU programmes and projects ▪ improvement of company-media relations ▪ it obtains the Freedom to Operate (FTO)	M	• Records of public engagement sessions. • Records of minutes of meetings. • Records of Third Party Grievances. • Records of GMoU implementation status.	Quarterly	NCDMB /FMEnv/DPR
	Disruption of fishing activities	H	NCDMB shall: • issue timely information to stakeholders particularly fisher folk on the nature and timing of activities that may interfere with fishery operations • ensure proper signposting and mapping of any sub-sea structures to exclude trawling and avoid damage to fishing gear • make provision for fishing gear and fingerlings	L	• Evidence of stakeholder engagement • Evidence of project activity schedules • Site inspection report	Every six months	NCDMB /FMEnv/DPR

			• scheduling of project activities to minimize disruption of fishery activities				
	Impairment of air quality by emissions of air pollutants including greenhouse gases	H	• NCDMB shall use only pre-mobbed boats • NCDMB shall ensure that there is controlled use of all vessels and that their engines are turned off when not in use.	L	• Monitoring records of the criteria air pollutants • Vehicle/boat maintenance records • Vehicle/boat pre-mob records	Monthly	NCDMB /FMEnv/DPR
	Increase in incidence of STI's including HIV	H	• NCDMB shall ensure: • regular medical check-ups are conducted for the project work force • condoms are provided for workers • restriction of workers into the camp	M	• Enlightenment campaign records • Evidence of issuance of condoms • Records of regular medical records	Monthly	NCDMB /FMEnv/DPR
	Increase in noise and vibration levels	M	NCDMB shall ensure: • regular maintenance of heavy machinery in use • Heavy machinery are turned off when not in use • Heavy machinery and vehicles engines are fitted with effective silencers	L	• Noise monitoring records • Maintenance records • Vehicle/boat pre-mob records	Weekly	NCDMB /FMEnv/DPR

Movement of personnel and equipment to site	Interference with land and water transport	M	• NCDMB shall minimize movement at the peak hours of land and water transportation • NCDMB shall notify the community of the movement on the waterways	L			
	Pirate attacks and kidnappings	H	• NCDMB shall make adequate security arrangements. • NCDMB shall ensure that members of staff are sensitized on the peculiarity of the project environment.	M	• State/ company Security/Incident Reports • Evidence of approved security plans • Evidence of staff sensitization sessions	Daily	NCDMB /FMEnv/DPR
	Water traffic accidents	H	NCDMB shall ensure: • the creation of awareness amongst local communities on the potential of increase in traffic on water and the need for extra precautions through public enlightenment • compliance with NCDMB journey management policy for water transport • Marine boat quarter master training for boat drivers • water borne crafts are pre-mobbed and pre-mobilization/compliance certificate issued	L	• Records of awareness sessions • Journey management records; IVMS records • NCDMB drivers permit/ DEP certificates • First aid box and contents	Weekly	NCDMB /FMEnv/DPR

			• that all personnel for water related operations shall have certificate of swimming proficiency • the provision of First Aid facilities in all water borne crafts & at sites • the use of PPE at sites • daily pep talk • carry out job hazard analysis		• Maritime accident records • Minutes of pep talk meetings • Site inspection report • Incident reports (injuries / fatalities).		
Site Preparation (vegetation clearing)	Exposure of workers to wildlife attack	M	NCDMB shall provide and enforce usage of PPE by field workers. NCDMB shall provide First aid/Anti venom and insect repellant on site. NCDMB shall create awareness among site workers and nearby communities on the likelihood of exposure to wildlife	L	• Evidence of provision of PPE/first aid facility • Awareness campaign records	Daily	NCDMB /FMEnv/DPR
	Impairment of air quality by emissions of air pollutants including GHG	M	NCDMB shall use only pre-mobbed equipment. NCDMB shall ensure that there is controlled use of all equipment and that the engines are turned off when not in use.	L	• Monitoring records of the criteria air pollutants • Boat maintenance records • Boat pre-mob records	Monthly	NCDMB /FMEnv/DPR

	Increase in Social vices	H	NCDMB shall ensure: ▪ intensive enlightenment campaign and health education for the abatement of abuse of drugs, alcohol and sexual promiscuity in the community and among workers ▪ that contractors enforce the alcohol and drug policy for their staff ▪ regular medical check-ups are conducted for project work force condoms are provided for workers	L	• Enlightenment campaign records. • Records of alcohol/drug policy • Evidence of issuance of condoms. • Records of regular medical records.	Monthly	NCDMB /FMEnv/DPR
	Influx of migrant workers and camp-followers pressure on existing infrastructure	M	NCDMB shall: • provide accommodation with necessary amenities at the base camp for its workers to reduce pressure on the pre-existing facilities • ensure that there is site and camp base clinics/first aid and personnel • ensure that local workforce is employed from the project communities in line with Nigerian Content Development (NCD) directives	L	• Evidence of workforce • accommodation • Employment records	Quarterly	NCDMB /FMEnv/DPR
	Loss of biodiversity	M	NCDMB shall limit clearing and all earth digging activities to necessary areas • NCDMB shall carry out the re-vegetation of cleared area.	L	• Record of vegetation clearing • Record of re-vegetation	Weekly	NCDMB /FMEnv/DPR

	Work site accidents	M	NCDMB shall ensure: • the creation of awareness amongst local communities on the potential of increase in traffic on land and water • compliance with NCDMB journey management policy for land and water transport • Marine boat quarter master training for boat drivers • that all water borne crafts are pre-mobbed and pre-mobilization/compliance certificate issued • that all personnel for water related operations shall have certificate of swimming proficiency • the provision of First Aid facilities in all water borne crafts at sites • compensation for proven project-induced injuries, accidents and fatalities • enforcement of the use of PPE at sites • that daily pep talks are conducted • shall carry out job hazard analysis	L	• Records of issuance of PPE • Records of tool box meeting • Evidence of approved JHA • HSSSE incident records • Driver certifications • Safety training records Pre-mob records • Swimming certificates • Evidence of first aid boxes on all water borne crafts at sites	Weekly	NCDMB /FMEnv/DPR

	Disruption of fishing activities	H	NCDMB shall: • issue timely information to stakeholders particularly fisher folk on the nature and timing of activities that may interfere with fishery operations • ensure proper signposting and mapping of any sub-sea structures to exclude trawling and avoid damage to fishing gear • make provision for fishing gear and fingerlings • scheduling of project activities to minimize disruption of fishing activities	L	• Evidence of stakeholder engagement • Evidence of project activity schedules • Site inspection report	Every six months	NCDMB /FMEnv/DPR
Movement of construction equipment to Site	Interference with land and water transport	H	NCDMB shall: • minimize river crossing time • proactively engage the community prior to any blockages of the waterways • minimize movement during peak community movement time	L	• Record of water crossing time • Evidence of community engagement • Record of travel time	Daily	NCDMB /FMEnv/DPR
	Pirate attacks and kidnappings	H	• NCDMB shall make adequate security arrangements. • NCDMB shall ensure that members of staff are sensitized on the peculiarity of the project environment	M	• State/ company Security/Incident Reports • Evidence of approved security plans	Daily	NCDMB /FMEnv/DPR

					• Evidence of staff sensitization sessions		
	Surface water Contamination	M	• NCDMB shall treat all effluents to regulatory limits before discharging into the environment.	L	• Effluent monitoring records	Monthly	NCDMB /FMEnv/DPR
Site Construction Equipment / Facility Set-Up	Noise and vibration nuisance	M	NCDMB shall ensure: • regular maintenance of cranes and other heavy equipment used for the rig set-up • cranes and other heavy equipment used for the rig set-up are turned off when not in use • that the engine cranes and other heavy equipment used for the rig set-up are fitted with effective silencers	L	• Equipment maintenance records • Equipment pre-mob records	Weekly	NCDMB /FMEnv/DPR

Table 7.2: Environmental Management Plan (EMP) of Brass Island Proposed Shipyard Project (Operational Phases)

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
OPERATION AND MAINTENANCE	Increase in concentrations of NO_2 and SO_2 in the air due to incomplete combustion from power generating plant, heavy machinery, and vehicular activities	H	Upgrade to high efficiency flare nozzle	L	• Monitoring records of the criteria air pollutants • boat maintenance records • Vehicle/boat pre-mob records	Monthly	NCDMB /FMEnv/DPR
	Acidification of soil in Proposed project area	H	Upgrade high efficiency flare nozzle	L	• Monitoring records of the air pollutants • Boat maintenance records • Boat pre-mob records	Monthly	NCDMB /FMEnv/DPR
	Increase salinization (salt water intrusion) of surface and groundwater as a result of dredging and channelization	H	Limit channelization to as low as possible	M	• Enlightenment campaign records • Records of alcohol/drug policy	Monthly	NCDMB / FMEnv/ DPR
	Successional changes in the plant cover due	H	Re-use of dredge spoil for reclamation purposes		• Noise monitoring records	Weekly	NCDMB/FMEnv/DPR

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
	to dumping of dredge spoils along the shoreline and slots				• Maintenance records • Rig pre-mob records		
	Increased levels of heavy metals in plant tissues	H	Immediate clean-up of crude oil spill (likely source of heavy metals) by physical processes Remediation (bioremediation) of contaminated soil	M	• Approved Mud density records • Sub-surface pressure monitoring records	Daily	NCDMB /FMEnv/DPR
	Decrease in wildlife as a result of increased hunting and habitat loss	H	Limit land take Increase surveillance to reduce poaching and lumbering activities Create alternative source of income generation	L	• Waste management records	Daily	NCDMB /FMEnv/DPR
	Increased access to forest resources as a result of channelization and pipeline right of way (RoW), leading to deforestation	H	Limit land take to proposed site Increase surveillance to reduce poaching and lumbering activities Create alternative source of income generation	L	•	Weekly	NCDMB /FMEnv/DPR
	Nominal increase in income of members of the community as a result of employment	P	Positive Impact		• Job generation	Monthly	NCDMB /FMEnv/DPR

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
	generating activities from the Tank Farm activities				• Evidence of community engagement		
	Decrease in access to potable water as a result of communal crises	H	Proactive engagement with communities Implementation of PGMoU	L	• Evidence of community involvement		NCDMB /FMEnv/DPR
	Increase in numbers and access to health facilities	P	Positive Impact		• Records of Health facilities	Weekly	NCDMB /FMEnv/DPR
	Decrease in child and maternal mortality	P	Positive Impact		• Enlightenment campaign records. • Records of regular medical records.	Weekly	NCDMB /FMEnv/DPR
	Increase in non-communicable diseases	M	Step-up health education and sensitisation activities prior commencing construction activities and support condom donation initiatives. NCDMB shall organise awareness session on communicable diseases related to water and sexual behaviour.	L	• Enlightenment campaign records. • Records of regular medical records. • Evidence of issuance of condoms.	Weekly	NCDMB /FMEnv/DPR

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
			Step-up HIV/AIDS awareness programmes. Augment the supply and issue of condoms to workers on the project and possibly extend to commercial sex workers in the vicinity if identified.				
	Increase in levels of alcohol and cigarette consumption	M	Step-up health education and sensitisation activities prior commencing construction activities	L	• Records of alcohol/drug policy	Monthly	NCDMB /FMEnv/DPR
	Third party agitation	H	NCDMB shall: ensure effective consultation with stakeholders Ensure commitment and transparent adherence to PGMoU programmes and projects. Identify and address legacy issues	M	• Records of Third Party Grievances • Records of work stoppages at locations. • Records of G-MoU programmes implementation Minutes of meetings		NCDMB /FMEnv/DPR

Table 7.3: Environmental Management Plan (EMP) of Brass Island Proposed Project (Decommissioning/Abandonment Phase)

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
	Impairment of air quality by emissions of air pollutants including greenhouse gases	M	• NCDMB shall use only pre-mobbed equipment • NCDMB shall ensure that there is controlled use of all equipment and that equipment engines are turned off when not in use.	L	• Monitoring records of the criteria air pollutants • boat maintenance records • Vehicle/boat pre-mob records	Monthly	NCDMB /FMEnv/DPR
	Increase in noise and vibration levels	M	• NCDMB shall use only pre-mobbed equipment • NCDMB shall ensure that there is controlled use of all equipment and that equipment engines are turned off when not in use.	L	• Pre-mob records		
	Loss of income/employment	H	• NCDMB shall support entrepreneurial skill development and opportunities for community members to cushion the effect of reduction in	L	• Disengagement records		

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
			economic/income generating activities.				
Movement of personnel and equipment out of site	Interference with land and water transport	M	• NCDMB shall minimize movement at the peak hours of land and water transportation • NCDMB shall notify the community of the movement on the waterways	L	• Journey management record • Evidence of communication to community		
	Pirate attacks and kidnappings	H	• NCDMB shall make adequate security arrangements. • NCDMB shall ensure that members of staff are sensitized on the peculiarity of the project environment.	M	• State/ company Security/Incident Reports • Evidence of approved security plans • Evidence of staff sensitization sessions	Daily	NCDMB /FMEnv/DPR
	Land and water traffic accidents	H	NCDMB shall ensure: • the creation of awareness amongst local communities on the potential of increase in traffic on land and water and the need for extra precautions through public enlightenment	L	• Records of awareness sessions • Journey management records; IVMS records • NCDMB drivers permit/ DEP certificates	Weekly	NCDMB /FMEnv/DPR

Project Activity	Description of Impact	Rating before mitigation	Mitigation measures	Rating after mitigation	Parameters to be Monitored	Monitoring Frequency	Responsible/ Action Party
			• compliance with NCDMB journey management policy for land and water transport • Marine boat quarter master training for boat drivers • water borne crafts are pre-mobbed and pre-mobilization/compliance certificate issued • that all personnel for water related operations shall have certificate of swimming proficiency • the provision of First Aid facilities in all water borne crafts & at sites • the use of PPE at sites • daily pep talk • carry out job hazard analysis		• First aid box and contents • Maritime accident records • Minutes of pep talk meetings • Site inspection report • Incident reports (injuries / fatalities). • Swimming certificate		

CHAPTER EIGHT

8.0 CONCLUSIONS

NCDMB has carried out the Environmental Impact Assessment (EIA) of the proposed Tank Farm Project at Okpoama, Brass Local Government Area, Bayelsa State. This was carried out in order to predict the impact of the proposed project activities on the various biophysical and socio-economic components of the project's environment and host communities and also to proffer adequate mitigation and enhancement measures for adverse and beneficial impacts respectively.

Extensive literature review and field sampling and measurements/testing were used to carefully establish and assess the status and sensitivities of the various ecological and socio-economic components of the project area.

Data acquisition from terrestrial, aquatic and socio-economic environment as well as the assessment of the sensitivities of the various biophysical and socio-economic parameters involved a multi-disciplinary approach. Consultations with the host communities, local government authority and officers as well as regulatory authorities are ongoing and shall continue throughout the project life cycle.

The impacts assessment of the proposed development project shows that it will impact positively on the national economy as well as the revenue base of the project proponent and contribute to socio-economic development within the host communities and result in economic empowerment for the indigenes and residents as well as other professionals. These would be by way of contrinuting to national GDPA as well as creating employment opportunities for skilled and semi-skilled labour, awardment of contracts for supplies and services among others.

The adverse impact of the proposed projects on water, land use, vegetation, wildlife, air, socio-economics and health are localized and can be controlled and ameliorated if the recommended measures are strictly followed.

Considering the workable proffered mitigation measures for adverse impact, the benefits of the proposed project outweigh the negative impacts. In view of the foregoing, NCDMB requests that the project be approved for implementation.

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APPENDICES

Appendix A: Field Data Gathering Methodologies

Climate and Meteorology Studies

Prevailing climatic conditions was sourced from existing literature to compliment field data which included the following parameters: Rainfall, Ambient temperature, Wind direction and Speed, Solar radiation, Atmospheric Pressure, Relative Humidity, and Cloud Cover. Climatic field data were obtained using Oregon Weather equipment (see Plate A1).

Air Quality Studies: Ten (10) air quality sampling points were established within the proposed project area while two (2) air quality sampling points were established outside the proposed project area as control. The GT-331 VI.04 A Met One Instrument, Inc. Aerosol Mass Monitor Model GT-331 was used in determination of suspended particulate matter (SPM). Levels of VOC were measured using a MultiRAE PLUS (PGM- 50), a programmable Multi Gas monitor used to monitor organic vapours. H_2S, CO_2, CO, SO_2, and NO_x were measured using an Industrial Scientific Corporation ITX Multi-Gas monitor. Measurements were done by holding the sensor to a height of about two meters in the direction of the prevailing wind and readings recorded at stability (See Plate A2).

Plate A2: Air quality monitoring

Noise (sound) Level

Noise levels were measured at eleven (11) sampling stations using a Cole-Parmer Extech Model 407736 Sound Level Meter. The instrument is hand-held and digital. The equipment measures noise via a microphone probe that generates signals approximately proportional to located sound waves. Measurements were done by directing the probe towards the direction of the prevailing wind and readings recorded at stability. The sound level measured was viewed from the reading on the meter LCD.

Geology and Hydrogeology

Four (4) borings were done in the project area and two (2) boring was drilled as control using a 5 – inch hand auger to drill each of the boreholes to 12.0 meters. Samples recovered from the auger were used for lithologic log description, while the borings were installed with piezometers for water level measurements and determination of groundwater flow direction.

The static water level (SWL) in the boreholes was measured with a water level indicator model ELWA-PL 15. The flow direction was determined using the Three-Point-Problem. Three boreholes points on the Island were visually assessed and their geographic positions were recorded using the hand held Global Positioning System (GPS).With aid of a water level indicator, the depth to water table (D_{wl}) at each borehole (BH) was recorded. The surface elevation and depth to water table were used in calculating the hydraulic head at the respective borehole points using the equation below.

$$H=E - D_{wl} \qquad \text{(Equation 1)}$$

Where H = Hydraulic head

E = Surface Elevation

Dtw =Depth from top of borehole casing to water level

Hg = Height of casing above the ground

D_{wl}= Depth to water table=Dtw-Hg

A direction perpendicular to the equi-potential line (line joining points of equal Hydraulic head) is known as the groundwater flow direction

Groundwater samples were collected from the boreholes drilled within the project area and at the control points. The water samples were collected in clean new plastic bottles for physico-chemical analysis. Samples for microbiological analysis were collected in Mc Cartney bottles while samples for heavy metals were collected in glass bottles acidified with concentrated sulphuric acid. After each collection, the container lid was replaced immediately to avoid oxygen contamination. The samples were stored in an ice-packed cooler and transported to the Tudaka Analytical Nigeria Limited for analysis.

Plate A2: Borehole monitoring well

Soil Studies

Field protocols were carried out to meet the needs of the baseline study and for information that were adequate and suitable for achieving valuable results.

The major considerations for soil sample distribution and sampling pattern were:

- Adequate coverage of representative and / or probable soil morphological types within the study area;
- Capturing the possible effects of existing land use patterns on soil environment and;

- Establishing the potential impact(s) of the proposed project on the soil environment, including the land use patterns in the area.

From the field sampling plan, which was based on the project location map and reconnaissance visit to the area, a total of ten (10) soil sample stations (both top and bottom) were established, spreading within and around the project location while two (2) sampling points were established out the proposed project area as control.

At each of the sample stations, at least, three random spots were augered at two depth levels (Top Sample (T), 0 – 15cm; Bottom Sample (B), 15- 30 cm), with the aid of 9cm diameter dutch auger at about the centre of the sample station (Anon., 1986). At each of the sample stations (SS) and soil depth levels (T or B), the soil samples were bulked together to give a composite sample. The soil samples from different sample stations and soil depth levels were, on each occasion, collected in polythene bags and labeled accordingly (**see Plate A3**). For example, soil sample from first sample station (i.e. SS1) and first depth level (0-15cm) (i.e.; T) was coded as SS1T. Samples for physico-chemical analysis shall be collected into coded plastic bags, while glass containers with screw cap, lined with Teflon and sterile plastic bottles were used to collect samples for microbiology analysis respectively.

Plate A3: Soil sampling during the Field Work

Water and Sediment Sampling

Five (5) surface water samples were collected from the water bodies within the project area while two (2) surface water sample were collected outside the project area as control sample. Sediment samples were obtained from all water sampling points. Samples were collected using a two-litre plastic container that have been pre-treated by washing in dilute hydrochloric acid and rinsed with distilled water. At the sample collection point the plastic container was rinsed with the relevant sample to be collected. Water samples were taken by submerging the container below the surface and allowing it to overflow.

The samples for heavy metals studies were preserved with nitric acid. Samples for hydrocarbon analysis were collected in glass bottles. Samples for microbiological analysis was collected in sterile glass bottles and stored in ice-packed containers and in the refrigerator. Duplicate Winkler bottles were also used to sample in the same manner for the determination of the chemical oxygen demand (COD).

Plate A4: Aquatic Studies (in-situ measurement)

Hydrobiology Studies

Phytoplankton

Samples were collected in sub-surface area of the water of about 20-50cm deep. Fifty (50) litres of surface water samples were collected along the Brass River from five (5) sampling points which representing the upstream, midstream and downstream; and from two control points. The samples were subjected to filtration process using a plankton net of 30–50µm mesh size. The residue of the plankton sample was collected and preserved in 50ml and treated with 4% formalin before being stored in a chest cooler.

In the laboratory, the collected samples were further concentrated by sedimentation over a period of 48 hours. Further concentration was done using a centrifuge at a speed of 100 rev/mm. 1ml of the sample was taken to a Sedgwick rafter cell for a preliminary scan using a microscope. Thereafter, another 1ml of the concentrated sample was diluted with 9m1 of distilled water. The sample was thoroughly mixed and five subsamples of 1ml each were placed in a Sedgwick rafter cell and viewed under a binocular microscope (x200) and identified to the least possible limit.

Zooplankton

Plankton net of mesh size of 30–50µm was towed for a minimum of 5 minutes at a speed of approximately 5km/h for each sampling point. The zooplankton on the sides of the net was washed down into the collection bottle. Samples were then put in a 250 ml labelled container and preserved with 4% formaldehyde prior to microscopic analysis (Yigit, 2006; Kolo *et al.*, 2010). APHA (1998) was used as a guide to aid plankton species identification.

Benthic macrofauna

Samples were collected using an Eckman's grab. The composite sample was washed using a sieve with 0.5mm mesh. The retained residue was moved into a well labelled container using forceps and preserved with 4% formaldehyde. A total of five (5) samples were collected which was evenly distributed along the upstream, midstream, and downstream sections within the Brass River. In the laboratory, the samples were washed using 0.125 mm mesh sieves, then sorted and identified under a stereomicroscope which adapts Asibor (2015). The identification of the benthic macro-invertebrates collected in the study were based mainly on the keys provided by Brown (1980), Madsen (1985), Schneider (1990), Bouchard (2004) and Verma (2006).

Plate A5: Hydrobiology Sampling

Vegetation

Assessment of the vegetation around the proposed project was carried out in six (6) transects, established around the site. The transects were also orientated such as to increase the probability of including most plants occurring in the area. To facilitate vegetation monitoring in future and assess magnitude of change due to the project, efforts were made to locate transects in sites where the impacts are likely to be felt and close to the soil sampling stations.

All plant species found along each transect were as much as possible identified, counted and listed in the field. Taxonomically difficult forms (which could not be immediately identified with certainty) were collected, properly labelled, pressed and subsequently transported to the Herbarium of Dept of University of Port Harcourt, Port Harcourt for further keying and identification. Throughout the period plant identification followed the well-illustrated keys of Hutchinson and Dalziel (1968), Stanfield (1970), Lowe and Stanfield (1974) and Akobundu and Agyakwa (1998). From the counts taken for each species the percentage frequencies of occurrence were estimated right on the field. Thereafter, the plants were scrupulously screened for any pathological conditions arising from insect pests, fungal/bacterial infections and unfavourable environmental variables (Hill and Waller, 1982).

Wildlife

Investigations into the wildlife species resident around the proposed project area were conducted using a combination of conventional methods (Moshby 1964, Dasmann 1963, Sutherland 2000 and Davies 2002). The combinations of techniques are considered quite appropriate, since the major objective was to provide a comprehensive checklist of wild animals' characteristic by the area and highlight their conservation status. The methods fall into two major categories. (a) Indirect method namely: (i) Interview technique which involves interacting with indigenous hunters and peasant farmers who are conversant with the terrain, wildlife habitat and diversity. (ii) Use of evidence of animal presence or occupation. (b) Direct Method which involves direct search of animals in the area under question to physically spot them, either by probing their habitat, hide outs, and/or using binoculars to locate and identify them.

Ten (10) indigenous hunters of proposed area within the age brackets of 25 – 60, who were willing to be interviewed, were engaged as escorts during the survey. In the process, the interviewed hunters were urged to describe the kinds and behaviour of animals resident in their bushes, indicate bushes of high faunal density, the most abundant and rarest species, and the date of last kill or sighting, to give insight to their conservation status. Interviewing of locals as adopted in this study, has been acknowledged by several wildlife ecologists as veritable source of information for the wildlife of any place. The hunters were also urged to present for examinations, remains of animals caught around proposed Project area such as skeleton (skull), hairs, feathers, scales, hoofs, harns, etc as well as provide date and year of capture, where possible. Colour plants of West African forest animals were also made available to the hunters for confirmation.

The interview session was followed by direct field search for wildlife around the vegetation transects and neighbourhood. The search was conducted radially (in the northern, southern, eastern and western directions) to increase the chances of encountering most wildlife and wildlife habitats or their evidence of presence. In recognition of the fact that animals' peak of activities varies, the search for wildlife was carried out in the mornings (6.00am – 9.00am), midday (11.00 – 2.00pm) and sunset (3.00 – 6.00 pm) daily, in the process probing humid habitats such as vegetation undergrowths, burrows, rock crevices, with a prop and collecting / recording animal remains (droppings, carcass foot prints, sloughed skin, etc) found. Throughout the period, a walking rate of about 1km/hr was maintained, and stopovers were made at intervals of 3-5 minutes to listen to animal calls or vocalization. Tree crowns and branches were also screened using high power binoculars (Fujiyama model) to detect arboreal forms such as birds, squirrels, pangolins, primates, snakes, etc.

All captured, dislodged or sighted animals were identified to possible taxonomic levels, using the field guides or keys of Happold (1987) and Kingdom (1997) for mammals; Elgood et al (1994), Elgood (1960) for birds; Branch (1988) for reptiles; Webbs et al (1981) and Schiotz (1969) for Amphibians.

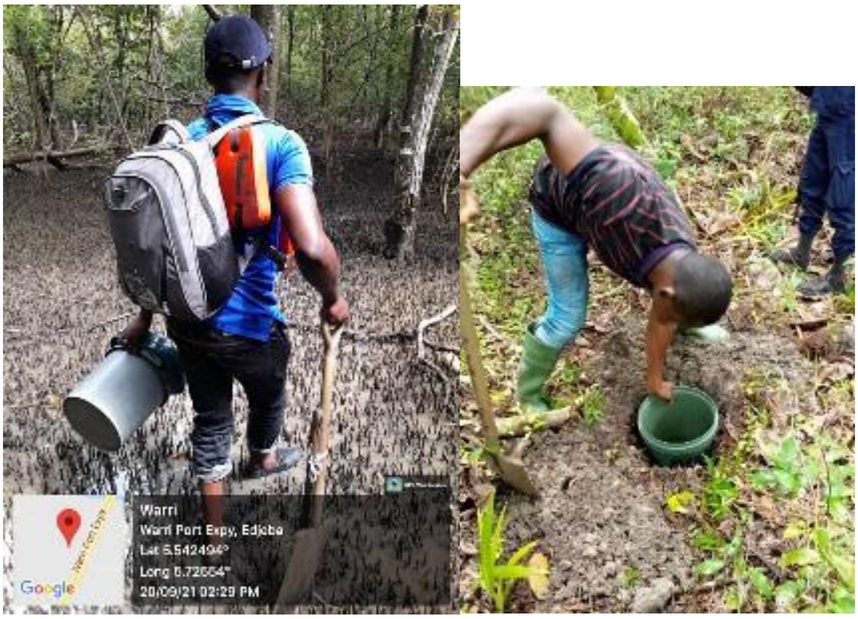

Plate A6: Wildlife Sampling Expert with the bucket fall trap

Appendix B: Laboratory Analytical Methods and Procedure

Water samples

Dissolved Oxygen, Conductivity, Salinity, pH, Total Dissolved Solids and Temperature of Water samples. These parameters were measured in-situ using the Multi-Parameter Water Quality Monitor (model 6000 UPG). The samples were collected in 50ml glass beakers and the equipment used to take the measurements directly.

Conductivity, Salinity, pH, and Temperature of Sediment Samples

20.0g of fresh sediment samples was weighed into a 50ml beaker and 20ml of distilled water added to the beaker. The mixture was thoroughly stirred and allowed to stand for 30 minutes and the Multi-Parameter Water Quality Monitor was then used to measure the above parameters directly.

Total Suspended Solids (TSS)

TSS was determined using the APHA 209D – Total Non-filtrate Residual Dried at 103-105^{o}C. The oven dried (at 105^{o}C for 1 hour) filter paper was used instead of glass fibre filter. The dried filter paper was weighed and then used to filter 100ml of the sample. The filter paper and the residue were then dried in the oven at 105^{o}C for 1 hour and allowed to cool. The paper and residue was then weighed and recorded. The drying cycle was repeated until a constant weight was attained i.e. until weight loss between successive weighing was less than 0.5mg. TSS was calculated as follows:

$$\text{TSS (mg/l)} = \frac{(A - B) \times 1000}{\text{Samples Volume (ml)}}$$

Where: A = Weight of filter paper

B = Constant weight of filter paper and filtrate

Particle Size Distribution

PSD was determined using the hydrometer method followed by sieving recommended for sediment samples containing more than 35% fine particles i.e. clays and slits. The test method is based on the BS 1377 (part 2; 1990), which is in accordance with the Dutch RAW and the American ASTM D422.

Total Microbial Count (water and Sediment samples)

Indirect cell count on sediment and water samples was carried out to determine the total viable microbial populations. The test methods used are the ASTM D5465 – 93: Determining Microbial Colony Counts from Water Analysed by Plating Methods, and APHA 907: Standard Plate Count. Total microbial colonies were calculated as follows:

Plate Count (cfu/ml) = (No. of Colonies on Plate) x (Dilution factor).

Phosphate – Phosphorus in Sediment

Phosphate – Phosphorus in sediment samples was determined using UV/Visible spectrophotometer. The Stannous Chloride Reduction Method, based on the method described in the Chemical Analyses of Ecology Matter (2nded), was applied. Phosphate – phosphorus content of sediment samples was calculated as follows.

$$\text{Phosphate – phosphorus (mg/kg)} = \frac{\text{C (mg/l) x Solution Volume (1) x 1000}}{\text{Aliquot x Sample weight (g)}}$$

Where C = mg phosphate obtained from calibration graph using the UV/Visible spectrometer and Vision software version 3

Aliquot = Volume (ml) of extract used for analyses / Volume (ml) of extractant used for the extraction

1000 = Conversion factor to kg

Phosphate – Phosphorus (P) in Water

The Phosphate-phosphorus content of water samples was determined by spectrophotometery using the UV-4 Unicam Spectrometer. Phosphate (mg/l) content was calculated as follows.

$$P\ (mg/l) = \frac{mg\ P\ (\text{in approximately } 104ml \text{ final volume}) \times 1000}{\text{Sample Volume (ml)}}$$

Sulphate – Sulphur (S) in Sediment

The test method used to determine sulphates-sulphur in sediment samples is the Turbidimeteric method, which is based on the method described in the Chemical Analysis of Ecological matter (2^{nd}ed.). The sulphates=sulphur (S) content was calculated as follows.

$$S\ (mg/kg) = \frac{C\ (mg) \times \text{Solution Volume (ml)} \times 1000}{\text{Aliquot (ml)} \times \text{Sample weight (g)}}$$

Where C = mg of S obtained from calibration graph

1000 = Conversion factor to kg

$$\text{Aliquot} = \frac{\text{Volume of extract used for analysis}}{\text{Volume of extractant solution used.}}$$

Sulphate-Sulphur (S) in Water Samples

The APHA 426C method (Turbidimeteric Method) described in the Standard Method for Examination of Water and Wastewater was used to determine the sulphates-sulphur content of water samples. S was calculated as follows:

$$S\ (mg/l) = \frac{Mg/l\ S \times 1000ml}{Sample\ Volume\ (ml)}$$

Nitrate-Nitrogen (N) in Sediment Samples

The Brucine Colorimetric method described in GEMS/Water Operation Guide, 1987 was used to determine the nitrate-nitrogen content of sediment samples. N was calculated as follows.

$$N\ (mg/kg) = \frac{mg\ (N)\ from\ calibration\ graph \times Volume\ of\ extractant \times 100}{Volume\ of\ extract\ (ml) \times Sample\ weight\ (g)}$$

Where the 1000 is the conversion factor to kg.

Nitrate-Nitrogen (N) in Water Samples

The test method used to determine the nitrate-nitrogen content water samples is the Brucine Colorimetric method described in the GEMS/Water Operational Guide, 1987. Nitrate-nitrogen content of water samples was calculated as follows.

N (mg/l) = (mg/l N from calibration graph) – (mg N from reagent blank)

Oil and grease in Sediment Samples

Oil and grease (OG) content of sediment samples was determined using Infra-Red (IR) Spectrophotometery following the ASTM D3921 method. The only deviation from the ASTM method was that 50mm cells were used for concentrations, which ranged from 0.5mg/l to 30mg/l.

The method used for extraction is the Dutch Standard Method VPRC 88 – 19 and the OG contents were calculated as follows.

$$\text{OG (mg/g)} = \frac{\text{Instrument reading (mg/l)} \times \text{Volume of extract (l)}}{\text{Weight of Sample (g)}}$$

Total Petroleum Hydrocarbon (TPH) in Sediment/soil Samples

Infrared Spectrophotometery, as described in ASTM D3921, was used to determine the TPH in sediment samples. The only deviation from the ASTM method was that 50mm cells were used for concentrations, which ranged between 0.5mg/l and 30mg/l. The method of extraction was the Dutch Standard Method VPRC 88 – 19 and TPH contents were calculated as follows.

$$\text{Actual TPH (mg/l)} = \frac{\text{Instrument reading (mg/l)} \times \text{Volume of extract (l)}}{\text{Weight of Sample (g)}}$$

Exchangeable Cations in Sediment/soil

Exchangeable cations in sediments samples were determined using ATI Unicam Atomic Absorption Spectrophotometer (AAS), Model 939. The samples were prepared according to the procedure described in the ASTM D5198. Actual determination of exchangeable Cation contents was carried out in accordance with the procedures described below:

Na, Mg and K:APHA3111B (18^{th} edition) / ASTM D3561

Al: APHA3111D (18^{th} edition)

Ca: FPLL in-house method (FPLL Quality Systems Manual, 1999)

Cation contents were calculated as follows:

$$\text{Cation concentration (mg/kg)} = \frac{(A - B)\,C}{D}$$

Where: A = Concentration of metal in sample (mg/l) as determined by AAS

B = Concentration of the metal found in blank (mg/l)

C = Volume of extract (ml)

D = Weight of dry sample (g)

Exchangeable Cations in Water

Exchangeable cations in water samples were determined using ATI Unicam Atomic Absorption Spectrophotometer (AAS), Model 939. ASS measurements were carried out in accordance with the procedures described below.

Na, Mg and K:APHA3111B (18^{th} edition) / ASTM D3561

Al: APHA3111D (18^{th} edition)

Ca: FPLL in-house method (FPLL Quality Systems Manual, 1999)

Cation contents were calculated as follows:

$$\text{Cation concentrations (mg/l)} = \frac{C \times Y}{X}$$

Where C = Concentration of Cation determined from calibration curve (mg/l)

Y = Final volume made-up (ml)

X = Volume of sample (ml)

Heavy Metals in Sediment/soil samples

Heavy Metals in Sediment samples were determined using ATI Unicam Atomic Absorption Spectrophotometer, Model 939. The sample digestion/preparation procedure followed is described in ASTM D5198/D3974. ASS measurement of heavy metal content sediment samples was done following the procedures indicated below:

Cd, Zn, Mn, Cu, Fe, Ni, and Pb: APHA 3111B (18^{th} edition)

Ba: ASTM D3651

V: APHA 303C (15^{th} edition)

Cr: FPLL in-house method (FPLL Quality Systems Manual, 1999)

Results were calculated as follows:

$$\text{Metal concentration in sample (mg/kg)} = \frac{(A - B) \times C}{D}$$

Where: A = Concentration of metal in sample (mg/l) as determined by AAS

B = Concentration of the metal found in blank (mg/l)

C = Volume of extract (ml)

D = Weight of dry sample (g)

Heavy Metals in Water Samples

Heavy metal content of water samples was determined using ATI Unicam Atomic

Absorption Spectrophotometer, Model 939. AAS measurement of heavy metal content sediment samples was done following procedures indicated below:

Cd, Zn, Mn, Cu, Fe, Ni, and Pb:	APHA 3111B (18th edition)
Ba:	ASTM D3651
V:	APHA 303C (15th edition)

Cr: FPLL in-house method (FPLL Quality Systems Manual, 1999)

Results were calculated as follows:

$$\text{Metal concentration (mg/l)} = \frac{C \times Y}{X}$$

Where: C = Concentration of metal from calibration curve (mg/l)

Y = Final volume made-up (ml)

X = Sample volume (ml)

Recommended Preservatives and Sample Storage Water, Soil and Sediment

S/N	PARAMETER	Vol REQD (ML)	CONTAINER	PRESERVATION	MAXIMUM HOLDING PERIOD
1.	pH	35	P,G	Cool, 4 ^{0}C Det. On site	6 hours
2.	Electrical Conductivity	100	P,G	Cool, 4 ^{0}C	24 hours
3.	Colour	50	P,G	Cool, 4 ^{0}C	24 hours
4.	Odour	200	G, only	Cool, 4 ^{0}C	24 hours
5.	Turbidity	100	P,G	Cool, 4 ^{0}C	7 days
6.	Total Dissolved Solids (TDS)	50	-	Filter on site cool 4 ^{0}C	24 hours
7.	Total Suspended Solid	50	-	Filter on site	6 months
8.	Total Hardness	100	P,G	Cool, 4 ^{0}CHNO_3 To pH <2	7 days
9.	Acidity and alkalinity	100	P,G	Cool, 4 ^{0}C	24 hours
10.	Salinity as Cl	50	P,G	None required	7 days
11.	Chemical Oxygen Demand	50	P,G	2ml H_2SO_4 per litre	7 days
12.	Biochemical Oxygen Demand (BOD)	1,000	P,G	Refrigeration at 4 ^{0}C	6 hours
13.	Surfactants as (MBAS)	250	P,G	Cool, 4 ^{0}C	24 hours
14.	Dissolved Oxygen (DO)	300	G, only	Det. On site	No holding
15.	Ammonia	400	P,G	Cool, 4 ^{0}C H_2SO_4 or pH<2	24 hours
16.	Oil and Grease	1,000	G, only	Cool, 4 ^{0}C H_2SO_4 or pH<2	24 hours
17.	Nitrate NO_3	100	P,G	Cool, 4 ^{0}C H_2SO_4 or pH<2	24 hours
18.	Sulphate (SO_2/4)	50	P,G	Cool, 4 ^{0}C	7 days
19.	Carbonate (CO_3) free CO_2& HCO_3	-	P,G	-	-
20.	Cyanides	500	P,G	Cool, 4 ^{0}C NaOH to pH 12	24 hours
21.	Phosphorous	-	-	40mg, $HgCL_2$ per litre 4^{0}C	7 days
22.	Phenolics	500	G, only	Cool, 4 ^{0}C H_2SO_4 or pH< 41.g $CuSO_4$/ litre	24 hours
23.	Chromium	100	P,G	HNO_3 to pH<2	-
24.	Arsenic	100	P,G	HNO_3 to pH<2	6 months
25.	Cadmium	100	P,G	HNO_3 to pH<2	6 months
26.	Cobalt	-	P,G	HNO_3 to pH<2	6 months
27.	Copper	-	P,G	HNO_3 to pH<2	6 months

28.	Iron	-	P,G	HNO_3 to pH<2	6 months
29.	Mercury	100	P,G	Filter, HNO_3 to pH<2	38 days (GLASS)
30	Lead	100	P,G	HNO_3 to pH<2	6 months
31	Nickel	100	P,G	HNO_3 to pH<2	6 months
32	Zinc	100	P,G	HNO_3 to pH<2	6 months
33	Vanadium	100	P,G	HNO_3 to pH<2	6 months
34	Calcium	100	P,G	None required	6 months
35	Magnesium	100	P,G		6 months

- P = Plastic, G = Glass

Source: Environmental Guidelines and Standards for Petroleum Industry in Nigeria (EGASPIN). Draft revised Edition Issued by the Department of Petroleum Resources, Lagos 1991 and revised in 2002.

Note: Table covers water, soil and sediment media.

Appendix C: Results

Appendix C1: Results for Ambient Air Concentrations and Meteorology of The Okpoama Tank Farm Project Area

Sample Points	Easting	Northing	CO_2 (ppm)	CO (ppm)	NO_2 (ppm)	SO_2 (ppm)	CH_4 (ppm)	VOC (ppm)	$PM_{2.5}$ (µg/m^3)	PM_{10} ($\mu g/m^3$)	Temp. (°C)	Noise (dB)	Wind/S (m/s)	Wind Direction
Point 1	006º 15' 27.44"E	4º 20' 42.85"N	37.4	2.2	0.016	0.011	0.03	4.5	25.5	31.3	33.1	50.2	1.2	NE
Point 2	006º 15' 27.12"E	4º 20' 38.33"N	26.2	1.5	0.012	0.01	0.01	2.5	27.1	31.7	33.0	45.4	0.6	NE
Point 3	006º 15' 30.05"E	4º 20' 38.82"N	26	0.2	<0.01	<0.01	0.03	0.95	23.6	34.2	34.8	49.5	0.4	SW
Point 4	006º 15' 28.42"E	4º 20' 39.52"N	18.6	<0.01	<0.01	<0.01	<0.01	<0.01	24.7	31.1	36.1	47.1	2.1	SW
Point 5	006º 15' 29.16"E	4º 20' 40.09"N	18.9	<0.01	<0.01	<0.01	<0.01	<0.01	25.6	35.7	36.2	49.8	1.7	SE
Point 6	006º 15' 27.09"E	4º 20' 40.40"N	12	<0.01	<0.01	<0.01	<0.01	<0.01	21.3	26.6	36.5	50.3	1.2	NE
Point 7	006º 15' 29.10"E	4º 20' 39.70"N	8.4	<0.01	<0.01	<0.01	0.02	0.7	17.8	19.2	35.6	51.2	0.2	SW

Point 8	006º 15' 35.04"E	4º 20' 38.01"N	13.7	<0.01	<0.01	<0.01	0.03	0.95	24.2	22.6	35.8	57.8	1.0	SE
Point 9	006º 15' 28.06"E	4º 20' 37.41"N	14.9	<0.01	<0.01	<0.01	<0.01	1.3	21.4	19.8	34.6	53.4	0.6	SE
Point 10	006º 15' 30.59"E	4º 20' 45.30"N	8.8	0.45	0.012	0.017	0.03	2.1	22.5	25.0	34.0	55.8	0.4	NW
Controls														
Control Pt.1	006º 17' 23.89"E	4º 18' 25.89"N	4.2	<0.01	<0.01	<0.01	<0.01	<0.01	26.7	31.2	32.9	47.4	1.7	NE
Control Pt. 2	006º 17' 20.65"E	4º 18' 35.59"N	6.4	<0.01	<0.01	<0.01	<0.01	<0.01	21.6	53.4	32.8	48.7	1.4	SW

Appendix C2: Wet Season Mean Ambient Air Concentrations and Climate Data in the Proposed Brass Island Shipyard Project Site

S/N	Parameters	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Control 1	Control 2
		4º 20' 18.4"N 006º 15' 18.7"E	4º 20' 14.1"N 006º 15' 27.1"E	4º 20' 6.0"N 006º 15' 27.5"E	4º 20' 6.2"N 006º 15' 15.6"E	4º 20' 4.2"N 006º 15' 18.7"E	4º 19' 48.3"N 006º 15' 3.0"E	4º 19' 49.3"N 006º 15' 3.1"E	4º 19' 44.6"N 006º 15' 8.9"E	4º 19' 42.6"N 006º 15' 13.2"E	4º 19' 54.3"N 006º 15' 1.3"E	4º 18' 44.6"N 006º 17' 41.7"E	4º 20' 44.6"N 006º 15' 28.9"E
1	SOx	<0.01	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.02	0.03	<0.01
2	CO	0.2	0.3	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	0.3	0.9	0.2
3	NH_3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	H_2S	0.1	0.11	0.14	<0.1	0.14	0.18	0.11	<0.1	0.1	0.09	0.1	0.11
5	VOC	1.8	1.4	1.6	0.9	1.9	0.8	0.4	0.2	0.6	1.7	2.4	1.7
6	NOx	0.024	0.034	0.039	0.02	0.039	0.033	0.019	0.011	0.009	0.02	0.007	0.009
7	CO_2	121.2	113.4	129.1	132.2	142	138.3	128.4	122.3	128	124	148.4	136.9
8	SPM	14	11	15	13	17	15	10	11	13	13	20	17
9	SO_2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
10	Noise level	39.4	42.6	47.6	44.5	48.3	46.2	46.5	46	43.1	48.9	52.9	43.4
11	Wind speed	1.8	1.4	1.4	0.9	1.9	0.7	0.4	0.7	1.1	2.4	1.8	0.4
12	R/Humidity	76.5	78.4	78.9	82	88.9	88.6	87.8	89.9	90.2	88.7	92.7	90.1

Appendix C3: Results for Surface Water Analysis of The Okpoama Tank Farm Project Site (Dry Season)

Parameters	**Unit**	4° 20' 15.118"N 6° 15' 40.118"E	4° 20' 38.52"N 6° 15' 36.427"E	4° 20' 45.686"N 6° 15' 31.668"E	4° 20' 45.299"N 6° 15' 25.948"E	4° 20' 40.851"N 6° 15' 21.785"E	4° 20' 22.568"N 6° 15' 15.816"E	4° 18' 25.897"N 6° 17' 23.892"E	4° 18' 39.599"N 6° 17' 25.82''E
Parameters	**Unit**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW C1**	**SW C2**
Physiochemical:									
pH		7.12	6.98	7.03	6.94	6.96	7.01	7.06	6.91
Electrical Conductivity	µS/cm	30440	30940	30740	34280	31800	34360	30160	30840
TDS	mg/L	16742	17017	16907	18857	17490	18898	16588	16962
Temperature	^{0}C	27.1	26.8	27.3	27.4	27.5	27.4	27.7	27.2
Colour	Pt-Co	6.0	8.0	7.0	5.0	8.0	7.0	4.0	2.0
Salinity	ppt	18.03	18.48	18.15	20.43	18.76	20.48	17.63	18.26
TSS	mg/L	32.94	11.07	20.98	51.49	31.32	41.26	5.22	1.17
Nitrite	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DO	mg/L	7.1	6.9	7.2	7.3	7.0	7.2	7.0	7.1
Turbidity	NTU	81.50	85.80	85.00	339.00	216.00	130.00	11.10	4.84
BOD_5	mg/L	2.25	2.40	1.95	2.10	2.10	1.80	2.25	1.95
COD	mg/L	80.00	83.20	91.73	85.33	97.07	102.40	92.80	76.80
THC	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonium	mg/L	0.35	0.31	0.48	0.45	0.41	0.54	0.30	0.26
Chloride	mg/L	8398	8598	9498	9898	8648	9298	8548	8448
Nitrate	mg/L	2.97	3.88	2.34	1.25	3.15	1.52	1.23	1.74
Phosphate	mg/L	<0.01	0.07	<0.01	0.01	0.01	0.01	<0.01	<0.01
Sulphate	mg/L	1413	1465	1446	1584	1492	1637	1621	1431
Total hardness	mg/L as $CaCO_3$	1060	890	1034	1340	853	990	852	900
Carbonates	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Alkalinity	mg/L as $CaCO_3$	96.0	106.0	78.0	80.0	82.0	108.0	74.0	78.0
Oil & Grease	mg/L	<0.01	0.34	<0.01	<0.01	0.82	0.34	<0.01	<0.01

Heavy Metals:									
Cu	mg/L	0.03	0.03	0.05	0.03	0.05	0.04	0.02	0.01
Fe	mg/L	1.87	2.00	0.74	2.08	1.99	2.16	2.17	1.80
Ni	mg/L	1.51	1.66	1.49	1.77	1.65	1.73	1.56	1.49
Zn	mg/L	0.12	0.18	0.13	0.16	0.14	0.17	0.19	0.17
Pb	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	mg/L	0.16	0.08	0.13	0.12	0.10	0.10	0.15	0.21
Cd	mg/L	0.13	0.12	0.13	0.14	0.13	0.14	0.13	0.13
Cr	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ba	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
V	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cations:									
Na	mg/L	6419	6274	6152	7533	6005	6120	5428	5605
K	mg/L	13.49	19.65	17.82	15.90	14.97	11.39	9.82	10.29
Ca	mg/L	280.05	321.95	312.20	326.83	317.01	429.27	336.59	322.21
Mg	mg/L	93.35	115.24	98.07	108.94	110.96	102.76	112.20	106.10
Organics:									
TPH	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PAH	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Microbiological Test:									
THB (x 10^4)	cfu/ml	2.3	4.8	2.6	3.2	1.4	2.7	1.6	2.0
THF (x 10^2)	cfu/ml	3.1	2.2	1.7	3.5	1.9	1.0	2.6	1.8
HUB(x 10^2)	cfu/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
HUF(x 10^2)	cfu/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SRB(x 10^2)	cfu/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Feacal Coliform	MPN/100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Appendix C4: Results for Surface Water Analysis for the Proposed Brass Island Shipyard Project Area (Wet Season)

Parameters	Units	SW 1	SW 2	SW 3	SW 4	SW 5	SW-C1	SW-C2
		4.331333 N 6.249778 E	4.333417 N 6.249861 E	4.335806 N 6.2515 E	4.33725 N 6.252417 E	4.339194 N 6.253556 E	4.32952 N 6.24817 E	4.34648 N 6.25721 E
pH		8.6	8.1	7.9	7.6	7.7	7.5	7.4
Temp	°C	28.1	27.3	27.4	27.6	27.3	26.9	27.6
TDS	mg/l	5900	4500	3600	3300	3200	5200	2400
EC	µS/cm	11700	9000	7200	6700	6500	10500	4800
Turbidity	N.T.U	147.2	174.9	176.7	191.7	135.1	227.7	52.61
DO	mg/l	4.70	4.20	3.60	4.50	6.50	4.10	5.60
TSS	mg/l	160.00	190.00	200.00	210.00	150.00	240.00	70.00
Total Alkalinity	mg/l	0.46	0.40	0.36	0.32	0.34	0.30	0.28
Salinity	mg/l	5154.08	3483.62	2017.39	1644.88	1530.74	3890.85	478.67
BOD	mg/l	2.40	1.90	1.60	2.10	2.00	1.60	1.40
COD	mg/l	5.85	4.52	3.81	5.00	4.76	3.90	3.33
Chloride	mg/l	2862.40	1934.70	1120.40	913.52	850.13	2160.86	265.84
SO_4	mg/l	271.99	207.45	165.96	152.13	147.52	239.72	110.64
NO_3	mg/l	28.91	22.05	17.64	16.17	15.68	25.48	11.76
NO_2	mg/l	0.54	0.41	0.33	0.30	0.29	0.48	0.22
PO_4	mg/l	0.43	0.38	0.35	0.31	0.29	0.41	0.16
NH_4	mg/l	0.16	0.11	0.09	0.08	0.06	0.13	0.05
Na	mg/l	349.60	309.57	215.40	149.85	105.98	175.09	65.06
K	mg/l	65.328	53.924	46.930	37.442	32.112	51.360	28.25
Ca	mg/l	92.084	71.397	40.581	21.673	19.654	91.856	31.414
Mg	mg/l	171.084	140.820	93.891	70.981	55.932	102.089	52.797
O&G	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
THC	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAH	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mn	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ni	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
V	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ba	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	mg/l	0.025	0.019	0.045	0.033	0.027	0.018	0.022
TCC	MPN/100ml	240.00	270.00	310.00	190.00	210.00	240.00	170.00
FCC	MPN/100ml	60.00	70.00	90.00	40.00	40.00	70.00	200.00
THB x 10^8	cfu/ml	5.34	5.71	7.83	5.11	5.23	5.58	4.96

THF x 10^3	cfu/ml	1.9	2.4	3.5	1.5	1.7	2.2	1.4
HUB x 10^5	cfu/ml	2.41	2.64	3.27	2.18	2.32	2.87	2.13
HUF x 10^2	cfu/ml	0.7	1.2	2.1	ND	0.5	0.9	ND

Appendix C5: Results for Sediment Analysis of the Okpoama Tank Farm Project Site (Dry Season)

Parameters	**Unit**	4° 20'15.118" N 6° 15' 40.188"E	4° 20'38.52" N 6° 15' 36.427"E	4° 20'45.686" N 6° 15' 31.668"E	4° 20'45.299" N 6° 15' 25.948"E	4° 20'40.851" N 6° 15' 21.785"E	4° 20'22.568" N 6° 15' 15.816"E	4° 18'25.897" N 6° 17' 23.892"E	4° 18'25.892" N 6° 17' 25.82''E
Parameters	**Unit**	**SED 1**	**SED 2**	**SED 3**	**SED 4**	**SED 5**	**SED 6**	**SED C1**	**SED C2**
pH (1:1, sediment to water)		6.14	5.76	6.24	6.29	5.68	6.20	5.74	5.83
Electrical Conductivity	µs/cm	55590	53880	49920	58200	56700	58800	50700	50400
Temperature	°C	26.3	26.5	26.6	27.0	27.0	26.9	25.4	26.7
Redox Potential	mV	+94	+76	+34	+112	+17	+89	+146	+135
Nitrite	mg/kg	0.217	0.193	0.227	0.165	0.198	0.169	0.208	0.160
Chloride	mg/kg	6736	7445	4963	5849	4786	6558	4609	5495
Salinity	mg/kg	12169	13450	8966	10568	8646	11848	8326	9927
Carbonate	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sulphate	mg/kg	6681	7506	4858	5527	4714	6367	4602	5485
TOC	%	1.68	1.64	1.83	1.56	0.31	1.48	3.28	2.94
Phosphate	mg/kg	3.37	1.43	1.40	2.02	2.53	1.50	2.37	1.43
Oil and Grease	mg/kg	9.16	12.59	10.02	15.45	9.13	10.24	7.16	6.31
Ammonium	mg/kg	1.04	0.91	1.09	0.78	0.94	0.81	0.99	0.74
Nitrate	mg/kg	2.91	2.54	3.05	2.17	2.64	2.27	2.77	2.08
Total Nitrogen	%	0.45	0.41	0.30	0.35	0.34	0.36	0.35	0.28
THC	mg/kg	4.35	3.65	2.96	2.26	2.96	2.26	1.91	0.87
CEC	meq/100g	7.93	6.57	8.54	6.27	6.02	7.10	5.70	5.07
Colour, Munsell	Munsell Colou	Dull Yellowish	Grayish	Dark reddis	Dark Grayish	Olive Black	Dark Grayish	Grayish	Dull yellow

	r Description	Brown	Brown	h Gray	Yellow		Yellow	Brown	Orange
	Munsell Colour Code	Hue 10YR 5/3	Hue 5R 5/2	Hue 7.5R 4/1	Hue 25YR 5/2	Hue 5Y 3/2	Hue 25YR 5/2	Hue 5R 5/2	Hue 10YR 6/4
Particle Size Distribution:									
Sand	%	2	3	2	3	4	1	1	4
Silt	%	62	62	81	69	80	88	77	81
Clay	%	36	35	19	28	16	11	22	15
Texture, Triangle	%	silty clay loam	silty clay loam	silty loam	silty loam	silty loam	silty	silty loam	silty loam
Heavy Metals:									
Cu	mg/kg	8.10	8.50	5.43	5.51	5.42	4.86	1.41	1.32
Fe	mg/kg	651.25	511.25	373.75	297.50	551.25	768.75	506.25	479.15
Ni	mg/kg	4.05	3.30	5.10	1.85	6.15	5.70	4.60	1.30
Zn	mg/kg	39.42	39.75	30.73	31.97	32.31	31.33	2.63	2.56
Pb	mg/kg	1.55	2.10	1.10	1.20	0.65	0.65	0.20	0.10
Mn	mg/kg	6.05	5.05	4.80	6.70	6.70	7.10	5.80	4.40
Cd	mg/kg	0.55	0.41	0.11	0.17	0.10	0.19	0.10	0.08
Cr	mg/kg	2.90	1.35	1.80	0.95	0.95	0.50	0.25	0.10
Ba	mg/kg	2.70	2.00	3.50	3.05	1.65	0.80	0.10	0.20
V	mg/kg	0.15	<0.001	0.22	0.40	0.30	0.10	<0.001	<0.001
Hg	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cations:									
Na	meq/100g	1.61	1.60	0.71	0.71	1.60	0.62	0.65	0.66
K	meq/100g	0.12	0.09	0.17	0.07	0.09	0.13	0.08	0.07
Ca	meq/100g	2.71	2.91	2.34	2.87	2.44	2.57	2.40	1.97
Mg	meq/100g	3.49	1.96	5.32	2.62	1.89	3.78	2.57	2.37
Organics:									
TPH	mg/kg	2.847	2.016	1.748	2.001	1.911	1.868	1.275	0.553
PAH	mg/kg	0.060	0.020	<0.001	<0.001	0.080	<0.001	<0.001	<0.001

BTEX	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Microbiological Test:									
Parameters	**Unit**	**SED 1**	**SED 2**	**SED 3**	**SED 4**	**SED 5**	**SED 6**	**SED C1**	**SED C2**
THB (x 10^4)	cfu/g	3.4	2.9	4.3	2.0	3.2	2.5	2.2	3.1
THF (x 10^2)	cfu/g	2.7	3.8	2.2	3.1	4.8	3.6	2.6	4.0
HUB (x 10^2)	cfu/g	Nil	0.5	Nil	Nil	0.8	Nil	Nil	Nil
HUF (x 10^2)	cfu/g	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SRB (x 10^2)	cfu/g	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Feacal Coliform	MPN/ 100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Appendix C6: Bottom Sediment Analysis Results for the Proposed Brass Island Shipyard Project Area (Wet Season)

Parameters	Units	Sed 1	Sed 2	Sed 3	Sed 4	Sed 5	Sed C1	Sed C2
		4.331333 N 6.249778 E	4.333417 N 6.249861 E	4.335806 N 6.2515 E	4.33725 N 6.252417 E	4.339194 N 6.253556 E	4.32952 N 6.24817 E	4.34648 N 6.25721 E
pH		7.4	7.1	6.7	6.3	6.9	7.2	6.5
EC	mS	7.31	11.12	6.82	4.68	7.54	6.86	9.42
Textural class		Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay
Colour		Dark	Dark	Dark	Dark	Dark	Dark	Dark
Cl	mg/kg	912.36	1392.81	852.47	585.15	930.24	957.38	912.73
SO_4	mg/kg	233.965	357.037	218.581	149.994	238.452	245.503	233.965
NO_3	mg/kg	99.645	152.061	93.093	63.882	101.556	104.559	99.645
PO_4	mg/kg	38.69	59.042	36.146	24.804	39.432	40.598	38.69
NH_4	mg/kg	7.65	11.68	7.15	4.91	7.80	8.03	9.88
Na	mg/kg	436.972	666.831	408.239	280.141	445.352	458.521	563.873
K	mg/kg	176.198	268.883	164.613	112.960	179.577	184.888	227.368
Ca	mg/kg	654.23	542.12	325.65	296.12	285.76	243.92	231.23
Mg	mg/kg	29810	27682	30114	27123	25123	19283	17123
O&G	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THC	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TPH	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PAH	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Cd	mg/kg	0.045	0.053	0.074	0.123	0.082	0.041	0.055
Cr	mg/kg	0.286	0.321	0.197	0.637	0.241	0.197	0.209
Ni	mg/kg	0.172	0.116	0.096	0.053	0.102	0.079	0.053
V	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ba	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	mg/kg	6723.23	7603.76	5628.72	6192.23	5823.12	4623.89	4123.11
Zn	mg/kg	29.423	31.524	21.762	25.873	24.391	20.134	17.672
Cu	mg/kg	0.157	0.341	0.571	0.212	0.178	0.151	0.123
Mn	mg/kg	97.623	111.12	88.234	91.653	82.345	76.542	65.432
THB x 10^8	cfu/g	5.98	6.13	7.29	5.27	5.49	6.02	5.14
THF x 10^3	cfu/g	2.4	2.6	3.1	2.1	2.3	2.5	1.8
HUB x 10^5	cfu/g	3.12	3.53	4.11	2.69	2.87	3.24	2.56
HUF x 10^2	cfu/g	1.3	1.6	1.8	ND	0.9	1.4	ND

Appendix C7: Results for Soil Analysis (Top Soil 0-15cm and Bottom Soil 15-30cm) for Okpoama Tank Farm Prpject (Dry Season)

Parameters	**Unit**	4° 20' 42.855N" 6° 15' 27.44E"		4° 20' 38.33N" 6° 15' 27.12E"		4° 20' 38.82N" 6° 15' 30.08E"		4° 20' 39.82N" 6° 15' 28.42E"		4° 20' 40.09N" 6° 15' 29.16E"		4° 20' 40.40N" 6° 15' 27.09E"		4° 20' 39.27N'' 6° 15' 29.10E"	
Parameters	**Unit**	**SS 1T**	**SS1 B**	**SS 2T**	**SS 2B**	**SS 3T**	**SS 3B**	**SS 4T**	**SS 4B**	**SS 5T**	**SS 5B**	**SS 6T**	**SS 6B**	**SS7 T**	**SS 7B**
Physiochemical:															
pH (1:1, soil to water)		5.21	5.31	4.01	4.27	3.81	3.87	3.88	3.78	3.84	3.40	3.40	3.92	4.33	4.15
Electrical Conductivity	µs/cm	158	145	353	350	142	213	221	281	3050	4360	618	833	284	629
Temperature	°C	27.3	27.4	26.2	27.8	26.0	26.0	27.0	27.7	27.0	26.3	27.5	25.8	27.4	26.8
Redox Potential	mV	+100	+200	+151	+108	+160	+150	+172	+188	+183	+207	+166	+166	+145	+156

Nitrite	mg/kg	0.140	0.136	0.141	0.126	0.078	0.107	0.117	0.093	0.174	0.146	0.213	0.189	0.050	0.032
Chloride	mg/kg	49.63	42.54	88.63	81.54	38.99	60.27	53.18	70.90	567.20	815.35	148.89	225.24	56.72	262.33
Sulphate	mg/kg	42.82	36.56	84.40	82.12	41.11	69.02	46.24	70.73	554.28	758.18	127.68	201.74	61.62	266.08
Carbonate	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOC	%	1.03	0.92	0.82	0.12	0.80	0.84	1.17	1.13	1.01	0.90	1.07	1.03	0.86	0.89
Phosphate	mg/kg	1.30	0.98	2.17	2.34	1.02	0.65	0.83	1.10	1.63	1.25	3.30	2.11	0.84	1.06
Ammonium	mg/kg	0.69	0.64	0.66	0.58	0.35	0.50	0.54	0.43	0.83	0.76	1.01	0.89	0.21	0.15
Nitrate	mg/kg	1.94	1.80	1.85	1.62	0.97	1.39	1.52	1.20	2.31	1.90	2.82	2.50	0.60	0.41
Porosity	%	56.5	56.9	53.9	53.1	50.9	50.5	54.6	55.4	58.0	56.5	48.3	46.0	47.1	48.3
Total Nitrogen	%	0.31	0.28	0.29	0.27	0.26	0.24	0.25	0.19	0.34	0.37	0.44	0.36	0.17	0.08
THC	mg/kg	<0.01	< 0.01	<0.01	<0.01	<0.01	<0.01	1.57	0.87	0.52	1.91	<0.01	<0.01	<0.01	<0.01
CEC	meq/100g	3.22	2.59	4.47	2.19	4.63	3.568	4.43	3.48	2.21	3.77	3.31	3.21	5.18	3.80
Colour	Munsell Colour Description	Dull Yellowish Brown	dull yellow orange	Dull Yellowish Brown	Dull Yellowish Orange	Dull Orange	Dull yellow Orange	Dull Orange	Dull Orange	grayish brown	grayish brown	Dull yellow Orange	Dull yellow Orange	Dull Orange	Orange
	Munsell Colour Code	Hue 10 YR 4/3	Hue 10 YR 6/4	Hue 10 YR 5/3	Hue 10 YR 7/4	Hue 7.5 YR 7/4	Hue 10 YR 7/4	Hue 7.5 YR 6/4	Hue 7.5 YR 6/4	Hue 7.5 YR 4/2	Hue 7.5 YR 6/2	Hue 10 YR 6/4	Hue 10 YR 7/4	Hue 7.5 YR 7/4	Hue 7.5 YR 7/6
Heavy Metals:															

Cu	mg/kg	4.45	3.00	0.15	0.10	2.80	1.10	<0.001	<0.001	<0.001	<0.001	0.55	0.40	0.20	0.35
Fe	mg/kg	1256.75	692.25	681.00	604.25	1963.50	1186.25	2467.00	1019.25	1802.50	1780.00	1382.75	1565.25	911.00	1327.00
Ni	mg/kg	<0.001	<0.001	0.60	0.90	1.80	2.05	0.30	<0.001	2.55	1.40	1.05	0.90	3.15	2.40
Zn	mg/kg	14.19	6.81	0.18	0.49	11.24	5.41	12.48	4.08	1.30	<0.001	12.19	4.39	7.86	6.55
Pb	mg/kg	<0.001	<0.001	<0.001	<0.001	0.30	0.20	0.95	0.60	<0.001	<0.001	1.05	0.80	0.40	0.60
Mn	mg/kg	7.10	4.10	3.45	2.00	5.30	3.80	4.60	1.15	1.55	2.30	1.65	2.55	0.90	1.90
Cd	mg/kg	0.60	0.25	<0.001	<0.001	0.70	0.40	0.65	0.55	0.45	0.20	0.25	<0.001	0.50	0.45
Cr	mg/kg	<0.001	<0.001	0.30	0.10	0.70	0.45	0.25	0.05	<0.001	<0.001	1.70	1.35	1.00	0.70
Ba	mg/kg	1.10	0.95	<0.001	<0.001	0.60	0.35	1.85	1.70	2.00	2.25	0.30	<0.001	<0.001	0.60
V	mg/kg	0.45	<0.001	<0.001	<0.001	0.85	0.55	1.55	0.85	0.25	0.15	<0.001	<0.001	0.65	0.20
Hg	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cations:															
Na	meq/100g	0.59	0.34	0.28	0.33	0.39	0.53	0.27	0.47	0.22	0.49	0.33	0.26	1.89	1.52
K	meq/100g	0.11	0.19	0.11	0.08	0.21	0.16	0.21	0.06	0.08	0.11	0.16	0.08	0.29	0.27
Ca	meq/100g	1.57	1.08	2.30	1.05	3.05	1.06	1.24	1.15	1.18	2.73	1.52	1.00	1.58	1.03

Mg	meq/100g	0.94	0.98	1.79	0.72	0.97	1.81	2.71	1.80	0.73	0.44	1.31	1.86	1.42	0.97
Organics:															
TPH	mg/kg	0.012	<0.001	0.008	0.010	0.008	<0.001	0.863	0.326	0.164	1.222	0.013	<0.001	0.014	<0.001
PAH	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Microbiological Test:															
THB (x 10^4)	cfu/g	6.2	4.1	5.3	2.8	6.0	4.5	3.2	1.8	5.3	3.8	6.2	4.4	5.1	3.7
THF (x 10^2)	cfu/g	3.2	2.8	4.3	3.7	5.1	3.2	6.0	4.7	3.1	2.6	4.6	3.1	2.9	1.4
HUB (x 10^2)	cfu/g	Nil	Nil	Nil	Nil	0.8	Nil	Nil	Nil	1.3	Nil	1.1	Nil	Nil	Nil
HUF (x 10^2)	cfu/g	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1.0	Nil	Nil	Nil	Nil	Nil
SRB (x 10^2)	cfu/g	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Feacal Coliform	MPN/100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Appendix C8: Results for Soil Analysis (Top Soil 0-15cm and Bottom Soil 15-30cm) (Continue)

Parameters											
Parameters	**Unit**	**SS8T**	**SS8B**	**SS9T**	**SS9B**	**SS10T**	**SS10B**	**SS1CT**	**SS1CB**	**SS2CT**	**SS2CB**
Physiochemical:											

pH (1:1, soil to water)		3.57	3.07	2.87	2.97	4.16	4.55	3.37	3.51	5.22	4.05
Electrical Conductivity	µs/cm	15295	10890	15235	13755	5090	8885	1168	769	6930	8730
Temperature	ºC	25.3	25.2	25.8	27.7	26.9	25.1	27.1	27.6	25.2	25.3
Redox Potential	mV	+229	+257	+234	+163	+131	+201	+191	+194	+158	+190
Nitrite	mg/kg	0.093	0.059	0.165	0.131	0.083	0.054	0.074	0.040	0.102	0.045
Chloride	mg/kg	1595.25	2127.00	2304.25	1949.75	850.80	992.60	322.60	290.69	709.00	886.25
Sulphate	mg/kg	1313.60	1978.82	2270.43	2049.45	855.57	822.53	326.46	295.70	687.55	831.08
Carbonate	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOC	%	0.78	0.80	0.74	0.70	0.66	0.72	0.55	0.37	0.89	1.44
Phosphate	mg/kg	3.91	1.84	3.59	3.47	2.16	1.58	1.90	1.45	2.03	1.83
Ammonium	mg/kg	0.41	0.26	0.78	0.61	0.38	0.23	0.33	0.16	0.48	0.18
Nitrate	mg/kg	1.20	0.74	2.17	1.71	1.06	0.65	0.92	0.46	1.34	0.51
Porosity	%	44.9	45.6	53.1	53.5	55.4	54.3	52.8	51.7	55.1	53.6
Total Nitrogen	%	0.19	0.12	0.33	0.28	0.17	0.11	0.16	0.08	0.20	0.09
THC	mg/kg	1.91	2.96	2.61	3.31	0.87	1.57	<0.01	<0.01	<0.01	<0.01
CEC	meq/100g	12.43	9.55	8.11	5.46	6.62	6.72	3.59	3.28	4.38	2.89
Colour	Munsell Colour Description	grayish brown	grayish brown	Grayish Red	Dark reddish Gray	Dull Yellowish Brown	Olive Black	Grayish Brown	Dull Yellowish Brown	Dark Grayish Yellow	Dark Grayish Yellow
	Munsell Colour Code	Hue 7.5 YR 5/2	Hue 7.5 YR 5/2	Hue 2.5 YR 5/2	Hue 10R 3/1	Hue 10YR 5/3	Hue 5Y 3/2	Hue 7.5 YR 6/2	Hue 10YR 5/3	Hue 25YR 5/2	Hue 25YR 4/2
Heavy Metals:											
Cu	mg/kg	1.60	1.05	1.80	2.40	4.65	3.60	1.60	1.40	0.40	0.20
Fe	mg/kg	951.00	1311.50	2440.00	2631.00	2613.25	1822.75	3569.25	1188.25	1247.25	742.75
Ni	mg/kg	1.50	1.20	1.55	1.35	<0.001	<0.001	0.55	0.20	0.35	<0.001
Zn	mg/kg	7.53	7.16	15.05	7.28	7.33	8.07	12.62	12.65	4.99	4.09
Pb	mg/kg	<0.001	<0.001	1.20	1.00	1.80	1.40	0.25	<0.001	<0.001	<0.001

Mn	mg/kg	1.60	3.60	0.95	5.85	6.80	5.95	4.00	2.90	1.30	1.00
Cd	mg/kg	<0.001	<0.001	1.90	2.05	2.00	1.35	<0.001	<0.001	<0.001	<0.001
Cr	mg/kg	<0.001	<0.001	2.00	1.75	1.75	1.25	0.10	<0.001	<0.001	<0.001
Ba	mg/kg	0.25	<0.001	0.90	1.20	0.20	2.80	0.50	0.30	<0.001	<0.001
V	mg/kg	<0.001	<0.001	1.30	0.75	1.15	0.80	<0.001	<0.001	<0.001	<0.001
Hg	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cations:											
Na	meq/100g	6.36	3.85	4.66	2.28	4.09	3.15	1.56	0.94	1.59	0.74
K	meq/100g	0.20	0.13	0.17	0.28	0.22	0.15	0.26	0.29	0.26	0.24
Ca	meq/100g	2.68	3.21	2.15	1.74	1.23	2.25	1.10	1.15	1.55	1.08
Mg	meq/100g	3.19	2.36	1.13	1.15	1.07	1.16	0.66	0.90	0.98	0.83
Organics:											
TPH	mg/kg	0.772	1.036	1.476	2.190	0.659	1.010	<0.001	<0.001	<0.001	<0.001
PAH	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Microbiological Test:											
THB (x 10^4)	cfu/g	6.8	4.1	2.6	1.3	4.3	2.8	6.0	4.3	5.4	3.0
THF (x 10^2)	cfu/g	3.6	2.2	5.3	3.3	6.1	4.8	3.6	2.1	4.0	1.8
HUB (x 10^2)	cfu/g	2.1	Nil	Nil	Nil	1.3	Nil	Nil	Nil	Nil	Nil
HUF (x 10^2)	cfu/g	1.0	Nil	Nil	Nil	0.2	Nil	Nil	Nil	Nil	Nil
SRB (x 10^2)	cfu/g	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Feacal Coliform	MPN/100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Appendix C9: Results for Soil Analysis (Top Soil 0-15cm and Bottom Soil 15-30cm) of The Proposed Brass Island Shipyard Project Area (Wet Season)

Parameters	Units	SS1T	SS1B	SS2T	SS2B	SS3T	SS3B	SS4T	SS4B	SS5T	SS5B	SS6T	SS6B

			4º 20' 18.4"N 006º 15' 18.7"E		4º 20' 14.1"N 006º 15' 27.1"E		4º 20' 6.0"N 006º 15' 27.5"E		4º 20' 6.2"N 006º 15' 15.6"E		4º 20' 4.2"N 006º 15' 18.7"E		4º 19' 48.3"N 006º 15' 3.0"E	
pH			5.2	5.4	5.7	6.1	7.4	7.6	6.8	6.7	7.2	7.4	6.4	6.8
EC		mS	0.38	0.31	1.69	3.62	0.10	0.22	0.09	0.14	0.15	0.21	0.14	0.18
Grain size	Sand		13.6	14.3	62.5	56.7	58.8	51.2	87.2	85.6	52.6	50.7	43.4	39.7
	Silt		21.8	9.6	26.4	30.3	28.5	32.3	7.3	8.7	40.4	42.1	46.4	50.3
	Clay		64.6	76.1	11.1	14.0	12.7	16.5	4.5	5.7	7.0	7.2	10.2	11.0
Textural class			Clay	Clay	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy	Sandy	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
Porosity		%	75.0	81.0	58.0	66.0	62.0	68.0	45.0	47.0	60.0	63.0	52.0	55.0
Permeability		cm/s	0.04	0.02	0.04	0.03	0.03	0.02	0.08	0.07	0.04	0.04	0.03	0.02
Bulk density		g/cm	1.58	1.62	1.30	1.33	1.32	1.34	1.22	1.24	1.40	1.46	1.45	1.48
TOC		%	3.53	3.46	2.64	2.81	2.34	2.72	1.65	1.92	2.66	2.95	3.16	3.30
SO_4		mg/kg	9.73	7.94	43.28	92.71	2.56	5.63	2.31	3.59	3.84	5.38	3.59	4.61
NO_3		mg/kg	2.89	2.36	12.86	27.55	0.76	1.67	0.69	1.07	1.14	1.60	1.07	1.37
NO_2		mg/kg	0.24	0.20	1.09	2.33	0.06	0.14	0.06	0.09	0.10	0.14	0.09	0.12
PO_4		mg/kg	2.01	1.64	8.95	19.17	0.53	1.16	0.48	0.74	0.79	1.11	0.74	0.95
NH_4		mg/kg	<0.01	<0.01	0.02	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Na		mg/kg	118.49	96.93	137.77	80.90	102.23	94.92	82.01	53.13	103.35	84.69	93.13	64.02
K		mg/kg	53.17	22.58	74.09	30.19	90.83	61.83	89.75	51.17	91.25	53.75	60.17	43.50
Ca		mg/kg	234.89	197.23	279.12	256.42	196.54	143.23	179.62	155.21	245.13	179.62	297.27	156.23
Mg		mg/kg	178.65	125.83	332.29	271.23	309.27	243.12	203.76	165.42	188.97	165.52	179.27	145.34
O&G		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
THC		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAH		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As		mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd		mg/kg	0.026	0.019	0.034	0.019	0.056	0.039	0.045	0.033	0.027	0.019	0.035	0.017
Cr		mg/kg	0.345	0.279	0.516	0.442	0.298	0.144	0.132	0.092	0.232	0.178	0.212	0.188
Ni		mg/kg	0.198	0.056	0.113	0.091	0.086	0.077	0.104	0.079	0.053	0.027	0.019	<0.001
V		mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Pb	mg/kg	0.765	0.432	0.986	0.611	1.112	0.876	0.765	0.511	0.876	0.672	0.954	0.694
Ba	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	mg/kg	2354.12	2097.65	1789.65	165423	1342.78	1212.19	1786.65	1672.65	1439.16	1164.23	1072.21	987.23
Zn	mg/kg	3.293	279.18	5.542	4.123	4.564	4.091	3.876	3.332	5.283	4.971	3.987	3.332
Cu	mg/kg	0.564	0.341	0.297	0.224	0.451	0.392	0.287	0.221	0.192	0.151	0.209	0.164
THB x 10^8	Cfu/g	1.47	1.41	2.56	1.87	2.39	1.57	1.63	1.56	2.31	2.20	2.03	1.89
THF x 10^3	Cfu/g	ND	ND	0.37	0.24	0.31	0.19	0.22	.0.12	0.46	0.38	0.37	0.31
HUB x 10^5	Cfu/g	ND	ND	0.60	0.43	0.51	0.34	0.38	ND	0.53	0.48	0.51	0.44
HUF x 10^2	Cfu/g	ND	ND	0.26	ND	0.21	ND	ND	ND	0.21	0.14	0.15	ND

Appendix C9: Results for Soil Analysis (Top Soil 0-15cm and Bottom Soil 15-30cm) of The Proposed Brass Island Shipyard Project Area (Wet Season) continues

Parameters		Units	SS7T	SS7B	SS8T	SS8B	SS9T	SS9B	SS10T	SS10B	SSC1T	SSC1B	SSC2T	SSC2B
			4º 19' 49.3''N 006º 15' 3.1''E		4º 19' 44.6''N 006º 15' 8.9''E		4º 19' 42.6''N 006º 15' 13.2''E		4º 19' 54.3''N 006º 15' 1.3''E		4º 18' 44.6''N 006º 17' 41.7''E		4º 20' 44.6''N 006º 15' 28.9''E	
pH			6.3	6.6	5.9	6.2	6.4	6.7	6.3	6.9	7.3	7.8	6.3	6.5
EC		mS	0.41	0.36	0.24	0.53	1.04	0.86	0.27	0.23	0.17	0.13	0.42	0.64
Grain size	Sand		52.5	50.1	68.9	68.5	57.1	52.7	38.0	34.3	45.7	38.6	79.8	45.5
	Silt		37.5	38.8	19.8	19.4	35.3	38.1	11.3	11.3	36.6	34.5	11.8	13.3
	Clay		10.0	11.1	11.3	12.1	7.6	9.2	50.7	54.4	17.7	26.9	8.4	41.2
Textural class			Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Clay	Clay	Loam	Loam	Sandy	Sandy Clay
Porosity		%	54.0	57.0	55.0	59.0	61.0	64.0	66.0	72.0	45.0	48.0	41.0	72.0
Permeability		cm/s	0.03	0.03	0.05	0.04	0.04	0.03	0.05	0.04	0.11	0.08	0.07	0.02
Bulk density		g/cm	1.41	1.44	1.28	1.31	1.31	1.33	1.44	1.53	1.31	1.34	1.28	1.55
TOC		%	3.71	3.54	3.87	4.18	3.46	2.98	2.78	2.43	5.52	4.94	1.26	1.63
SO_4		mg/kg	10.50	9.22	6.15	13.57	26.64	22.03	6.92	5.89	4.35	3.33	10.76	16.39
NO_3		mg/kg	3.12	2.74	1.83	4.03	7.92	6.55	2.06	1.75	1.29	0.99	3.20	4.87
NO_2		mg/kg	0.26	0.23	0.15	0.34	0.67	0.55	0.17	0.15	0.11	0.08	0.27	0.41
PO_4		mg/kg	2.17	1.91	1.27	2.81	5.51	4.55	1.43	1.22	0.90	0.69	2.22	3.39
NH_4		mg/kg	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Na		mg/kg	123.16	107.65	98.76	77.65	145.38	139.28	110.92	84.37	96.54	70.12	67.56	55.23
K		mg/kg	79.19	54.39	67.12	43.29	80.72	63.21	79.19	54.32	77.12	53.23	40.22	27.56
Ca		mg/kg	308.71	276.12	220.18	179.82	205.65	171.82	203.46	187.62	195.54	177.23	222.54	198.72
Mg		mg/kg	154.38	144.09	120.79	115.28	146.28	139.19	156.29	123.29	208.76	179.27	212.18	189.54
O&G		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
THC		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAH		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX		mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As		mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd		mg/kg	0.019	0.011	0.053	0.029	0.043	0.017	0.033	0.021	0.016	0.011	0.024	0.013

Cr	mg/kg	0.197	0.115	0.246	0.179	0.301	0.197	0.096	0.075	0.171	0.152	0.102	0.084
Ni	mg/kg	0.117	0.094	0.081	0.067	0.045	0.031	0.079	0.053	0.019	0.011	0.023	0.017
V	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	mg/kg	0.453	0.319	0.506	0.447	0.311	0.278	0.252	0.179	0.221	0.176	0.156	0.114
Ba	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	mg/kg	1987.65	1567.43	2012.98	1796.28	1096.28	978.65	1139.76	987.65	1214.23	1091.27	987.65	880.76
Zn	mg/kg	2.987	2.221	1.908	1.765	2.192	1.796	2.221	1.564	1.098	0.786	1.112	0.905
Cu	mg/kg	0.432	0.333	0.291	0.254	0.761	0.564	0.328	0.197	0.241	0.228	0.165	0.114
THB x 10^8	Cfu/g	1.75	1.68	1.88	1.54	1.93	1.74	1.59	1.50	2.83	2.47	1.64	1.43
THF x 10^3	Cfu/g	0.20	0.13	0.26	0.18	0.36	0.19	ND	ND	0.72	0.40	0.19	ND
HUB x 10^5	Cfu/g	0.32	0.25	0.43	0.31	0.47	0.42	0.25	0.17	1.04	0.83	0.37	ND
HUF x 10^2	Cfu/g	0.16	ND	ND	ND	0.13	ND	ND	ND	0.37	0.21	ND	ND

Apendix C10: Result for Ground Water of the Okpoama Tank Farm Project Area (Dry Season)

		4^O 20' 38.07"N 6^O 15' 27.05"E	4^O 20' 38.727"N 6^O 15' 29.832"E	4^O 20' 40.529"N 6^O 15' 28.947"E	4^O 18' 35.179"N 6^O 17' 20.67"E
Parameters	**Unit**	**GW 1**	**GW 2**	**GW 3**	**GW C**
Physiochemical:					
pH		6.87	6.81	6.64	7.03
Electrical Conductivity	µS/cm	3340	2348	3080	1780
TDS	mg/L	1887	1291	1394	979
Temperature	^{0}C	25.7	26.1	26.1	26.0
Colour	Pt-Co	13.0	10.0	15.0	9.0
Salinity	ppt	1.72	1.17	1.56	0.88
TSS	mg/L	21.15	20.32	18.31	14.84
Nitrite	mg/L	0.015	0.028	0.016	0.013
DO	mg/L	5.7	5.6	5.9	5.7
Turbidity	NTU	118.0	115.0	132.0	97.6
BOD_5	mg/L	1.65	1.95	1.95	2.10
COD	mg/L	27.73	21.33	23.47	19.07
THC	mg/L	<0.01	<0.01	<0.01	<0.01
Ammonium	mg/L	1.06	1.19	1.12	0.41
Chloride	mg/L	879.04	619.20	824.93	508.71
Nitrate	mg/L	2.96	3.33	3.15	1.16
Phosphate	mg/L	0.07	0.11	0.09	<0.01
Sulphate	mg/L	98.60	81.24	83.70	53.45

Total hardness	mg/L as $CaCO_3$	308	174	221	174
Carbonates	mg/L	0.00	0.00	0.00	0.00
Total Alkalinity	mg/L as $CaCO_3$	84.00	72.00	86.00	70.00
Oil & Grease	mg/L	<0.01	<0.01	<0.01	<0.01
Heavy Metals:					
Cu	mg/L	0.01	<0.001	<0.001	<0.001
Fe	mg/L	0.85	2.71	1.91	1.68
Ni	mg/L	1.34	0.89	1.13	1.27
Zn	mg/L	0.13	0.07	0.14	0.23
Pb	mg/L	<0.001	<0.001	<0.001	<0.001
Mn	mg/L	0.38	0.42	0.34	0.32
Cd	mg/L	<0.001	<0.001	<0.001	<0.001
Cr	mg/L	<0.001	<0.001	<0.001	<0.001
Ba	mg/L	<0.001	<0.001	<0.001	<0.001
V	mg/L	<0.001	<0.001	<0.001	<0.001
Hg	mg/L	<0.001	<0.001	<0.001	<0.001
Cations:					
Na	mg/L	436.08	389.13	508.82	269.90
K	mg/L	7.75	5.53	5.62	2.65
Ca	mg/L	93.33	45.13	46.67	37.95
Mg	mg/L	55.78	15.04	25.56	19.32
Organics:					
TPH	mg/L	<0.001	<0.001	<0.001	<0.001
PAH	mg/L	<0.001	<0.001	<0.001	<0.001
BTEX	mg/L	<0.001	<0.001	<0.001	<0.001
Microbiological Test:					
THB (x 10^4)	cfu/ml	1.3	1.8	2.0	1.6
THF (x 10^2)	cfu/ml	1.0	2.1	1.4	0.8
HUB(x 10^2)	cfu/ml	Nil	Nil	Nil	Nil
HUF(x 10^2)	cfu/ml	Nil	Nil	Nil	Nil
SRB(x 10^2)	cfu/ml	Nil	Nil	Nil	Nil
Feacal Coliform	MPN/100ml	Nil	Nil	Nil	Nil

Apendix C11: Result for Ground Water of The Proposed Brass Island Shipyard Project Area (Wet Season)

Parameters	Units	BH 1	BH 2	BH 3	BH 4	BH-C1	BH-C2
		4°20’18. 64” N 6°15’18. 61” E	4°20’06. 65” N 6°15’27. 79” E	4°18’31. 75” N 6°15’54. 72” E	4°19’55. 71” N 6°15’02. 83” E	4°18’13. 18” N 6°14’41. 78” E	4°18’12. 13” N 6°17’42. 04” E
pH		7.7	7.5	7.0	6.9	8.2	7.5

Temperature	°C	27.2	28.4	28.0	28.1	28.5	27.6
TDS	mg/l	16200	16600	8200	3100	110	720
EC	µS/cm	32600	33200	16400	6200	230	1440
Turbidity	N.T.U	41.89	43.91	61.37	94.63	11.37	178.70
DO	mg/l	3.70	4.20	4.40	4.60	5.80	6.301
TSS	mg/l	60.00	60.00	80.00	120.00	20.00	200.00
Total Alkalinity	mg/l	13.92	13.46	0.38	0.28	1.02	0.44
Salinity	mg/l	17099.03	18,408.76	4806.59	3105,89	37.01	411.71
BOD	mg/l	1.10	1.30	1.10	1.00	1.10	0.90
COD	mg/l	2.39	2.83	2.50	2.17	2.44	1.96
Chloride	mg/l	9496.30	10223.68	2669.44	1724.92	20.55	228.65
SO_4	mg/l	346.82	365.26	108.02	32.91	4.07	23.19
NO_3	mg/l	79.384	81.34	40.18	15.19	0.54	3.53
NO_2	mg/l	1.48	1.52	0.75	0.28	<0.01	0.07
PO_4	mg/l	0.331	0.36	0.13	0.07	<0.01	<0.01
NH_4	mg/l	0.871	<0.01	<0.01	<0.01	<0.01	<0.01
Na	mg/l	502.72	515.59	281.76	79.68	8.42	21.02
K	mg/l	107.361	128.044	62.282	27.872	1.768	7.208
Ca	mg/l	145.002	161.358	88.827	42.183	3.210	10.395
Mg	mg/l	231.952	256.467	101.412	61.280	5.128	13.223
O&G	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THC	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TPH	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PAH	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	mg/l	<0.001	<0.001	<0.001	0.145	<0.001	<0.001
Cd	mg/l	<0.001	<0.001	<0.001	0.019	<0.001	<0.001
Cr	mg/l	<0.001	<0.001	<0.001	0.006	<0.001	<0.001
Ni	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
V	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ba	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	mg/l	0.013	0.009	0.011	0.821	0.004	0.006
Zn	mg/l	0.035	0.017	0.022	0.071	0.008	0.011
TCC	MPN/100ml	40.00	60.00	40.00	40.00	90.00	20.00
FCC	MPN/100ml	ND	ND	ND	ND	ND	ND

THB x 10^8	cfu/ml	2.91	3.06	2.54	2.82	3.86	2.37
THF x 10^3	cfu/ml	0.6	0.9	0.4	0.5	1.1	0.3
HUB x 10^5	cfu/ml	1.57	1.92	1.42	1.50	2.17	1.15
HUF x 10^2	cfu/ml	ND	ND	ND	ND	ND	ND

Appendix D: Questionnaire on Socio-Economics and Community Health Survey Used in This Study

(Questionnaire No…………………………)
House No……………………………………………………………………………

INTRODUCTION

There is a plan to carry out an evaluation study of the NCDMB (TANK FARM) in your community. This study is aimed at generating information and data that will be used in developing an Environmental Impact Assessment (EIA) study. We therefore request your participation in this study by responding to the questions below in a sincere and appropriate manner. Your responses will be treated as confidential. Thank you for your cooperation.

SECTION A: Respondent's Bio Data/ Household Characteristics

1. Community………………………………….LGA………………………………………
   House No. ………………………………..

2. Sex: [a] Male [b] Female

3. Age: [a] Less than 20years [b] 21-29years [c] 30-39 [d] 40-49 [e] 50-59 [f] 60-69 [g] 70year+

4. Marital status [a] Single [b] Married [c] Divorced/Separated [d] Widow/Widower

5. Religion: [a] Christian [b] Traditional Religion [c] Islam [d] Others

6. How long has the head of your household lived in the community? [a] Less than 5years [b] 5-10years [c] More than 10years

7. Age and Sex structure. How many members of your household, including yourself, fall into the following age and sex categories? Please indicate numbers in the table below.

Age Range	Male	Female	Total
0-4			
5-12			
13-18			
19-25			
26-59			
60-69			
70years+			

SECTION B: Human Capital

8. How many members of your household aged 15-64years, including yourself, have been continuously unemployed in the last 6months? Please, tick from the following.

Males		**Females**	
15-24years	25-64years	15-24years	25-64years
0	0	0	0
1-2	1-2	1-2	1-2
3-4	3-4	3-4	3-4

5 and above	5 and above	5 and above	5 and above

9. How many members of your household, including yourself, have acquired training in the following skills? Please, indicate number.

Skills	**Males**			**Females**		
	15-24years	25-64years	Total	15-24years	25-64years	Total
No Skill						
Carpentry/Furniture making						
Electrical/Electronic installation and repairs						
Plumbing						
Metal works (machine/smiths)						
Welding/Fabrication						
Masonry						
Tailoring/Fashion design/Textile work						
Auto repairs (mechanic, electrical, panel beating, vulcanizing, painting						
ICT (computer works)						
Catering						
Hat making/bending						
Instrumentation/Calibration						

Safety/Security						
Teaching						
Administration						
Building (architecture, quantity surveying, estate management						
Engineering						
Land Surveying						
Health services						
Managing micro/small business						
Leadership skills						

10. How many child birth have you had in your household in the last 5 years?

[a] None [b] 1 [c] 2 [d] 3 [e] 4 [f] 5

11. Where did the mothers receive ante-natal care?

[a] None [b] Traditional birth attendant (TBA) [c] Hospital/Clinic/Health center [d] maternity home [e] Church/Prayer house

12. Where is the place of child delivery?

[a] Home [b] TBA [c] Hospital/clinic/Health center [d] maternity [e] Church/prayer house

13. Where was the birth registered?

[a] None [b] Government agency [c] Community [d] Church

14. How many members of your household aged 0-5years have been immunized?..............................

15. How many deaths occurred in your household in the last one year?

[a] None [b] 1 [c] 2 [d] 3 [e] 4 [f] 5

16. Do members of your household use any of these against mosquito bites and malaria?

[a] Ordinary mosquito nets [b] Insecticide treated mosquito nets [c] Preventive drugs [d] Insecticides

17. In the past four weeks, how often were you sick to seek medical help?

[a] None [b] 1-2 times [c] 3-4 times [d] 5 times [e] More than 5 times

18. Where did you seek help?

[a] Hospital/Clinic/Health Center [b] Drug store (Chemist) [c] Traditional healers [d] Self-medication [e] Church/Prayer house [f] Nowhere

19. What is the distance between your household to the nearest health facility? [a] Less than 500m [b] 500m-1km [c] 1-2Km [d] More than 2km

20. What time does it take for members of your household to get to the nearest health facility to your residence? [a] Less than 30mins [b] 30mins-1hour [c] 1-3hours [d] More than 3 hours

21. What is the cost of transportation to your nearest health facility?

[a] Less than ₦50 [b] ₦50-N100 [c] ₦100-₦200 [d] ₦300-₦500 [e] More than ₦500

22. Did any member of your household (including yourself) suffer from any of these symptoms/diseases in the last six months? How frequently, please tick…

Degree / Ailment	Always	Sparingly	Seldom	Never
Whooping Cough				
Tuberculosis				
Asthma				
Dysentery				
Diarrhea				
Cholera				
Pile				
Hypertension				
Congestive heart problem				
Pneumonia				
Epilepsy				
Rheumatism				
Rashes				
Eczema				
Ringworm				
Eye pains				
Cataract				
Glaucoma				
Typhoid fever				
Malaria				
Sickle cell anemia				
Sexually transmitted diseases (STDs)				

23. How often in the past one year did you have problems satisfying the food needs of your household?

[a] None [b] Sparingly [c] Seldom [d] Always [e] Never

24. How many meals is your household able to provide daily? Please tick

[a]None [b] 1 [c] 2 [d] 3 [e] more than 3

25. What is the distance to cover by members of your household to get the nearest public school to your residence?

[a] Less than 500m [b] 500m-1km [c] 1km-2km [d] 2km-3km [e] More than 3km

26. What time does it take for members of your household to get the nearest public school to your residence?

[a] Less than 10mins [b] 10-30mins [c] 30mins -1hour [d] 1-2hours [e] More than 2hours

27. What is the cost of transportation to your nearest school?

[a] Less than N50 [b] N50-N100 [c] N100-N200 [d] N300-N500 [e] More than N500

28. Does the school members of your household attend have equipped and functional laboratory? [a] Yes [b] No

29. How many members of your household are currently in school? Indicate numbers…………………………………….

School	**Male**	**Female**	**Total**
Nursery			
Primary			
Secondary			
Vocational/Technical			
Tertiary			
Total			

30. What is the highest level of education attained by all members of your household aged 15years and above, including yourself? Please indicate numbers in the table below…………………………………………………………………..

Education category	**Male**	**Female**
No formal education (NFE)		
Attempted primary school		
Completed primary school		
Attempted secondary school		
Completed secondary school		
Attempted tertiary school		
Completed tertiary school		

31. Estimate the time taken to get to the nearest ICT center that is nearest to your household?

[a] Zero (there is in house facility [b] Less than 10mins [c] 10-30mins [d] 30mins -1hour [e] More than 1hour [f] No ICT in my community

32. How many members of your household are computer literate? Please tick from table below………….

Male	Female
0	0
1-2	1-2
3-4	3-4
5 and above	5 and above

33. Has any member of your household relocated in the last 5 years [a] Yes [b] No

34. Why did they relocate? [a] School/apprenticeship [b] Work [c] marriage [d] To join the family

35. Where did they relocate to?..

SECTION C: Social/Political Capital

36. How many members of your household aged 15-64 years are engaged in the following economic activities? Indicate numbers in Table below…..

Economic Activity	Males	Females
farming		
Collection of forest products (fruits, firewood, etc)		
Livestock farming		
Fishing		
Collection of sea products (shell fish, etc		
Aquaculture (fish ponds)		
Trading (wholesale, distributorship		
Trading (petty trading		
Civil/public service		
Food processing (garri, palm oil milling, fish smoking, local gin, etc		

Hunting		
Lumbering		
Company employment		
Artisanship (carpentry, canoe carving, welding, etc		
Handicraft (pottery, weaving, tailoring, etc		
Contracts		
Apprenticeship/Training		

37. What is the approximate monthly income of your household?

[a] Less than N5,000 [b] N5,001-N10,000 [c] N10,001-N15,000 [d] N15,001-N20,000 [e] N20,001-N25,000 [f] N25,001-N30,000 [g]N30,001-N40,000 [h] N40,001-N45,000 [i] More than N50,000

38. What is your personal monthly income?

[a] Less than N5,000 [b] N5,001-N10,000 [c] N10,001-N15,000 [d] N15,001-N20,000 [e] N20,001-N25,000 [f] N25,001-N30,000 [g]N30,001-N40,000 [h] N40,001-N45,000 [i] More than N50,000

39. Does your household own any of these assets? Please tick from list below (only those working).

Livestock (chicken, goats, pigs, etc)	Other assets
[a] 1-20	[a] Electric fan
[[b] 21-50	[b] Refrigerator/freezer
[c] 1-100	[c] Television

[d] More than 100	[d] Video
Agric Equipment/Input [a] Fertilizer [b] Improved seedling [c] Fish fingerlings [d] Hooks/Nets [e] Herbicides	[e] Radio [f] Mattress [g] Watch/Clock [h] Sewing machine [i] bicycle [j] Motor cycle [k] Canoe [l] Speed boat [m] Car/truck [n] Commercial store

40. Do any NGOs operate in your community? What are their names and what do they do?

[a]…………………………………………………………………………………………[b]……
…………………………………………………………………………........................

[c]………………………………………………………………………………………… [d]
…………………………………………………………………………………………………….

41. Who inherits family assets in your community?

[a] First male child [b] First female child [c] male children [d] Female children [e] All children [f] male relatives [g] Female relatives

42. Who is responsible for taking final decisions on household matters in your household?

[a] Father [b] Mother [c] Parent jointly [d] Children [e] Everybody jointly

43. Who are responsible for taking decisions about the community?

[a] Traditional ruler [b] Community elders [c] Community development Committee/Trust [e] Men only [f] Women only [g] Youth only [h] All recognized stakeholders/groups

44. Are there any operational micro credit schemes in your community? [a] Yes [b] No

45. Has any member of your household ever benefitted from a micro credit loan? [a] Yes [b] No

46. How many members of your household belong to cooperative societies? [a] None [b] 1 [c] 2 [d] 3 [e] 4 [f] 5 and above

SECTION D: Natural Capital

47. How do you dispose your household waste?

[a] Burning [b] Burying [c] Composing [c] Dumping (gutters, creeks, bush) [e] Government refuse collection [f] Private commercial refuse collection

48. How do you dispose your household sewage (where does your household go to toilet)?

[a] Bush [b] Covered pit toilet [c] Open pit toilet [d] water closet [e] Pier system (water side)

49. What is your main source of water supply?

[a] rain [b] River/pond [c] Covered well [d] Open well [e] Private/commercial borehole [f] Public pipe borne water

50. What is your source of energy for cooking?

[a] Firewood [b] Kerosene [c] Cooking gas [d] Electricity [e] Coal

51. What is your source of energy for lighting?

[a] Kerosene lamp [b] Electricity [c] Community generator [d] Private generator

52. Has there been any encroachment on your community reserved forest, farm land, fishing site in the last 10 years? [a] Yes [b] No

53. What two reasons are responsible for this encroachment?

[a] Housing development [b] Industrial activities (eg oil and gas [c] Government acquisition for infrastructural development [d] Farming [e] Fetching firewood/lumbering [f] Environmental factors (erosion, flooding, silting)

54. Estimate the extent of land loss [a] None (no loss) [b] 1-5% [c] 5-10% [d] 10-20% [e] 20-30% [f] 30-50% [g] More than 50%

55. How is land acquired in your community? [a] Inheritance [b] Purchase [c] Lease/hire [d] Pledge/collateral

56. If you farm, how did you acquire your farm land? [a] Inheritance [b] Purchase [c] Lease/hire [d] Pledge/collateral

57. Who owns land in your community? [a] The community [b] families/Individuals [c] Both a & b

58. Who can acquire land in your community? [a] males only [b] Females only [c] Indigene only [d] Males/Female [e] Indigenes and none indigene

59. If you fish where do you carry out fishing activities? [a] Rivers/creeks [b] Ponds [c] wetlands

60. Does your community have any historical/archeological sites? [a] Yes [b] No [c] Do not know

SECTION F: Physical Capital

61. Does your community have any of the following facilities? Please tick…. [a] Tarred roads [b] Untarred earth roads [c] Bridges [d] Public primary school [e] public secondary school [f] public electricity [g] Public water supply [h] Market [i] Community Hall

62. What mode of transport do your household members use for distances more than 3km?

[a] Trekking [b] bicycle [c] Motor cycle [d] Canoe [e] Speed boats [f] Buses/taxis [g] Private cars

63. What is the travel time by public transport to your LGA headquarters? [a] 1-10mins [b] 10-30mins [c] 30mins – 1hour [d] 1-2hours [e] more than 2hours

64. Which of the following house types do you live in? [a] Bungalow [b] Duplex [c] Tenement [d] Story building [e] Block of flats

65. Who owns the house your household live in? [a] Family house [b] Father [c] Mother [d] Self owned [e] Rented

66. How many bedrooms are in your house? [a] 1 [b] 2 [c] 3 [d] 4 [e] 5 and above

67. How many people sleep in one room? [a] 1 [b] 2 [c] 3 [d] 4 [e] 5 and above

68. What is the construction (walling) material? [a] Thatch [b] Plank/wood/Straw [c] Corrugated iron sheets (zinc) [d] Cement blocks [e] Bricks [f] Mud

69. What is the roofing material? [a] Thatch [b] Asbestos [c] Corrugated iron sheets (zinc) [d] Aluminum [e] Slate

70. How many members of your household have access to telephone lines? [a] None [b] 1 [c] 2 [d] 3 [e] 4 [f] 5 and above

71. How many telephone services do you receive in your community? [a] None [b] 1 [c] 2 [d] 3 [e] 4 [f] 5 and above

<u>SECTION G: Perceptions/Expectations</u>

72. What impact do you think the NCDMB operation may cause your community?

[a]……………………………………………………………………………………….

[b]…………………………………………………………………………………………..

[c]………………………………………………………………………………………

[d]………………………………………………………………………………………….

73. What benefits (for yourself and your community) do you expect from NCDMB operation in your area?

[a]………………………………………………………………………………………..

[b]………………………………………………………………………………………..

[c]…………………………………………………………………………………………

[d]………………………………………………………………………………………..

74. What enhancement or/ and mitigation measures do you suggest to ameliorate the associated impacts NCDMB operation may cause your area?

[a] …………………………………………………………………………………………………

[b] ……………………………………………………………………………………………….

[c] ……………………………………………………………………………………………………

[d] ………………………………………………………………………………………………

75. Other comments

Appendix E: Attendance

ATTENDANCE LIST FOR FIELD DATA GATHERING EXERCISE

Project Title: Environmental Impact Assessment for the Proposed Shipyard @ Brass Island, Bayelsa State.

Proponent: ~~[illegible]~~ NCDMB

Date: 20/09/2021

S/N	Names	COMPANY/ ORGANIZATION	DESIGNATION	EMAIL	PHONE NUMBER	SIGNATURE
1	Uduak John (mas)	FMEnv. Abuja	SCE	uduakjohn41@gmail.com	08037454855	
2	Osaro James Opuh	Lympson		[illegible]	0703123905[illegible]	
3	Hafus O-O	Lympson		[illegible]@gmail.com	07069034230	
4	Alphonsus Isowu	Lympson	SIA	[illegible]@gmail.com	08035779057	
5	Dr. Gijo, A. H.	Lympson	Fauna	harrygijo@gmail.com	08067359359	
6	Authority Benson	Lympson	Fauna	authority[illegible]	[illegible]	
7	Paul Akporowho	"	Pg. Env	[illegible]	08023726789	
8	Nikade Paul	NCDMB	Supervisor STPD	[illegible]	08102351161	
9	Dr. Augustine Olayinde	Lympson	Soil/Geology	augustine[illegible]@yahoo.com	0803588246[illegible]	
10	ELEGBE SITHANKGOD	OKPOAMA	P.R.O	[illegible]	08134545769	
11	Agala N. Ofariya	EWOAMA	Youth TR	Agala Ofariya[illegible]	08137270233	
12	SAMUEL EBIH-TA	OKPOAMA	YOUTH SEC	[illegible]	07030583186	
13	Sinte Iniemo	OKPOAMA	Youth Vice	2020[illegible]	0803056471[illegible]	

ATTENDANCE LIST FOR FIELD DATA GATHERING EXERCISE

4°R'43.516"N
6° 44'41.028" E

Project Title: Environmental Impact Assessment for the Proposed Shipyard @ Brass Island, Bayelsa State.

Proponent: ~~China Harbour Engineering (Nigeria) Limited~~ NCDMB

Date:

S/N	Names	COMPANY/ ORGANIZATION	DESIGNATION	EMAIL	PHONE NUMBER	SIGNATURE
1	HRH Dokubo				08062768401	
2	CHIEF OBIN/L CHIEF				07061544549	
3	CHIEF SAMUEL OKOROGHA				08037059421	
4	ELDER Loveday Eugene [illegible]				07064423362	
5	Elder D. Ohiko				08060912277	
6	Elder E. Nichol				07038703125	
7	Elder E. Ariwino				07036463524	
8	Emmanuel Felix					
9	Mrs Sibia Nitson				08082519705	
10	Ms Inikio Kapua				07062151681	
11	Jonathan Hart				07038926340	
12	Sister Alafina				08064588314	
13	Sikiglo Bobot				08131029513	
14	Kenneth Park	Lympson	SIA			
15	Alphonsus Isowu			[illegible]@gmail.com	08035779057	

Appendix F: Sample Chain of Custody

LYMPSON LEOSENTINO LIMITED

7, Agadze Street, Off Aminu Kano Crescent, Wuse II District, Abuja.

CHAIN OF CUSTODY

PROPONENT: NCDMB	PROJECT NAME: EIA of Brass Island Shipyard	PROJECT LOCATION: Brass, Bayelsa State

Field Sample No. /Identification	Date/Time	Grab	Composite	Sample Container (Size/Make)	Sample Type (Effluent, Leachate, BH etc.)	Preservation Method	Analysis Requested	Lab. Remark	Lab. Log Number
SOIL (SS1–10, and 2 Control) Top and Bottom	20/9/2021	Soil Auger		Polythene bags	Soil	Cooling	pH, EC, Particle size, T/Class, Porosity, Permeability, Bulk density, TOC, SO4, DO, NO3, PO4, NH4, TIN, Na, K, Ca, Mg, CEC, O&G, THC, TPH, PAH, BTEX, As, Cd, Cr, Ni, V, Pb, Ba, Hg, Fe, Zn, Cu, THB, THF, HUB & HUF		
SEDIMENT (SED 1–5, and 2 Control)	21/9/2021	Ekman Grab		Polythene bag	Sediment	Cooling			

Sampler's Signature: [signature]

Relinquished By: Ottuman H.O

Date: 21/9/21 Time:

Supervised by: Mrs Uduak John, FMEnv. Abuja

Date: Time:

Received by: Fatoyinbo T.

Date: 21/9/2021 Time: 7:15pm

Sampler's Remark: Samples were adequately preserved from field

Received for Laboratory by (Name & Signature): [signature] (Thelma)

Lab. No.:

LYMPSON LEOSENTINO LIMITED

7, Agadze Street, Off Aminu Kano Crescent, Wuse II District, Abuja.

CHAIN OF CUSTODY

PROPONENT: NCDMB	PROJECT NAME: EIA of Brass Island Shipyard	PROJECT LOCATION: Brass, Bayelsa State

Field Sample No. /Identification	Date/Time	Grab	Composite	Sample Container (Size/Make)	Sample Type (Effluent, Leachate, BH etc.)	Preservation Method	Analysis Requested	Lab. Remark	Lab. Log Number
BH (BH1-4 and 2 control)	21/9/2021			PLASTIC CANS & GLASS BOTTLES	BH (Groundwater)	Cooling and Acidification	pH, Temp, TDS, EC, Turbidity, TSS, T/Hardness, Salinity, DO, BOD, COD, Cl, SO_4, NO_3, NO_2, PO_4, NH_4, CO_3, Na, K, Mg, Ca, O&G, THC, TPH, PAH, BTEX, Mn, Cd, Cr, Ni, V, Pb, Fe, Zn, TCC, FCC, Ba, Hg	Samples were properly preserved on received.	
SW (SW 1-5, and 2 Control)	21/9/2021			PLASTIC CANS & GLASS BOTTLES	Surface Water				

Sampler's Signature:	Relinquished By: Otthuman H.O	Date: 21/9/21 Time:	Supervised by: Mrs Udulak John FMEnv. Abuja	Date: Time:	Received by: [signature]	Date: 21/9/2021 Time: 7:15pm
Sampler's Remark: Samples were adequately preserved from field			Received for Labpratory by (Name & Signature): [signature] - Indaka			Lab. No.: