ENVIRONMENTAL IMPACT ASSESSMENT
(DRAFT REPORT)

for

PROPOSED STEEL PIPE THREADING AND VALVE ASSEMBLY FACILITIES AND RELATED ACTIVITIES AT LEKKI FREE ZONE IN IBEJU LEKKI LOCAL GOVERNMENT AREA- LAGOS

SUBMITTED BY

BELL OIL AND GAS FZE

Lekki Free Zone, Lekki Coastal road, Ibeju-Lekki, Lekki Corridor, Lagos

TO

FEDERAL MINISTRY OF ENVIRONMENT

JULY 2020

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Prepared by

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FOR

BELL OIL AND GAS FZE

Lekki Free Zone, Lekki Coastal road, Ibeju-Lekki, Lekki Corridor, Lagos

JULY 2020

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LIST OF ABBREVIATIONS AND ACRONYMS USED

ASTM	=	America Society for Testing and Materials (Developing Standards)
BOD	=	Biochemical Oxygen Demand
BOGFZE	=	Bell Oil and Gas Free zone
BAT	=	Best Available Technology
CALIL	=	China Africa Lekki Investments Limited
CO	=	Carbon monoxide
CDAs	=	Communities Development Associations
CITIES	=	Convention on International Trade in Endangered Species
COD	=	Chemical Oxygen Demand
cfu/g	=	coliform count unit per gram
CTP	=	Central Treatment Plant
CPS	=	Coastal Plains Sands
DBH	=	Diameter at Breast Height
DO	=	Dissolved Oxygen
DPR	=	Department of Petroleum Resources
EGASPIN	=	Environmental Guidelines and Standards for the Petroleum Industry
ESIA	=	Environmental Impact Assessment
EA	=	Environmental Assessment
EMP	=	Environmental Monitoring Plan
ESIA	=	Environmental and Social Impact Assessment
FEPA	=	Federal Environmental Protection Agency
FGD	=	Focus Group Discussion
FMEnv	=	Federal Ministry of Environment (Nigeria)
FTZ	=	Free Trade Zone
GIEC	=	Global Impact Environmental Consulting Limited
GIS	=	Geographic Information System
GPS	=	Global Positioning System
GRE	=	Glass Reinforced Epoxy
GRM	=	Grievance Redress Mechanism
HUB	=	Hydrocarbons Utilizing Bacteria
HUF	=	Hydrocarbons Utilizing Fungi
HSE	=	Health, Safety and Environment
IFC	=	International Finance Cooperation
IOC	=	International Oil Companies
IPP	=	Independent Power Plant
ITCZ	=	Inter-Tropical Covergence Zone
ITD	=	Inter-Tropical Discontinuity
IUCN	=	International Union for Conservation of Nature and Natural Resources
KIIs	=	Key Informant Interviews
LADOL	=	Lagos Deep Offshore Logistics Base
LASEPA	=	Lagos State Environmental Protection Agencies

LAWMA	=	Lagos Waste Management Authority
LCDA	=	Local Council Development Area
LFTZ	=	Lekki Free Trade Zone
LFZDC	=	Lekki Free Zone Development Company
LGA	=	Local Government Area
LGC	=	Local Government Council
LIWIL	=	Lekki Worldwide Investments Limited
LMEnv&WR	=	Lagos State Ministry of the Environment and Water Resources
NIMET	=	Nigeria Institute of Meteorology
NESREA	=	National Environmental Standards and Regulatory Enforcement Agency
NEPZA	=	Nigeria Export Processing Zone Act
NIS	=	Nigerian Industrial Standard
NPC	=	National Population Commission
OCTG	=	Oil Country Tubular Goods
OEM	=	Original Equipment Manufacturer
pH	=	Hydrogen Ion Concentration
ppm	=	part per million
PAP	=	Project Affected Populations
PSU	=	Primary Sampling Units
SMEs	=	Small Medium Enterprises
SON	=	Standard Organization of Nigeria
SSIs	=	Semi-Structural Interviews
SPM	=	Suspended Particulate Matter
SPEB	=	State Primary Education Board
THB	=	Total Heterotrophic Bacteria
THC	=	Total Hydrocarbons
THF	=	Total Heterotrophic Fungi
TOC	=	Total Organic Carbon
ToR	=	Terms of Reference
TSP	=	Total Suspended Particulate
TSS	=	Total Suspended Solids
UT	=	Ultrasonic Testing
UNESCO	=	United Nations Educational Scientific and Cultural
UNEP	=	United Nations Environmental Protection
VOC	=	Volatile Organic Compounds
WHO	=	World Health Organization

EXECUTIVE SUMMARY

ES1.0 Introduction

The proposed Steel Pipe Threading and Valve Assembly facilities by Bell Oil and Gas FZE, an independent oil services company specialised in supplying dedicated professional services to the upstream sector of the oil and gas industry in Nigeria is a project in support of the Federal Government Policy on both private and public participation in the Oil and Gas industry as well as the Nigerian Content Act and government's commitment to promoting Nigerian content. Most importantly, the policy encourages those that provide service to the upstream and downstream sector of the Oil and gas industry such as the Dangote refinery project under construction, a crucial project to the Nigerian economy located in the same axis as the proposed project. With this strategic development and the interest so far, the accessibility and availability of locally made threaded steel pipes and valves locally would be increase. This will boost local production capacity and increase foreign earnings for the Government.

The proposed steel pipe threading is a spiral ridge on the end of a pipe that enables pipes to be joined together. The Oil Country Tubular Goods (OCTG) threading facility will be supported by several lathes and advanced CNC equipment in 15,000 square meters of manufacturing space and storage. The facility will thread OCTG steel pipe up to range 3 length and 13-3/8″ diameter. In addition to threading, tubular repairs and fabrication of crossovers, pup joints, couplings and other accessories, the proposed facility will also offer in-house gauging, inspection and storage capabilities. For the valve assembly, testing repair and maintenance plant, the proposed project will assembly of smaller valve sizes including testing, repair, painting, and maintenance of OMB as well as other Original Equipment Manufacturer (OEM) valves.

The proposed project is planned to be located within the Lekki Free Zones (LFZ), a special designated area within the economic nerve centre of Nigeria, Lagos State, where normal trade barriers like quotas, tariffs are removed and the bureaucratic necessities are narrowed in order to attract new business and foreign investments. The proposed project site is geographically advantageous for trade and places near international airports, seaports, to mention few.

As part of the regulatory requirements, a project such as the proposed Steel Pipe threading and Valve Assembly Facilities project requires an Environmental Impact Assessment in order to evaluate the baseline situation of the proposed project area and also to identify the likely impacts (positive or negative) that could arise from the planned project. To obtain the regulatory approval for this planned project, Bell Oil and Gas FZE invited Global Impact Environmental Consulting Limited to conduct the Environmental Impact Assessment Study for their proposed Steel Pipe threading and Valve Assembly facilities project in fulfillment of the regulatory requirements.

Bell Oil and Gas FZE is committed to conducting its operations with excellence in a socially responsible and ethical manner, paying due attention to the protection of the Environment, the Health and Safety of its employees, contractors, stakeholders and the general public. An Environmental Impact Assessment EIA study has therefore been carried out. This is in compliance with existing regulatory requirements, and in line with Bell Oil and Gas FZE Corporate Policy on Health, Safety and Environment (HSE).

The proposed Steel Threading Pipe and Valve Assembly facilities and related activities Project is located within an industrial layout north-west direction of the existing Lekki Free Trade Zone. It is situated at the eastern part of Lekki, which covers a total area of about 155 km^2. Administratively, it is located within the Ibeju Lekki Local Area (LGA) of Lagos state. The proposed project area covers a total land area of approximately 15,146.0 square meters. It is about 500 meters west of the on-going Dangote Refinery Plant. Its geographical extent is between 3^0 58' 14.12" E – 3^0 58' 12.50"E and 6^0 27' 36.89"N – 6^0 27' 43.64"N. Closet communities (about 4.39KM) to the site are Ilege and Idasho while it can be accessed mainly by either through Ilege or Idasho community road junction off the Ibeju/ Free Trade Zone express road or through Lekki Lagoon (it is bout 3.22Km northward to Lekki Lagoon shoreline).

The EIA has been prepared to meet the following specific national and local regulatory requirements but not limited to:

- Federal Environmental Protection Agency (FEPA, now the Federal Ministry of Environment) Environmental Guidelines and Standards, including the ESIA Decree No. 86 of 1992.
- Nigeria Export Processing Zone Authority Act No 63, 1992
- The Department of Petroleum Resources (DPR) Environmental Guidelines and Standards for the Petroleum Industry (EGASPIN) – 2002
- The Oil and Gas Pipelines Regulations (1995)
- EIA Act Cap E12 LFN 2004.
- The Nigeria Forestry Act, 1937

- Nigerian Endangered Species (Control of International Trade and Traffic) Act No. 11 of 1985
- Nigeria Content Act 2010
- The Nigerian Factories Act No 16 of 1987
- Lagos State Environmental Protection and Management Law, 2017
- Lagos State Physical Planning and Urban Development Law 2005
- Local Government Edicts

The environmental guidelines of international organizations such as IUCN and ratified convention, for instance Convention on Biological Diversity to mention few were also taken into cognizance in carrying out this EIA study. In addition, environmental guideline of lending organizations such as the World Bank was also considered.

This report relates to the EIA for the proposed Steel Pipe threading and Valve Assembly project and will cover the assessment of planned project activities, the environment around the project area, and the associated and potential impacts of the proposed project as well as reasonable mitigation options for the negative impacts.

ES2.0 Project Justification and Alternatives

Need for the Project

Demand for Oil Country Tubular Goods (OCTG) is directly influenced by the demand growth for fossil fuels. Deep, horizontal, sour gas and offshore wells are the key drivers for OCTG demand. Since those types of wells require a higher grade of OCTG, the growth of OCTG demand will be around higher grades, premium connection and sour services products that the proposed facility is expected to focus on. As of Q2 2019, the global demand for OCTG is on the rise, in some places showing a double-digit growth rate. According to Fast markets MB research, OCTG consumption in the Middle East is expected to reach 1.33 million tonnes in 2019 and 1.36 million tonnes in 2020, up from 1.3 million tonnes in 2018. In Nigeria, drilling activity increased in 2018, with all IOCs and indigenous E&P buying OCTG, first from destocking of locally available inventory. This trend is expected to continue through 2019 and beyond as long as crude oil prices stabilize.

Furthermore, there is a huge gap in the market for quicker response to casings and tubing used for drilling operations, together with valve repair and maintenance. The upcoming Petroleum refinery by Dangote Group in the same axis as the proposed project is also a potential market. It is on the premises above that BOG has entered into a Joint Venture agreement with a major Line

Pipe & OCTG Mill for the threading plant, together with a technical services agreement for the local assembly, repair, testing and painting of valves. Hence, the need for proposed project.

Benefit of the Project

The proposed Steel Pipe Threading and Valve Assembly facilities project will have a number of benefits. The benefits of this project will include:

1. Create direct and indirect, temporary and permanent employment opportunities for Nigerians;
2. Improve the local content participation in the oil and gas industry through the products from the facility;
3. Make available high quality and affordable threading pipes and valves to meet the yearnings of Nigerians oil and gas industry;
4. Reduce the foreign exchange expended on importation of threaded pipes and valves into the country hence improve the nation's economy; and
5. Increase in Government Revenue through collection of taxes.

The total cost for the proposed Steel Pipe Threading and Valve Assembly facilities is estimated to be $50million. However, it is expected that the value will include the cost of mobilization and other construction activities. Of this amount, at least 60% will be injected to the local economy through Facility Design development, acquisition of appropriate permits/ Licenses, Civil Engineering Services, Skilled and Unskilled labour etc.

The sustainability of this project is guaranteed with environmental, economic and social considerations.

Alternative Project Concepts

Three (3) alternative projects concepts were considered before the proposed concept was eventually selected. These include:

- Concept A: Importation of OCTG Pipes and Valves
- Concept B: Shipment of the threaded pipe and valve assembled facilities to Lagos from the Bell Oil & Gas facilities in Port Harcourt
- Concept C: Construction and operation of BOG Pipe Threading and Valve Assembly facilities Project

The construction and operation of the proposed Steel Pipe Threading and Valve Assembly at Lekki Free Zone was selected due to its reliability, safety and design as well as cost advantages over others. At the end, it was decided that the most attractive alternative is that, which has been adopted by project proponents.

Project Options

Various options to this project were considered and these include the No-Project Option; Delayed Project Option Go Ahead (Implement Project as Planned) Option; and Alternative Location Option.

ES 3.0 Project Description

The primary purpose of the Oil Country Tubular Goods (OCTG) threading project is to meet the requirements of the Nigerian content Act, which encourages local companies to add value in the industry through investments in equipment/infrastructure, manpower capacity development and skills/technology transfer. On this project, value will be added through the cutting of API & Premium connection threads in-country using Nigerian personnel who will be trained by our Chinese technical partner.

Bell Oil and Gas FZE is desirous of establishing a single threading line for production casings (5'' to 13-3/8'') on a parcel of land measuring 4.3hectares at Lekki Free Zone in Ibeju Lekki Local Government Area with future expansion to include lines for production of tubing (2-3/8'' to 4-1/2''). The in-country threading plant will position BOG as a key player and will be so categorized by the NCDMB. This will significantly increase BOG chances of winning tenders for OCTG with major International Oil Companies (IOC's) and smaller E&P companies.

For the valve assembly, testing repair and maintenance plant, BOG intend to develop an assembly facility of smaller valve sizes including testing, repair, painting, and maintenance of OMB valves as well as other OEM valves. Other product to be assemble in the facility include the Gate, Globe and Check (GGC) valves (up to 2" forged, all pressure class); floating ball valves (up to 6", all pressure class); Trunnion ball valve (up to 24", pressure class up to 1,500).

The proposed Steel pipe threading facility has a design capacity of (Production Tubing between 30,000-40,000 MT/year and Production Casing of 50,000-60,000 MT/year) of OCTG products. In the first two year of production, the plant shall commence with one (1) shift to produce 20,000MT of the products which will gradually increase to three (3) shifts to ramp production to 60,000MT per annul. Although, some of the OTCG products can be used in petroleum product marketing depots, the proposed project is targeted at the exploration and production companies in the Nigeria Oil sector, which have been categorized as below:

- International Oil Companies (IOCs)
- Local Exploration & Production (E&P) companies
- Marginal Field and indigenous Operators

These companies have their business operations in Lagos, Port Harcourt, Benin and Warri and the facility is strategically positioned to service them from proposed location at the Lekki Free zone, Lagos. The proposed facility is first of its kind in Lagos and part of efforts to grow the BOG market reach and sustain the current trade expansion around the world.

The proposed Steel Pipe Threading and Valve Assembly facilities will be completed within the period of Eighteen (18) months.

ES4.0 Environmental Characteristics of the Project Area

The baseline environmental characteristics of the project area have been described using data obtained from existing literature and field surveys. Field sampling and data collection (wet season) for the purpose of this EIA was conducted in the week of March 6th – 8th, 2018 in the presence of the FMEnv representative. Surveys covered Ambient air quality, Soil, surface and ground waters, and socio-economic characteristics of the project area. As approved by the Federal Ministry of Environment (FMEnv), one season (wet season) survey was conducted. To assess the extent of project influence, the spatial boundary of 500meters to the project area was considered High-level supervision by FMEnv representative and due diligence were ensured throughout the field data gathering and laboratory analysis.

Climate Characteristics

Climate of the study area is characterized by the dry and wet seasons and it rains in every month of the year with rainfall ranging between 20 and 350 mm. Every other measured meteorological parameter during the fieldwork agrees with climatic data of the area.

Ambient Air Quality and Noise levels

While CO was measured to be 1.5 – 2.0 ppm with SD of 0.82 ppm, NO_2 was 0.05 ppm with SD of 0.03 ppm. Also VOCs, SO_2, NH_3 and O_3 were 0.02 – 0.04 ppm (with SD of 0.18 ppm), 0.04 ppm (with SD of 0.01 ppm), 6.2 - 8.4 ppm (with SD of 3.38 ppm) and 0.04 – 0.05 ppm (with SD of 0.02 ppm) respectively. Nitrogen dioxide (NO_2) and SO_2 were detected in one of the sampling locations while CO, NH_3 and O_3 were detected in two locations with VOCs detected in three locations. Nitric Oxide (NO), CH_4 and H_2S were not detected in any of the locations. Only SO_2 and NH_3 breached their respective 1-hour standards and only CO was detected at the control station but within its limit. Similarly their daily equivalents are all within their respective FMEnv limits except SO_2 and NH_3.

Particulates were detected in all the sampling locations with 1-hour levels of 4.4 – 10.0 µg/m^3 (with SD of 1.7 µg/m^3), PM_{10} levels were 14.0 – 47.3 µg/m^3 (with SD of 10.6 µg/m^3) with TSP levels of 23.2 – 71.9 µg/m^3 (with SD of 15.2 µg/m^3). In all the sampling locations where detected, the 600 µg/m^3 1-hour FMEnv limit of TSP was not exceeded. Similarly their respective daily equivalents of 1.7 – 3.8 µg/m^3 (SD of 0.6 µg/m^3), 5.4 – 18.1 µg/m^3 (with SD of 4.1 µg/m^3) and 8.9 – 27.6 µg/m^3 (with SD of 5.8 µg/m^3) were all within limits. However these were higher than 0.1 µg/m^3, 0.8 µg/m^3 and 5.1 µg/m^3 earlier reported for $PM_{2.5}$, PM_{10} and TSP respectively in the study area (Yulong, 2017). This could be attributed to more anthropogenic activities in the area during this study than in the earlier study.

The ambient noise levels of the proposed project site and its surroundings were measured to be 28.7 – 55.0 dB(A) and 42.3 – 79.0 dB(A) as day-time L_{min} and L_{max} respectively with respective night-time levels of 32.2 – 55.0 dB(A) and 38.9 – 76.4 dB(A). The background noise levels (L_{90}) were 35.5 – 56.0 dB(A) and 33.7 – 55.6 dB(A) for day-time and night-time respectively. Both the day-time and night-time noise limits were not breached in any of the sampling locations at the proposed project site. Similarly the 70 dB(A) industrial area noise limit of the World Bank was not breached. Mobile plants and vehicular movements were the main anthropogenic sources of noise during the study.

Hydrology and Geology/ Geomophology

The project area is drained largely by Lekki lagoon and network of man-made creeklets and freshwater swamps in dendritic fashion.

Geologically, the subsurface geology of the project site reveals two basic lithology clay and sand deposits. These deposits are inter-bedded in places with sandy clay or clayed sand. The proposed project area is very gently sloping to a plain land, and lies within the sedimentary belt of southern Nigeria. It is typically a lowland rainforest ecosystem with deep, sorted sandy soils derived from coastal and lagoonal deposits. The parent material of the soils is devoid of nodules, concretions and gravels.

Soil Studies

Geomorphology and Physical Setting of the Study Area: The proposed project area is very gently sloping to a plain land, and lies within the sedimentary belt of southern Nigeria. It is typically a mosaic of lowland rainforest and freshwater swamp ecosystem with deep, porous, well sorted sandy soils derived from coastal and lagoonal deposits. The soils are devoid of nodules, concretions and gravels.

ES: Soils Study Approach: Field investigation and soil sampling were carried out randomly within the study area. Core soil samples, taken with Dutch Soil Auger, were homogenized in plastic buckets before sub-sampling for various parameters to be analyzed in the laboratory. Adequate QA & QC measures were put in place in the field and during laboratory analyses to preserve the quality of samples and generate reliable data. The various analytical procedures employed were those nationally and internationally approved.

Soil Type and Quality: Soils in the project location would classify as - tropical young, deep sandy soil i.e., Tropsamment in the USDA Soil Taxonomic System and Arenosol in the World Soil Resources Legend. The soils are considered not to be physically and chemically aggressive on account of high porosity, permeability, low chloride and sulphate content, and near neutral pH. Other soil data obtained did not show any evidence of heavy metal and hydrocarbon contamination/ pollution of the soils.

Vegetation and Landuse

Flora Features

A a total of fifty-nine (59) plant species belonging to twenty-eight (28) families were recorded in transects areas and comprising of both woody and herbaceous flora. Forty-one (41) species representing 70% of the encountered species were herbs, one (1) species representing 2% are lianas, five (5) species representing 8% are shrubs while twelve (12) plant species representing 20% were trees. The five most abundant plant species across the proposed project areas at LFTZ community and its environs include: Siam weed (*Chromonaela odorata*)*,* Haemorrhage plant (*Aspilia africana*)*,* Goat Weed (*Ageratum conyzoides*)*,* Nut sedge (*Cyperus ustulatus*)*, and* Nut grass (*Kyllinga erecta*)*.* However, five of the species that had the least abundance are: Stool Wood (*Alstonia boonei*)*,* Hog Plum (*Spondias mombin,* White Afara (*Terminalia superb*)*,* Wild Fig (*Ficus platyphylla*)*,* and *Solanum erianthum*.

IUCN Status of Flora Species

In terms of IUCN status using the Red List of Threatened Species Status (2019-1) only one (1) plants of conservation interest was identified within the study area. All the plants encountered encountered during the study showed that they can be categorised into three conservation status; most of the plants encountered are Data Deficient (DD), whereas only three (*Elaeis guineensis*, *Cyperus difformis* and *Trema orientalis*) of them are Least Concerned (LC). *Mitragyna stipulosa* is Vulnerable (V) and needs greater attention for its conservation. It is worthy of noting that those encountered are sampling sizes and are yet to be fully grown up.

Economic Plants

Economic plant species abound in the area and some identified includes: Raffia palm tree (*Raphia hookeri*), Palm oil tree (*Elaeis guineensis*), Mango (*Mangifera indica*), Banana (*Musa sapientum*) etc. The community inhabitants use these plants in a variety of ways.

Wildlife Resources

Several mammals including those that are common & uncommon, the endangered, vulnerable, and rare, reportedly known to be present in the area were carefully documented. The study area contains quite a few birds of the waterside and an abundance of species commonly associated with gardens, farmlands, fallows with scattered trees, and dense secondary growth. These were also documented.

Water Quality - Groundwater

The groundwater sources sampled and analysed for this study were borehole around the project area. The choice of investigated water quality parameters was guided by regulatory requirements especially for portability and pollution assessment. Samples were collected, preserved and analysed for the various parameters using applicable standard methods. The parameters with no holding time were measured *in situ*.

The groundwater samples were less turbid with turbidity values within the NIS (2015) drinking water standards. The water was strongly alkaline (pH = 8.55±0.15) during the dry season and neutral (pH = 6.93±0.30) in the wet season. The ionic hierarchy of dominance of the cations and anions (meq./L) was: Ca^{2+} > Mg^{2+}/ Na^{+} > Ca^{2+} > Mg^{2+} > K^{+} and SO_4^{2-} > Cl^{-}/ SO_4^{2-} for dry and wet season respectively with their values generally higher in the dry season than in the wet season. The oxygen parameters and nutrient compounds were generally higher in the dry season than in the wet season with their values in both seasons not suggestive of organic pollution. The heavy metals/trace elements occurred in trace concentrations from the groundwater samples in the area with an evidence of little or no inorganic pollution except for (Cr, Mn and Ni) in dry wet seasons as well as (Fe and Pb) in wet season with concentrations slightly above the prescribed NIS (2015) standards for drinking water. Organic compounds occurred in significantly low concentrations except for the mean PAHs values (1.856±0.729 mgL^{-1}) during the dry season, which was slightly above the NIS (2015) standards for drinking water, an indication of little or no organic pollution of the groundwater sources from the area. The presence of *E. coli* from the groundwater samples in the area during the dry season, suggest an indication of faecal/sewage contamination of the groundwater sources in the area in the dry season.

Land use Survey

Basically, five land use/land cover classes were discernable in the study area and these classes include (a) Bare land/ Sand filled Area (b) Developing Area (c) Communities /Settlement areas (d) Wetland/ Swampy Vegetation - Secondary regrowth vegetation (e) Road layout. The proposed project site is wholly within the freshwater swamp forest.

Settlements within the study area are mostly located outside the Lekki Free Zone along the coastline and the bank of Lekki lagoon probably because of the nearness to fishing grounds. The study area is readily accessible through the inland waterway of Lekki Lagoon by boats, while communities along the coastline are easily linked by tarred road coming from Lekki in Lagos.

Socio-economic Studies

The project is proposed within the Lekki Free Zone of Ibeju Lekki LGA, Lagos State. The host communities are Imobido , and Okun Tiye communities of Lekki LCDA in Ibeju – Lekki LGA, Lagos State, Nigeria. They are Yorubas of Ijebu Dialect originally. They still remain the dominant ethnic group in the communities though they now co-exist peacefully with other tribes and ethnicities that migrates to the area in line with the flourishing Ajah – Ibeju Lekki axis of the state. Their origin of the original inhabitants is traced to the ancient Oyo Empire of Southwest Nigeria. The socio- economic survey techniques adopted for this study includes the community interactions especially with the elders of the communities and Focused Group Discussion (FGD). The FGD revealed that they hailed from Ijebu Ode to Epe. The residents claimed they got to the current locations through surface waterbodies in search of solution to high death rate of adolescence, for fishing and farming expeditions around the 17th century.

The neighbouring settlements around the project area include Ilede, Idaso, Oke Isegun, Magon Isegun, Itoke, Idotun, Ala, Olomowewe, Okuraye and Elekuru. The two host communities (Tiye, and Imobido; and ten neighbouring settlements were part of the MOU signed with the State government on the creation of the Free Trade Zone. Despite the diversities of ethnic groups in the studied communities, it was stated categorically during the interview that there has never been ethnic violence among these different ethnic groups.

Taxicabs and motorcycles (Okada) are the most popular means of transportation in the vicinity. With respect to the proposed project site, accessibility to the site is through the Lekki Free Zone road, which is off the Epe-Lekki Express road. This road is paved with bitumen and dual carriage lanes, whereas the Lekki Free Zone road is a single lane road. The road leading to the Imobido and Tiye communities are earthen road and require attention.

The typical settlement pattern in the project area is linear as buildings are arranged along the road network. The proposed project neighbourhood contains a mixture of both commercial and residential land use. The housing types include bungalows, and face-to-face. The roofing materials are largely made of zinc.

Lastly, the FGD revealed that the perception of the resident populations of Lekki FZ project environment are not opposed to the industrialization drive of the State Government; through the creation of the Free Zone (FZ) within their immediate environment. The people are however, not unmindful that the land-take arising from the acquisition of FZ project and project construction activities and subsequent operation could affect them. In view of these, the Community representatives informed of their high expectations regarding the proposed project activities with particular reference to the associated positive effects. Some of these include increased and more permanent employment opportunities to indigenes at the skilled, semi-skilled and unskilled levels as company's operations enlarges and as opportunities emerge, economic empowerment of youth and women group through skills training/acquisition and micro-credit programs; vendor services/minor supplies (contractor), compensation for resource losses, scholarships and provision of infrastructures, e.g., electricity, water, roads, among others.

ES5.0 Associated and Potential Impacts:

For the purpose of impact identification, we considered the various project phases, and the activities to be undertaken for each phase. Based on biophysical, socio economic and health elements considerations, we were able to highlight the impacts that will attend each activity. Essentially, the strategy employed for impact identification is "Activity Related Impact identification". The planned project implementation will be in three main phases:

(i) Pre-construction phase
(ii) Construction and Installation of facilities Phase
(iii) Commissioning, Production Operations and Maintenance.
(iv) Decommissioning and Abandonment Phase.

Each project phase was broken down into specific activities and each activity was screened against specific biophysical, socio-economics and health impact parameters. All activity-environment interactions that were not screened out as un-important were assessed in further detail. The detailed assessment included characterization either as Positive or Negative, Direct or Indirect, severity ranking and overall impact significance. A severity versus likelihood matrix was used to arrive at the overall significance ranking of Low, Moderate or High. Summary of the beneficial and negative impacts for each project phase including their significance rankings are presented below:

Positive Impact of the BOG FZE proposed Steel Pipe Threading and Valve Assembly facilities Project

The EIA identified a number of positive impacts of the proposed Steel Pipe Threading and Valve Assembly facilities project. Most of these impacts affect the socio-economic and health environment as indicated below:

- Increase employment opportunities
- Improve economic growth
- Reduction in Foreign Exchange Expenditures on Importation
- Improve the local capacity development
- Improvement in the welfare of neighboring communities

Negative Impact of the Proposed Steel Pipe Threading and Valve Assembly facilities Project

Potential negative impacts arising from the proposed project are based on the each phase of development:

Pre-construction Phase:

- Increment of the noise level within the project environment
- Impact on ambient air quality due to possible emissions
- Possibility of traffic congestion
- Pressure on existing infrastructure
- Impact on public health & Safety due to the presence of construction workers within the communities

Construction Phase:

- Change the biodiversity of the project area
- Increase in noise level due to construction activities
- Impact on ambient air quality due to possible emissions
- Increase the waste generation and handling requirements due to construction activities
- Exact pressure on the existing infrastructure
- Impact on public health & Safety due to the presence of construction workers within the communities
- Possible soil & groundwater contamination from oil spillage during construction activities

Operational Phase

- Increase in noise level due to the operation of production facility
- Impact on ambient air quality due to possible particulate emissions
- Impact on traffic network during raw material offloading and products distributions
- Increase waste generation and handling/disposal

Decommissioning Phase

- Increase in noise level due to the decommissioning activities
- Impact on ambient air quality due to possible particulate emissions during decommissioning activities
- Increase waste generation and handling
- Reduce employment opportunities and income of the people within the project area
- Impact on public health & Safety due to the presence of workers during decommissioning activities

For this project, it is clear that although there are a number of positive issues arising from the proposed project, there will equally be some negative impacts. Most of these negative impacts are either low or moderate and can be mitigated with cost-effective mitigation measures. These mitigation measures form the focus of the next chapter of the report.

ES6.0 Mitigation Measures

Mitigation measures are options that can be used to either completely eliminate or minimize identified negative impacts of a development project. The design of the BOG FZE Proposed Steel Pipe Threading and Valve Assembly facilities project has gone beyond strict adherence to generic codes & standards, and developed a design basis customized for the project.

In addition to design mitigation measures a number of additional measures have been prescribed for the identified impacts ranked as having moderate and high significance. The mitigation measures ranged from simple practices such as the evacuation of the cleared vegetation by host communities, adequate erosion control and project-related transportation shall be timed to coincide with low traffic hours in the area. The residual impact ranking of most of these impacts such as landtake and change in landform after mitigation is low. Together with in-built measures, the prescribed impact mitigation measures are expected to significantly improve the environmental sustainability of the project.

ES7.0 Environmental Management Plan

Bell Oil and Gas (BOG) FZE places strong emphasis on maintaining safe and healthy working conditions for its personnel and minimizing the negative effects of its activities on the natural environment. BOG FZE is genuinely committed to the attainment of these objectives through the implementation of its policy and mitigation strategies outlined in this report.

The EMP developed for the proposed Steel Pipe Threading and Valve Assembly facilities Project has taken into consideration, all the specific project activities covering the site preparation, construction stage and the project operations phase. The EMP includes an Environmental Management System similar to the ISO 14001 Management System requirements, and an Environmental Monitoring Programme.

The environmental monitoring programme has two components. *Effects monitoring* involves the measurement of environmental parameters so as to detect changes in these parameters that can be attributed to the project, while c*ompliance monitoring* is the periodic or continuous measurements of environmental parameters or discharges to ensure that regulatory requirements and standards are met. Environmental monitoring will cover biophysical, socio-economic and health characteristics. Results obtained will be benchmarked against the baseline data. The monitoring schedule prescribed by this EIA shall be implemented as the Post-EIA Monitoring Programme.

The proponent intends to follow the monitoring programme proposed in this report and commits to make budgetary allocations from the planned project based on the prevailing market rate for consultancy of this nature.

ES8.0 Decommissioning/Closure and Abandonment of the proposed Steel Pipe Threading and Valve Assembly facilities

Since the Proposed BOG Steel Pipe Threading and Valve Assembly facilities Project will depend largely on the Nigeria petroleum resources, it will eventually be decommissioned and abandoned. The proposed Steel Pipe Threading and Valve Assembly facilities would be designed, built and maintained to operate efficiently for about 50years after which, it will be decommissioned and abandoned in conformance with a plan that meets local regulatory requirements and international standards.

The content of the plan will take into consideration the extent of the decommissioning (temporary or permanent, partial or complete shutdown), plans for future use of the decommissioned facilities and the site, and the condition of the site and environment at the time of decommissioning. A detailed post-operational study of the project on the environment will be conducted to determine appropriate restoration and remedial measures.

ES9.0 Recommendation and Conclusion

With the present drive of the Federal Government to woo investors into Nigeria economy, the planned project is one of the results and should be encouraged. However, this development should be achieved with sound environmental sustainability. With the detailed description of environmental baseline characteristics of the project area, and the exhaustive impact identification that have been presented in earlier sections of this report, we can conclude that the development will lead to a number of significant positive impacts if all recommended mitigations strictly adhere to. For instance, all precautionary measures applicable to the construction works like dust suppression measures, noise pollution control, watercourse protection, prevention of untreated wastewater discharge during the operational phase to the existing storm water catchment channel located beside the site in order to avoid surface water contamination will be implemented before and during the construction phase.

The proposed Steel Pipe Threading and Valve Assembly facilities project within the Lekki Free Zone development at Ibeju Lekki Local Government Area, Lagos by Bell Oil and Gas FZE will achieve the highlighted benefits in a sustainable manner if the recommended measures are strictly implemented, and the monitoring and management program for the environment are equally handled in proper perspectives.

ACKNOWLEDGEMENT

Bell Oil and Gas (BOG) FZE wishes to express her appreciation to the management of Lekki Free Zone Development Company for the opportunity to develop the proposed Steel Pipe threading and Valve Assembly facilities at the Lekki Free Zone. BOG FZE also expresses gratitude to the Federal Ministry of Environment for the opportunity to prepare the Environmental Impact Assessment for the proposed Steel Pipe threading and Valve Assembly facilities at the Lekki Free Zone. The proponent expresses appreciation to the EIA Consultant, Global Impact Environmental Consulting Ltd for undertaking the Environmental Impact Assessment (EIA) Study on their behalf. BOG FZE also recognizes the assistance received from all sources of data and information for this project, including the Planning Department of Lekki Free Zone Development Company, the Baales of the project affected communities namely Imibido, and Tiye Communities and the Ibeju Lekki Local Government Area.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

This is the report of an Environmental Impact Assessment (EIA) study carried out on the proposed Steel Pipe Threading and Valve Assembly facilities by Bell Oil and Gas FZE, an independent oil services company specialised in supplying dedicated professional services to the upstream sector of the oil and gas industry in Nigeria. It is a project in support of the Federal Government Policy on both private and public participation in the Oil and Gas industry as well as the Nigerian Content Act and government's commitment to promoting Nigerian content. Most importantly, the policy encourages those that provide service to the upstream and downstream sector of the Oil and gas industry such as the Dangote refinery project under construction, a crucial project to the Nigerian economy located in the same axis as the proposed project. With this strategic development and the interest so far, the accessibility and availability of locally made threaded pipes and valves locally would be increase. This will boost local production capacity and increase foreign earnings for the Government.

The proposed steel pipe threading is a spiral ridge on the end of a pipe that enables pipes to be joined together. The Oil Country Tubular Goods (OCTG) threading facility will be supported by several lathes and advanced CNC equipment in 15,000 square meters of manufacturing space and storage. The facility will thread OCTG pipe up to range 3 length and 13-3/8″ diameter. In addition to threading, tubular repairs and fabrication of crossovers, pup joints, couplings and other accessories, the proposed facility will also offer in-house gauging, inspection and storage capabilities. For the valve assembly, testing repair and maintenance plant, the proposed project will assembly of smaller valve sizes including testing, repair, painting, and maintenance of OMB as well as other Original Equipment Manufacturer (OEM) valves.

Under the provisions of the Nigerian Environmental Impact Assessment Act No 86 of 1992 as amended by EIA Act Cap E12 Law of the Federal Republic of Nigeria (LFN) 2004, an EIA is required prior to the development of the proposed Project. The purpose of the EIA is to identify and assess the potential environmental and social (E&S) risks and impacts of the Project so that they can be appropriately managed.

The EIA of the proposed Steel Pipe Threading and Valve Assembly facilities project was conducted on behalf of Bell Oil and Gas FZE by Global Impact Environmental Consulting Limited, an accredited Environmental Consultant.

1.2 Project Proponent

Bell Oil & Gas specializes in supplying dedicated professional services to the upstream sector of the oil and gas industry based in Port-Harcourt and Lagos State. Bell Oil & Gas was incorporated in January 2002 and has experienced unprecedented growth in the Nigerian oil industry. The company is an independent oil services company, which was formed and wholly owned by Nigerians. Bell Oil & Gas is a provider of Surface Protection services; Line Pipes & OCTG; Flow Control; Well Testing Services; the supply, installation and maintenance of Glass fiber Reinforced Epoxy (GRE) pipe systems, Drilling services and of Rotating Equipment. In addition, Bell Oil & Gas is a major suppliers of a range materials and equipment for several sectors in the Nigeria oil and gas industry. The company has an outstanding performance in the industry in term of output, sales volume, varieties and quality of products over the years. To achieve the business objectives, the project proponent intend to build Steel Threading Pipe and Valve Assembly facilities in Lekki Free Zone Lagos State, Nigeria, as part of its strategic approach to market expansion and drive to become one of the leading Oil and Gas servicing industry in the country.

As part of the company's strategic business in market expansion has decided to invest in the Nigeria economy by establishing their regional production facilities within the Lekki Free Zone. Bell Oil & Gas facilities will cover an area of 15,146.0 square meters and absorbs an investment of $10million in its first phase. The production factory is slated to come on stream in June 2021 and looks set to become a best-in-class smart plant in Nigeria and greater Africa as a whole.

The proposed project is planned to be located within the Lekki Free Zones (LFZ), E6 road, a special designated area within the economic nerve center of Nigeria, Lagos State, where normal trade barriers like quotas, tariffs are removed and the bureaucratic necessities are narrowed in order to attract new business and foreign investments. The proposed project site is geographically advantageous for trade and places near international airports, seaports, to mention few.

As part of the regulatory requirements, a project such as the proposed Steel Pipe Threading and Valve Assembly facilities project requires an Environmental Impact Assessment in order to evaluate the baseline situation of the proposed project area and also to identify the likely impacts (positive or negative) that could arise from the planned project. To obtain the regulatory approval for this planned project, **Bell Oil and Gas FZE** invited **Global Impact Environmental Consulting Limited** to conduct the Environmental Impact Assessment Study for their proposed project in fulfillment of the regulatory requirements.

This report relates to the EIA for the proposed project and will cover the assessment of planned project activities, the environment around the project area, and the associated and potential impacts of the proposed project as well as reasonable mitigation options for the negative impacts.

1.3 Project Location

The proposed Steel Threading Pipe and Valve Assembly facilities and related activities Project is located within an industrial layout north-west direction of the existing Lekki Free Trade Zone (LFTZ) (**Fig 1.1 and Plate 1.1**). It is situated at the eastern part of Lekki, which covers a total area of about 155 km^2. The zone is a joint venture partnership established in May 2006 pursuant to the Nigeria Export Processing Zones Act (NEPZA) among China-Africa, Lagos State Government and Lekki Worldwide Investments Limited. The Lekki Free Zone Development Company (LFZDC) manages Lekki Free Zone and shares immediate boundary with two other Free Zones Areas, which are Dangote Free Zone and Lagos Free Trade Zone. It is also located at an estimated 10km to Northwest Quadrant Free Trade Zone now rechristened as Alaro City.

Administratively, it is located within the Ibeju Lekki Local Area (LGA) of Lagos state (**fig 1.2**). The proposed project area covers a total land area of approximately 15,146.0 square meters. It is about 500 meters west of the on-going Dangote Refinery Plant. Its geographical extent is between 3^0 58' 14.12" E – 3^0 58' 12.50"E and 6^0 27' 36.89"N – 6^0 27' 43.64"N (**See Fig 1.3**). Closet communities (about 4.39KM) to the site are Ilege and Idasho while it can be accessed mainly by either through Ilege or Idasho community road junction off the Ibeju/ Free Trade Zone express road or through Lekki Lagoon (it is bout 3.22Km northward to Lekki Lagoon shoreline) as shown in **Figure 1.4**.

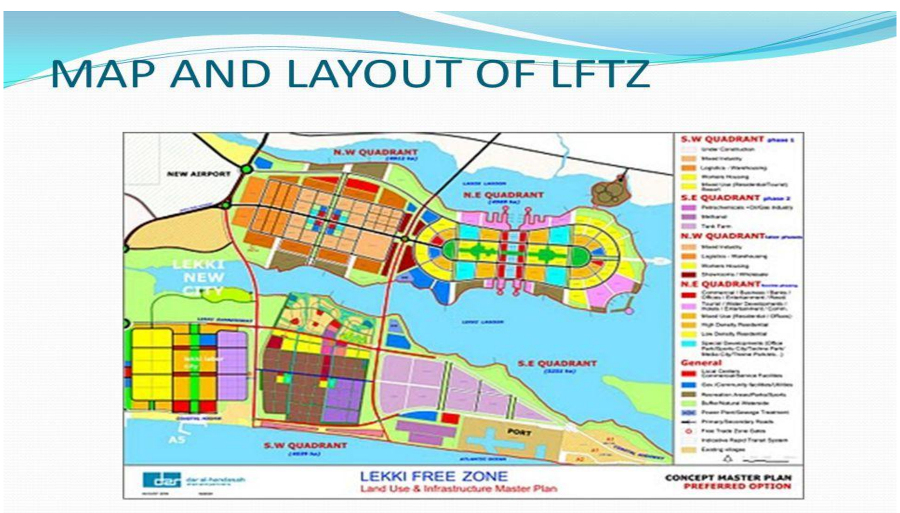


Fig 1.1: Map and Layout of Lekki Free Trade Zone

Plate 1.1: Front view of the Lekki Free Zone

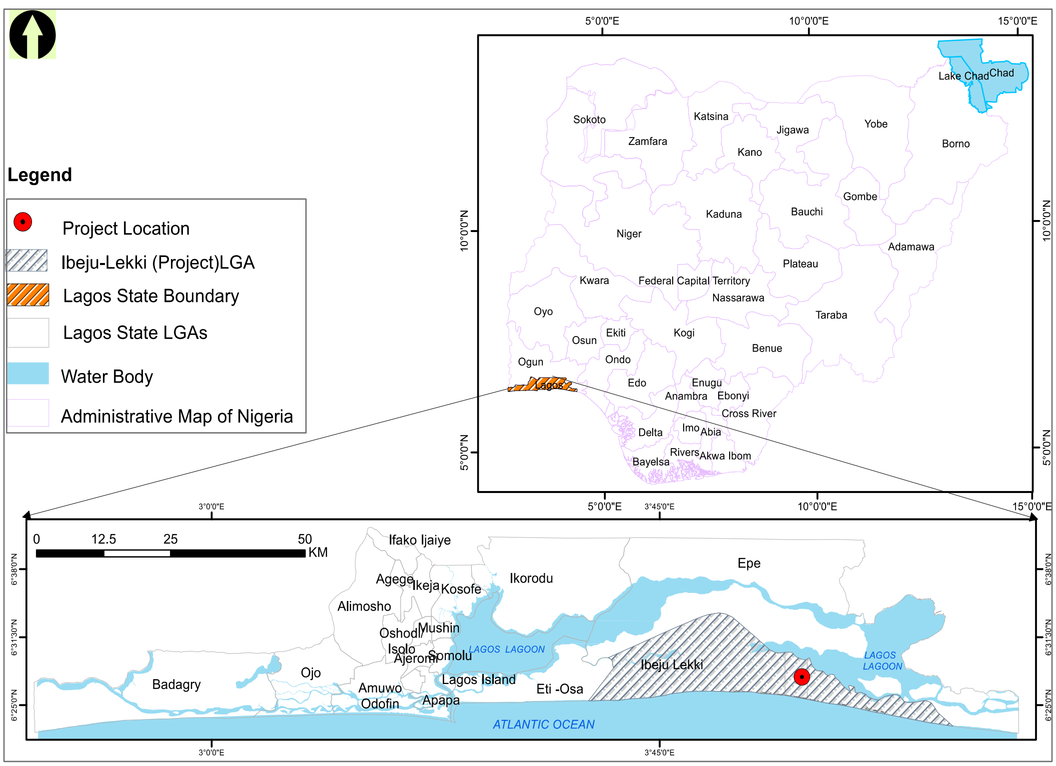


Figure 1.2: Administrative Map of Lagos State Showing Ibeju-Lekki LGA

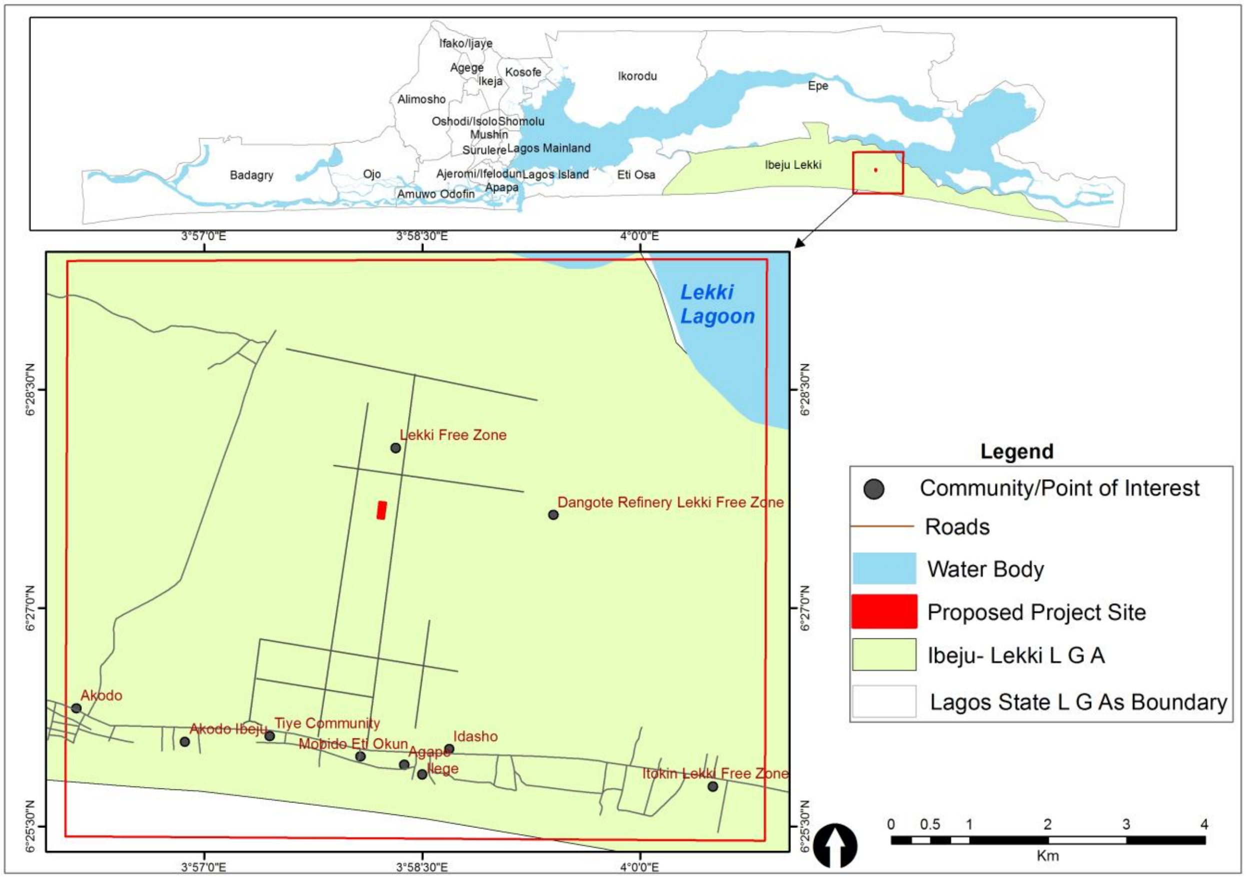


Figure 1.3: Administrative Map of Ibeju-Lekki LGA State Showing the project location

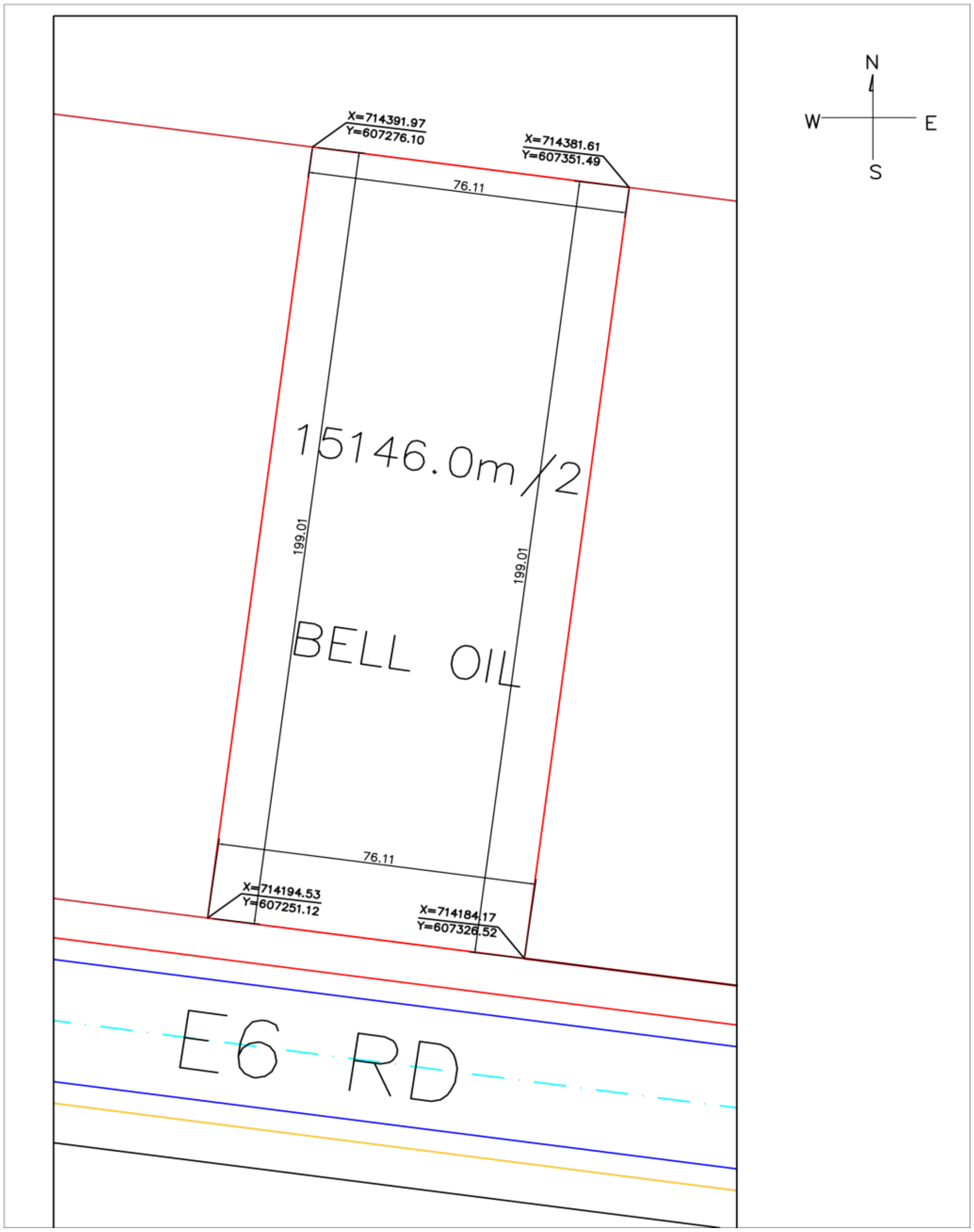


Fig 1.4: Perimeter survey of the proposed project site

The project site is situated on swampy forest vegetation. The site could be assessed by Lekki lagoon and by land through the accesible by land through single carriage Eleko-Lekki (Coastal) Road which is the major road linking the entire LFTZ from Lekki-Epe Expressway. The proposed project is estimated to use 10,176.13sqm while an estimated 4,823.87sqm will be reserved for future expansion, out of the project site covers 15,146.0 sq.m. The land budget for the project components based on the site layout is given in **Table 1.1.**

Table 1.1: Proposed project facility components and the breakdown of land requirement area

S/N	Project component	Area in sqm
1	Oil Country Tubular Goods (OCTG) Threading Assembly Plant	6, 480
2	Valve Assembly plant	800
3	Glass Reinforced Epoxy (GRE) Spooling Yard (Composite Pipe Workshop)	400
4	Administrative Building	792
5	Utility Area	50
6	Parking Area	50
7	Stacking Area	2160
7	Waste Storage Area	45.1

Figure 1.5: Satellite Imagery of the proposed Steel Pipe Threading and Valve Assembly Facilities project site

The proposed project location has viable advantage with its proximity to the proposed site for Lekki Deep Sea Port which will allow prompt delivery of raw materials, existing gas pipeline for energy supply, availability of oil and gas facilities and emerging mega city of Lagos that ensures immediate markets for the finished products as well as adequate protection against danger, damage, loss, and criminal activity with minimal occurrence of civil unrest. Also, its proximity to Lekki Lagoon and creeks provides added advantage.

1.4 EIA Objectives

The overall objective of the EIA study is to proactively identify and assess the potential environmental and social (including health and safety) risks and impacts associated with the proposed project throughout its life cycle and to put in place appropriate mitigation measures and management actions to address and monitor the identified risks and impacts. This is to ensure that the project is planned, constructed and operated in a sustainable manner and to promote its environmental and social performance.

Specifically, the objectives of the EIA are to:

- Assist Project design and planning by identifying those aspects of location, construction, operation and decommissioning, which may cause adverse environmental, social, health and safety effects.
- Establish the existing state of the Project environment (biophysical, social, economic and cultural) and identify any sensitive components of the environment.
- Recommend appropriate and practicable measures during construction, commissioning, operations and decommissioning to avoid and mitigate adverse effects and enhance beneficial impacts.
- Develop an appropriate Environmental Management Plan (EMP) for the Project including monitoring programme.
- Provide the basis for engagement with potentially affected communities and other stakeholders, including the relevant regulatory authorities.
- Prepare a detailed report presenting clear and concise information on the findings of the EIA.

1.5 EIA Terms of Reference

In line with the National EIA Procedural Guidelines, a detailed scoping report including Terms of Reference (ToR) was prepared and submitted to the FMEnv. The ToR section highlighted the general scope of the EIA including the overall data requirements on the proposed Project environment. The FMEnv-approved ToR for the EIA study is provided in **Annex**.

1.6 Legal and Administrative Framework

This section presents the legislation and policy context as well as environmental and social regulations that apply to the proposed project and the EIA study. The project shall ensure compliance with the applicable local and international regulations and standards throughout its life cycle.

1.6.1 National Policy, Guidelines and Regulations

1.6.1.1 The Department of Petroleum Resources (DPR) Environmental Guidelines and Standards for the Petroleum Industry (EGASPIN) – 2002, and 1991

The first major national environmental guidelines for oil and gas exploration and production activities came into effect in 1981 when the Department of Petroleum Resources (DPR) issued interim guidelines and standards on monitoring, treatments and disposal of effluents from the petroleum industry. Regulations existing before this time were not specific environmental acts or laws; they were limited to statutory provisions that requested voluntary environmental protection efforts from operators. In 1991, the sustainable Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) replaced the 1981 interim guidelines. In 2002, a revised EGASPIN was published, replacing an unpublished 1999 version. Oil companies are working in compliance with the 2002 requirements. These guidelines and standards have been reviewed and updated for implementation and enforcement by the Minister of Petroleum Resources, as empowered by the Petroleum Act of 1969.

The DPR EGASPIN published in 2002 serves as a key to non-technical personnel, providing advice on the activities conducted, the nature and amounts of wastes and discharges expected, and regulations and standards pertaining to these wastes and discharges. The DPR guidelines also specify that an EIA is a mandatory permit requirement for development drilling activities and other hydrocarbon processing facilities.

1.6.1.2 Procedure Guide for the Design and Construction of Oil and Gas Surface Production Facilities (2001)

These guidelines, issued by the DPR and pursuant to Regulations 36 and 39 of the Petroleum (Drilling and Production) Regulations (1969), outline permitting procedures for applications for approval of construction of all oil and gas surface production facilities in the Nigerian petroleum industry. The approval process for any project execution covers four sequential stages:

- Conceptual design
- Detailed design
- Pre-commissioning / oil and gas facility operating permit
- Decommissioning

1.6.1.3 The Oil and Gas Pipelines Regulations (1995), as Published in the Federal Republic of Nigeria Official Gazette (No. 49 Gas Pipelines Regulations 1995)

Federal Republic of Nigeria Official Gazette No. 26 of 2 October 1995, Vol. 82 [Government Notice No. 49], came into effect on 17 June 1995 and enlarged the scope and coverage of the pipeline Act of 1956. These regulations require that pipeline construction be performed in a manner that minimizes disturbance to the provisions of API RP 1102 or other recognized equivalent international operating standards.

1.6.1.4 The Petroleum Act (1969)

The Petroleum Act (1969) was the first comprehensive legislation introduced in Nigeria applicable to petroleum operation. The Act does not explicitly address impacts from pollution, except to make provisions for the power to create regulations for "the prevention of pollution of watercourses and the atmosphere." This Act allows for operations to be performed under safe working conditions and ensures the conservation of petroleum resources. The Minister of Petroleum Affairs is vested with the implementation of the Act.

Broad categories of regulations under the The Petroleum Act 1969 includes:

- ❖ Mineral Oils (Safety) Regulations (1962)
- ❖ Petroleum (Drilling and Production) Regulations (196)
- ❖ Petroleum Refining Regulations (1974)
- ❖ Mineral Oils (Safety) Regulations (revised 1997)

1.6.1.5 Oil Pipelines Act (1956)

This Act provided for licenses to be granted for the establishment and maintenance of pipelines incidental and supplementary to oil fields and oil mining, and for purposes ancillary to such pipelines. Environmental issues covered by the Act include the proposed pipeline route or alternative routes, notices before entry, damages, compensations, and dispute resolution.

1.6.1.6 Federal Ministry of Environment (FMEnv)

The FMEnv is the primary authority for the regulation and enforcement of environmental laws in Nigeria. The Act establishing the Ministry places on it the responsibilities of ensuring that all development and industry activity, operations and emissions are within the limits prescribed in the national guidelines and standards, and comply with relevant regulations for environmental pollution management in Nigeria as may be released by the Ministry.

In furtherance of her mandate, the FMEnv developed laws, guidelines and regulations on various sectors of the national economy. The specific policies, acts, guidelines enforced by FMEnv that are applicable to the proposed project are summarized below:

- ***National Policy on the Environment***
  Environmental management in Nigeria is based on the National Policy on the Environment (1989), revised in 1999 and 2017. The Policy states that Nigeria is committed to safeguarding the country's natural and built environment for the use of present and future generations. This commitment demands that efficient resource use and the reduction of environmental impacts are a core requirement of all developmental activities. The strategic objective of the Policy is to coordinate environmental protection and natural resources conservation for sustainable development.

- ***National Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991***. This represents the basic instrument for monitoring and controlling industrial and urban pollution.

- ***National Environmental Protection (Effluent Limitation) Regulations (1991*).** The Effluent Limitation Regulation makes it mandatory for industries to install anti-pollution and pollution abatement equipment on site. Appropriate penalties for contravention are also prescribed.

- ***National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991***. This imposes restrictions on the release of toxic substances into the environment and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency plan by industries.

- ***National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991***. This Statutory Instrument regulates the collection, treatment and disposal of solid and hazardous wastes from municipal and industrial sources and gives the comprehensive list of chemicals and chemical waste by toxicity categories.

1.6.1.7 EIA Act Cap E12 LFN 2004.

The EIA Act is the primary Act governing Environmental Impact assessment (EIA) in Nigeria. It was promulgated in order to enable the prior consideration of an EIA on specified public or private projects. The Act sets out the procedure to be followed and methods to be used in undertaking an EIA. Section 2(2) of the Act requires that where the extent, nature or location of the proposed project activity is such that it is likely to significantly affect the environment, an EIA must be undertaken in accordance with the provisions of the Act. National Environmental Impact Assessment Procedural and Sectoral Guidelines in response to the promulgation of the EIA Act, the FMEnv developed National EIA Procedural Guidelines and other set of guidelines on various sectors of the National economy. Applicable to this study is the EIA Guidelines for Manufacturing Sector (2013).

1.6.1.8 National Environmental Standards and Regulations Enforcement Agency (NESREA)

The Federal Government of Nigeria established the National Environmental Standards and Regulations Enforcement Agency (NESREA) in 2007 as a parastatal of the FMEnv. The Agency is charged with the responsibility of enforcing the environmental laws, guidelines, standards and regulations in Nigeria, specifically during the operational phase of developmental projects. The NESREA's regulations applicable to this pesticides production include:

- ***National Environmental (Surface and Groundwater Quality Control) Regulations, 2011***. The purpose of this regulation is to enhance and preserve the physical, chemical and biological integrity of the groundwater and surface water resources.
- ***National Environmental (Air Quality Control) Regulations, 2013***: The objective of this Regulation is to ensure the control of air pollutants that may affect the ambient environment.

- ***National Environmental (Hazardous Chemicals and Pesticides) Regulations, 2013***: The main objective of this Regulation is to ensure that best practices are applied and maintained in the transport, use, storage, handling and management of hazardous chemicals and pesticides.

1.6.1.9 Nigeria Export Processing Zone Authority Act No 63, 1992

Objective- To establish the Nigeria Export Processing Zone Authority, to among other things, improve develop and regulate all the export processing zones. The authority, in addition to any other functions conferred on the Authority, the functions and responsibilities of the Authority shall include:

1. Administration of the Authority and management of all the Export Processing Zones;

2. Approval of development plans of the Authority and the Zones annual budgets in respect to infrastructures, administrative buildings, promotion of Zones, the provision and maintenance of services and facilities;
3. Establishment of customs, police, immigration and similar posts in the Zones;
4. Supervision and co-ordination of the functions of various public sector and private sector organizations operating within the Zones and resolving any dispute that may arise amongst them;
5. Resolution of trade disputes between employers and employees in the Zone in consultation with the Federal Ministry of Employment, Labour and Productivity;
6. Adaptation of investment promotion strategies in the Zones, including the opening of Investment Promotion Offices abroad;
7. Recommend to the Federal Military Government of additional incentive measures for the Zones;
8. Establishment and supervision of Zonal Administrators for the purpose of managing the Zones and the grant of all requisite permits and licenses to approved enterprises.

In addition to the above stated functions, the highlight of the provisions within the Act include:
1) Any enterprise, which proposes to undertake an approved activity within a Zone, shall apply to the Authority in writing for permission to do so and shall submit such documents and information in support of its application, as the Authority may require.

(2) Subject to the provisions of this Act, the Authority may grant, subject to such terms and conditions as it thinks fit, approval for an enterprise to undertake the approved activity specified in its application brought under subsection (1) of this section.

(3) For the purposes of this section, "approved activity," means any of the activities specified in the Second Schedule to this Act.

(4) The Authority and any approved enterprise shall be entitled to import into a Zone, free of customs duty, any capital goods, consumer goods, raw materials, components or articles intended to be used for the purposes of and in connection with an approved activity, including any article for the construction, alteration, reconstruction, extension or repair of premises in a Zone or for equipping such premises.

***1.6.1.10 The Nigerian Factories Act Cap F1, LFN 2004 (Amended Factories Act No 16 of 1987*)**

The Nigeria factory was established to provide for the registration, etc. of factories; to provide for factory workers and a wider spectrum of workers and other professionals exposed to occupational hazards, but for whom no adequate provisions had been formerly made; to make adequate provisions regarding the safety of workers to which the Act applies and to impose penalties for any breach of its provisions.

The general application of the provisions of the Factories Act can be found under its section 83 that apply to premises it considers as factories. Section 87 of the Act gives the definition of a factory as “Any premises in which or within which, or within the close or curtilage or precincts of which one person is, or more persons are, employed in any process for or incidental to any of the following purposes”, namely:

(a) The making of any article or of part of any article; or
(b) The altering, repairing, ornamenting, finishing, cleaning, or washing, or the breaking up or demolition of any article; or
(c) The adapting for sale of any article, being premises in which, the work is carried on by way of trade or for the purposes of gain and to or over which the employer of the person or persons employed herein has the right of access or control; and in which ten or more persons are employed.

With respect to the proposed project, the provisions of the factories Act specified various conditions expected of a factory. For instance, the subsection 8 of Part 2 states that a “factory shall not, while work is carried on therein, be so overcrowded as to cause risk or injury to the health of the persons employed therein”. In addition, the Part 3 of the Act also provides the general safety provisions required for a factory.

1.6.1.11 Nigeria Content Act 2010

The Nigerian Content Act is a law targeted at promoting local participation in the oil and gas industry. The Act provides exclusive consideration for Nigerian indigenous service companies, which demonstrate ownership of equipment, Nigerian personnel and capacity to execute jobs in the Nigerian oil and gas industry.

The Nigerian Content Act came into force on April 22, 2010 following presidential assent by the then Acting President, Dr. Goodluck Jonathan. All regulatory authorities, operators, contractors, sub-contractors, 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.

With respect to the proposed project, the establishment of the proposed project is in line with the primary objectives of the Act to promote local participation in the oil and gas industry for the overall benefit of the Nigerian economy. The overall goal of the Act is to domicile a greater spend of the industry in Nigeria. The Nigerian Content Development and Monitoring Board (NCDMB) established in accordance with the provision in the Nigerian Content Act 2010.

1.6.1.12 Standards Organization of Nigeria Act 2015

Standards Organization of Nigeria (SON) is the apex standardization body in Nigeria. This SON Act 2015 has now replaced the Enabling Act No. 56 of 1971, which has three amendments: (Act No. 20 of 1978, Act No. 32 of 1984 and Act No. 18 of 1990). The proposed project operations and products such as the valves are expected to comply with Nigeria standards specifications or other designated and approved by the Council.

1.6.1.13 Nigerian Urban and Regional Planning Act LFN 2004 (NURP)

The Nigerian Urban and Regional Planning Act LFN 2004 (Revised version of Urban and Regional Planning Act No 88 of 1992) was enacted to form a basis of common and uniform practice for the nation and to coordinate standard development control in the country.

Prior to the enactment of the Nigerian Urban and Regional Planning Decree of 1992 in the country, there have been several ordinances and laws put in place either by the colonial administrators or the Nigerian government, which in one way or the other had facilitated the growth of Town and Country planning as well as its scope. These ordinances and laws include but not limited to: the 1863 Town Improvement Ordinance, 1904 Cantonment Proclamation, 1917 Township Ordinance, 1928 Lagos Town Planning Ordinance, 1946 Town and Country Ordinance, Western Nigerian Town and Country Planning Law Cap 130 of 1959, Northern Nigerian Town and Country Planning Law Cap 130 of 1963, Eastern Nigerian Town and Country Planning Law Cap 126 of 1963, Town and Country Planning of Bendel state of 1976, Kwara state Town Planning and Development Authority Edict of 1984, Ogun state Town and Country Planning Law Cap 127 of 1978, etc.

The Act was developed based on the three regional based Town and Country Planning Laws (the Western Nigerian Town and Country Planning Law Cap 130 of 1959, the Northern Nigerian Town and Country Planning Law Cap 130 of 1963 and the Eastern Nigerian Town and Country Planning Law Cap 126 of 1963), took their sources from the 1946 Town and Country Ordinance. Subsequent Town and Country Planning Laws in Nigeria states took their sources from these regional based Laws.

1.6.1.14 Criminal Code Act of 1990 (amended in 2004).

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

1.6.1.15 Labour Act of 1990 (amended in 2004).

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

1.6.1.16 Employees Compensation Act, 2010.

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

1.6.1.17 National Policy on Occupational Safety and Health.

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

1.6.2 State Regulations

1.6.2.1 Lagos State Laws.

The proposed Project falls within the jurisdiction of Lagos State Government. The key State administrative authorities and legal instruments that are relevant to the proposed Pipe Threading and Valve Assembly facilities Project are briefly described below:

- ***Lagos State Ministry of the Environment***. The Lagos State Ministry of the Environment is responsible for the protection and management of the environment in Lagos State. The authority administers the various laws of Lagos State on environmental protection.

- ***Lagos State Environmental Protection and Management Law, 2017***
  The law was meant to consolidate all laws relating to the environment for the management, protection and sustainable development of the environment in Lagos and for connected purposes. The law places the overall management of the environment and environmental matters in the State in the Lagos State Ministry of the Environment.

With respect to the Proposed Pipe Threading and Valve Assembly facilities project, the Lagos State Ministry of Environment is responsible for the environmental management, while the Lekki Free Zone is expected by law to follow the guideline of the State environmental laws and ensure that Bell Oil and Gas comply with the provisions of the environmental management and protection laws.

- ***Lagos State Environmental Protection Agency (LASEPA) Edict of 1996.*** The Edict establishing the Lagos State Environmental Protection Agency (LASEPA) was signed into law in November 1996. The Edict spells out clearly the functions of the Agency, the authority of the Agency, and acts that are prohibited within the State together with associated penalties for flouting such prohibitions. The functions of the Agency include; Monitoring and controlling of all forms of environmental degradation from agricultural, industrial and government operations, Monitoring of surface, underground and potable water, air, land and soils within the State to determine the pollution level etc.

1.6.2.2 Lekki Worldwide Investment Limited Establishment

The industrial cluster development started in May 2006 when the Chinese consortium in the name of CCECC-Beyond International Investment & Development Co., Ltd (CCECC-Beyond), now China Africa Lekki Investment Ltd (CALIL) as the majority shareholder, entered into a joint venture with the Lagos State government and the Nigerian partner "Lekki Worldwide Investment Ltd." to establish the Lekki Free Zone Development Company (LFZDC FZC) in Lagos, Nigeria.

Lekki Worldwide Investments Limited is a privately held company setup by the Lagos State Government to facilitate the development of the Lekki Free Zone (LFZ). Lekki Worldwide Investments Limited (LWIL) is the holding company (HOLDCO) for the land area comprising the Lekki Free Trade Zone (LFTZ).

LWIL's role is to:

- Enhance the entire land asset comprising the LFTZ
- Ensure the co-ordination of a strategic development pattern for LFTZ

Explore partnership opportunities with investors, project developers and financiers to realize the investment potentials of the Lekki Free Trade Zone

With respect to the planned activities, the project area is located within an already acquired land, a free zone. However, the proponent is expected to inform the Lekki Worldwide Investment Limited on their proposed project.

1.6.2.3 Lagos State Physical Planning, Urban and Regional Development Law No. 9 2005

The Lagos State Physical Planning, Urban and Regional Development law was enacted in 13th October 2005. The law provides for the administration of establishment and functions of Physical planning and development agencies, and for connected purposes

Under the law, the administration of Physical Planning and Urban Development in Lagos State is empowered to the ministry of Physical Planning and Urban Development. The Ministry shall exercise its Ministerial responsibility through implementation, execution, organization and co-ordination of the decisions of the State Executive Council on physical planning and development matters.

The law also establishes the Agencies/ or Authority:
The Lagos State Physical Planning and Development Authority;
The Lagos State Urban Renewal Authority; and
Any other agency as may be established.

For the purpose of this Law, the Ministry shall when required, delegate to the Authority specific responsibilities and functions for implementation. The Ministry shall be responsible for initiation, formulation and implementation of policies and coordination of programmes on all aspects of Physical Planning and Urban Development in Lagos State.

1.6.3 Local Government Edicts.

The proposed Pipe Threading and Valve Assembly facilities project in Lekki Free trade Zone falls within the jurisdiction of Ibeju-Lekki Local Government Council. Hence, the project's operation shall by edicts of the Local Government Council comply with all relevant edict of the council.

1.6.4 International Guidelines and Conventions

1.6.4.1 World Bank Guidelines for EIA

The sustainability of economic development has become of the most important challenges facing the World Bank in recent years. In response to growing awareness regarding environmental sustainable development, the bank introduced varieties of initiatives ranging from environmental assessment (EA) for specific projects or sectors.

In 2017, The World Bank Environmental and Social Framework sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity.

The comprehensive and detailed standards mandated an environmental assessment for all projects that may have significant impacts on the environment as a pre-requisite before any financial assistance is rendered. Some of those related to the project are:

- Environmental and Social Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Environmental and Social Standard 2: Labor and Working Conditions;
- Environmental and Social Standard 3: Resource Efficiency and Pollution Prevention and Management;
- Environmental and Social Standard 4: Community Health and Safety;
- Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Environmental and Social Standard 9: Financial Intermediaries; and
- Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure.

The bank is now required to screen and categorize all prospective loans for potential adverse environmental problems at the time of project identification. Also, in one of bank's EA source book, it is stipulated that EA should include an analysis of reasonable alternatives to meet the ultimate project objective". This alternatives analysis in EA is deigned to bring environmental and social considerations into the "upstream" stages of development planning – project identification and earlier – as well as the later stages of site selection, design and implementation.

1.6.4.2 Other International Conventions

The International Conventions that are relevant to the project and to which Nigeria is a signatory should be included. They include but not limited to:

- International Union for Conservation of Nature and Natural Resources (IUCN) guideline: an international organization working document of the IUCN in the field of nature conservation and sustainable use of natural resources. It is involved in data gathering and analysis, research, field projects, advocacy, and education. IUCN's mission is to "influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable".

- *United Nation Guiding Principle of the Human Environment, 1997:* aims to guide the international community in its efforts to achieve sustainable development. It reaffirms and seeks to build upon the Declaration of the United Nations

Conference on the Human Environment, adopted at Stockholm on 16 June 1972, hereinafter referred to as the Stockholm Declaration.

- *WHO Health & Safety Component of EIA, 1987* : WHO in its report on health and safety component of environment impact assessment (EIA) to protect human health indicates that:
  i. One of the fundamental considerations in the approval of projects, policies and plans should be the health of communities affected by them; greater consideration should be given to the consequence of development policies/programs for human health;
  ii. Environmental Impact Assessment should provide the best available factual information on the consequence for health of projects, policies and plan; and
  iii. Information on health impact should be available to the public.

- *United Nation Framework Convention on International Trade in Endangered Species, 1975*: CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

- *United Nation Framework Convention concerning the protection of the World Cultural and National Heritage sites (World Heritage Convention), 1972*: The Convention sets out the duties of State Parties in identifying potential sites and their role in protecting and preserving them. By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage. The States Parties are encouraged to integrate the protection of the cultural and natural heritage into regional planning programmes, set up staff and services at their sites, undertake scientific and technical conservation research and adopt measures which give this heritage a function in the day-to-day life of the community.

- *United Nation Framework on Convention of Biological Diversity, 1992*: is the international legal instrument for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources" that has been ratified by 196 nations. The objectives of the Convention on Biological Diversity are “the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources” (Article 1).

- *Basel Convention on the Control of trans-boundary movement of Hazardous Wastes and their Disposal, 1989*: The convention focuses attention on the hazards of the generation and disposal of hazardous wastes. The convention defines the wastes to be regulated and controls their trans-boundary movement to protect human and environmental health against their adverse effects.

- *United Nations Framework Convention on Climate Change - Kyoto Protocol (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 social beneficial, determined to protect the climate system for present and future generations.

- *United Nations Framework* Convention on the Migratory Species of Wild Animals (Bonn Convention), 1979: The Convention on the Conservation of Migratory Species of Wild Animals, also known as the Convention on Migratory Species (CMS) or the Bonn Convention, is an international agreement that aims to conserve migratory species within their migratory ranges.

- African Convention on the Conservation of Nature and Natural Resources (1969): is meant to encourage conservation, utilisation and development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view.

1.7 Bell Oil and Gas Health and Safety Policy

Bell Oil and Gas (BOG) established a set of policies guiding its operations on the protection of human health and the environment. These policies include, amongst others include Environmental Protection Policy, Occupational Health and Safety Policy, Security Access Control Policy, and Emergency Response Policy. The commitments and principles documented in the policies shall be applicable to the proposed pesticides Project.

Bell Oil and Gas Health, Safety and Environment Policy ensures that all activities shall be planned and executed in a manner that;

- Preserves the health, safety and security of all Company and contractor personnel and members of the public;

- Preserves the integrity and security of Company assets;
- Minimizes the impact of operations on the environment; and
- Is sensitive to the needs and concerns of the Host Communities.
- All personnel, including those of contractors, shall be trained and made fully aware of the hazards, risks, sensitivities and controls in place;
- Plans and procedures shall be in place to respond to any emergency or loss of control.

Every employee and contractor employee must plan and perform his work in accordance with this policy. Each employee is required to report, and where necessary, suspend any activity considered to be in contravention of this policy.

The implications of implementing this policy are that, - All activities shall be analyzed to systematically identify related hazards, risks and sensitivities; -Arrangements shall be put in place to control the hazards, risks and sensitivities and to deal with consequences should they arise; -Any activity which is unhealthy, unsafe, environmentally unsound or may adversely impact relations with the community, shall be suspended until an acceptable solution is found.

1.8 EIA Process

This EIA study has been carried out in line with the Federal Ministry of Environment EIA Procedural Guidelines as well as the relevant International Standards and Guidelines. The EIA process flowchart is summarized in **Figure 1.6**.

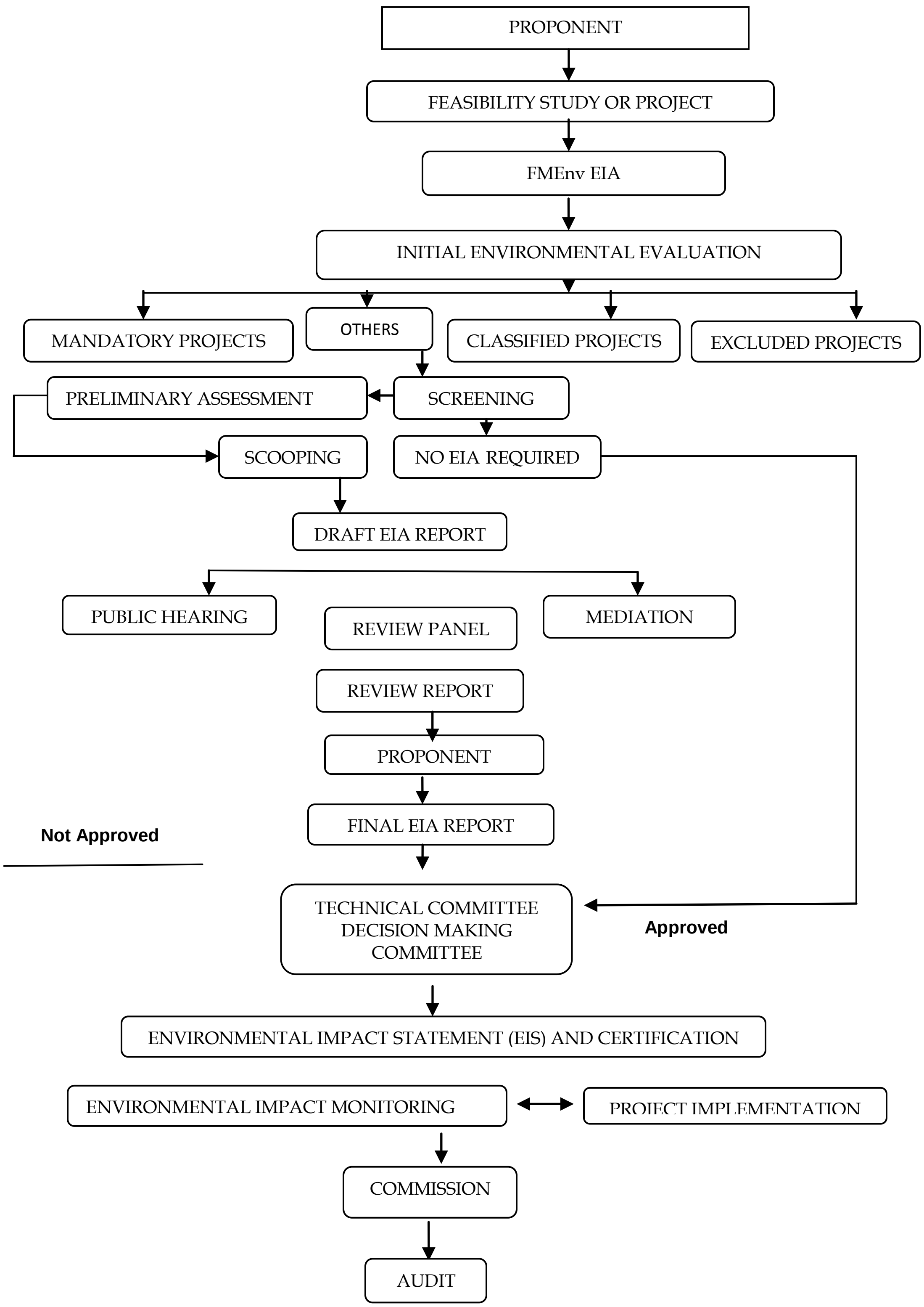


Figure 1.6 : Flow Chart of FMEnv EIA Procedure

This report thus provides a summarry of the pre-project baseline and a description of commitments to be met in the short and in the long term to avoid impacts or reduce these to an acceptable level. The EIA report will remain accessible as a source document in proponent's office throught the project life.

1.9 EIA Report Structure

In line with the FMEnv guidelines, this EIA report has been organized into nine (9) chapters, which is similar to the indicative outline of an EIA provided by the World Bank in its Environmental and Social Framework, 2016.

This report contains details of the Environmental Impact Assessment of the proposed Steel Pipe Threading and Valve Assembly facilities Project at Lekki Free Zone layout located in Ibeju-Lekki Local Government Area of Lagos State. The EIA report is structured as follows:

- Preliminary Sections: These include Table of Contents, List of Tables, Figures and Plates, and Executive Summary
- **Chapter One**: Introduction containing an overview of the proposed expansion Project, the EIA objectives and process and applicable legal and institutional framework.
- **Chapter Two**: Project Justification containing a rationale for the proposed project as well as the analysis of Project alternatives.
- **Chapter Three**: Project Description containing the technical elements of the Project and the Project's associated infrastructure and facilities.
- **Chapter Four:** Description of the Environment. It details the baseline data that are relevant to the Project location, design, and operation.
- **Chapter Five**: Potential and Associated Impacts. This takes into account all relevant environmental, social risks and impacts of the proposed project including cumulative impacts.
- **Chapter Six:** Mitigation measures for the identified environmental and social impacts.
- **Chapter Seven**: Is the Environmental Management Plan (EMP) for the Project. It summarizes the key measures and actions and the timeframe including responsibility for the implementation of the recommended measures.
- **Chapter Eight:** presents an overview of remediation plan after decommissioning and project closure.
- **Chapter Nine:** Conclusions and Recommendations
- References
- Appendices

1.10 Declaration

In line with all relevant National, State, Local Governments laws, regulation and Edicts, including International agreements/conventions, Bell Oil and Gas FZE declares that it has prepared this Environmental Impact Assessment (EIA) using the best available expertise in personnel, equipment and universally acceptable methods.

CHAPTER TWO

PROJECT JUSTIFICATION

2.1 Introduction

This section of the report provides the justification for the proposed project based on the need, benefits and the value of the project as well as analyses of the different options and alternatives to the project. The options to the project that were considered in line with the Environmental Impact Assessment procedural guidelines in the course of the EIA study include: **No-Project option; Delay project option; Go Ahead (Implement Project as Planned) Option while the Alternatives include Alternative location and Alternative Project Concept.**

2.2 Need for the project

Demand for Oil Country Tubular Goods (OCTG) is directly influenced by the demand growth for fossil fuels. In simple terms, the more wells are drilled, the more OCTG is required. In the short term, oil price volatility affects the demand for OCTG, as fewer wells are drilled during the industry downturn. Deep, horizontal, sour gas and offshore wells are the key drivers for OCTG demand. Since those types of wells require a higher grade of OCTG, the growth of OCTG demand will be around higher grades, premium connection and sour services products that the proposed facility is expected to focus on. With the absence of global data on wells length, the closest demand indicator for OCTG is the drilling rig utilization.

Over the last several years up until early 2015, the global market for OCTG was growing by around 5% annually. However, between 2015 and 2018, OCTG market went through an unprecedented cycle, which was probably the most challenging in the last 30 years. Demand for OCTG slowed down in 2015 and contracted by around 38% with further slides in 2016 and 2017 around 20%. *Reduced drilling activity and de-stocking of OCTG inventory were the key direct drivers that lowered the demand.* That is a whopping 50% drop in OCTG demand in 2-3 years.

As of Q2 2019, the global demand for OCTG is on the rise, in some places showing a double-digit growth rate. According to Fast markets MB research, OCTG consumption in the Middle East is expected to reach 1.33 million tonnes in 2019 and 1.36 million tonnes in 2020, up from 1.3 million tonnes in 2018. In Nigeria, drilling activity increased in 2018, with all IOCs and indigenous E&P buying OCTG, first from destocking of locally available inventory. This trend is expected to continue through 2019 and beyond as long as crude oil prices stabilize. Approximate worldwide demand and consumption for OCTG products is shown in **Table 2.1**

Table 2.1: OCTG Consumption by Region

S/N	Region	Consumption (%)
1	North America	31
2	Asian Pacific	27
3	CIS	15
4	Middle East	12
5	Latin America	8
6	Europe	4
7	Africa31	3

Table 2.2: OCTG Consumption by Group

S/N	Group	Consumption (%)
1		45
2		25
3		15
4		10
5		5

Furthermore, recent experiences in the Nigeria oil and gas industry with regard to contract award indicates that many more contracts are being structured to mandate in-country threading and stocking as well as other value-adding services that can aid local capacity development. The nature of contract structure is a pointer to the fact that players in this sector with no ability to thread, stock or contribute significantly to the value chain in Nigeria will eventually be marginalized.

It has also been observed that there is a huge gap in the market for quicker response to casings and tubing used for drilling operations, together with valve repair and maintenance. The upcoming Petroleum refinery by Dangote Refinery in the same axis as the proposed project is also a potential market. It is on the premises above that BOG has entered into a Joint Venture agreement with a major Line Pipe & OCTG Mill for the threading plant, together with a technical services agreement for the local assembly, repair, testing and painting of valves. Hence, the need for proposed project.

Lastly, the Nigerian Content Act and government's commitment to promoting Nigerian content laid the foundation for the support for the BOG Steel Pipe Threading Plant with Valve assembly. The Nigerian content law encourages local companies to add value in the Oil and Gas industry. BOG is also participating in several major tenders that require demonstrable capacity to stock as well as thread in order to be taken as a serious player. The proposed project is expected to provide a huge competitive advantage and also a platform for much higher margins than currently doable. By starting assembly, repair, testing and painting of simple valves, with a view to doing full scale manufacturing in the long-term, BOG will be able to make a stronger case for the exclusive use of its valves across specific existing installations and on new projects.

The need for the project is premised on the desire of the Nigeria Oil and Gas industry to meet the rising demand for OCTG at reasonable costs. It is also based on Bell Oil and Gas FZE desire to contribute to Nigeria's Industrial development and the desire to move from a consuming nation to a producing nation.

2.3 Benefit of the project

There are several benefits expected to accrue from the implementation of the proposed project. The beneficiaries of the envisaged benefits include the project proponent, the Government at all levels and the citizens. Specifically, this project will:

1. Create direct and indirect, temporary and permanent employment opportunities for Nigerians;
2. Improve the local content participation in the oil and gas industry through the products from the facility;
3. Make available high quality and affordable threading pipes and valves to meet the yearnings of Nigerians oil and gas industry;
4. Reduce the foreign exchange expended on importation of threaded pipes and valves into the country hence improve the nation's economy; and
5. Increase in Government Revenue through collection of taxes.

2.4 Value of the project

The estimated cost of the project is $50million. It is however anticipated that well over 60 percent of the total cost of the project shall be injected into the local economy through Facility Design development, acquisition of appropriate permits/ Licenses, Civil Engineering Services, Skilled and Unskilled labour etc.

2.5 Envisage sustainability

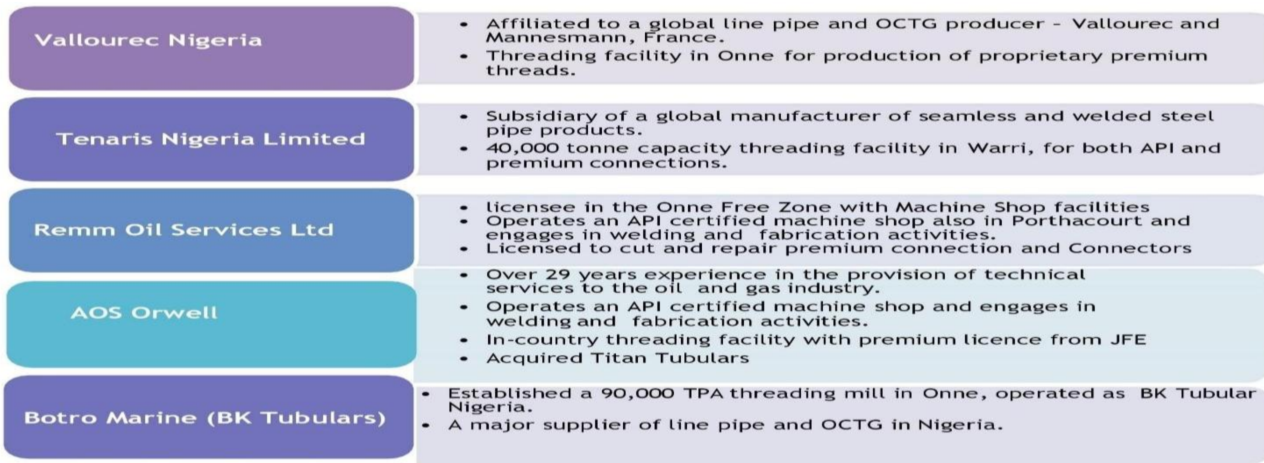
The sustainability upon which the proposed project is built is viewed in terms of economic, environmental, social and technical viability.

2.5.1 Economic sustainability

The project is envisaged to be economically and commercially viable throughout its designed life cycle. The project will attract tremendous patronage within the Nigeria petroleum upstream industry and West Africa sub- region due to the huge market for OCTG casing and tubing pipes in the sector, which is expected to generate sufficient annually to sustain operations and maintenance activities. The economic sustainability of the project is best considered on the current and future demand and supply dynamics of OCTG products both in Nigeria and around the world.

The Chinese companies have been the largest suppliers of API connection and

Group 1 & Group 2 OCTG. In Nigeria, Botro Marine (BK Tubulars) is a major supplier of Line Pipe and OCTG products. The economic sustainability of the project is guarantee because the supply of the OCTG and valve related products are readily available in Nigeria. Other top supplier of the products are Tenaris in Argentina, Vallource in France, US Steel Tubular products (USA), Nippon Steel, Arcelor Mitta in Indian, TMK in Russia and Independent Threaders. **Figure 2.1** is the scenario in the competitor analysis among the OCTG threading operators in Nigeria.



Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019

For valve assembly, a number of suppliers have also shown interest to expand local capacity in Nigeria. This includes Cameroon and Beamco Nigeria Limited. Industry project indicates that local valve assembly will be at 25-305 premiums with minimal impact on planned capex. The operational demand and current market position of valve assembly, testing and associated services are shown in **figure 2.2** and **figure 2.3** respectively.

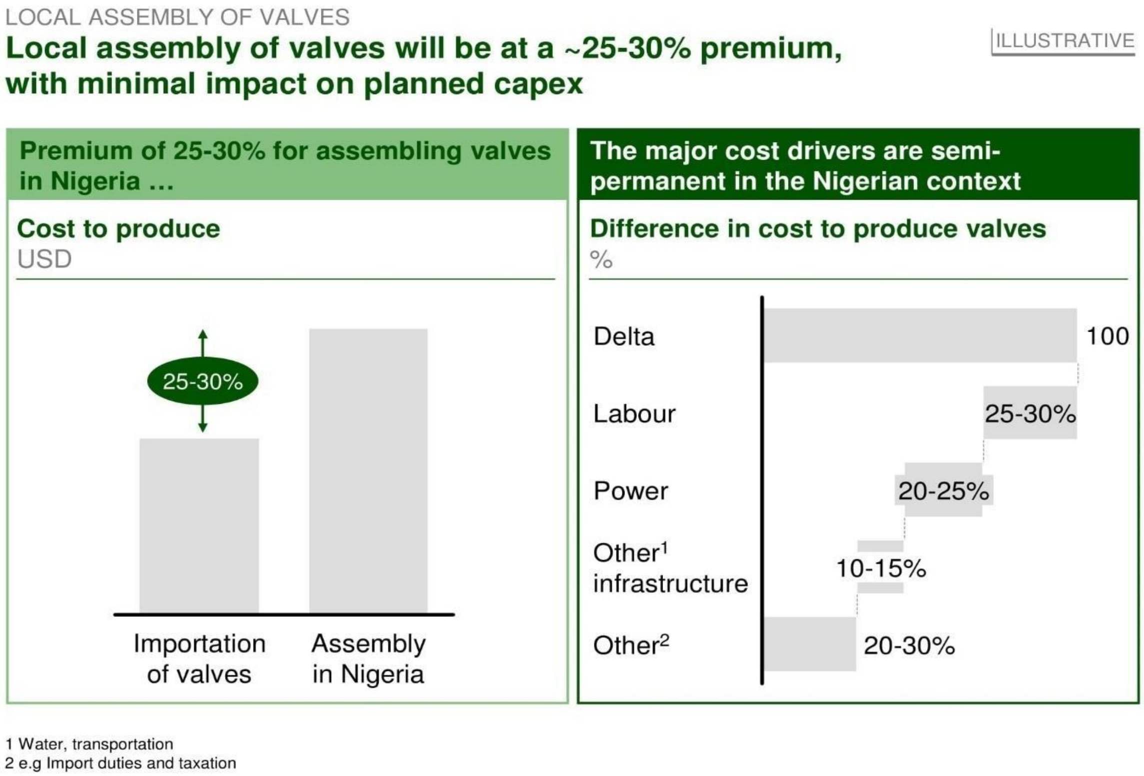


Figure 2.2: Premium for valve assembly in Nigeria (Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019)

LOCAL ASSEMBLY OF VALVES

A number of suppliers have shown interest in expanding local capacity

Supplier name	Current market positioning	Level of interest
Cameron	▪ Global market leader ▪ Only valve assembler in Nigeria ▪ Range of valves (simple to complex) with wider applications	▪ Plans in place to increase capacity from 3000 to 5000 valves p.a. ▪ Interested in growing local capacity if barriers to growth are addressed
Beamco Nig. Ltd	▪ Local supplier of valves in Nigeria to all IOCs – Flowserve – Tyco – KF – Audco	▪ Acquired facilities (9700m² ; 1600m² under roof) ▪ USD 6m capital outlay to date ▪ Barriers to kick-off of operation – Decision on which valve to assemble – Inclusion on the approved list of manufacturers – NAPIMS willingness to purchase premium valves

Figure 2.3: Current market positioning of valve assembly in Nigeria. Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019

In addition to availability of supply of OCTG and demand for the products in Nigeria, the economic sustainability of the project is hinged on the fact that BOG has also been involved in managing similar project in the past, particularly in Port Harcourt, Rivers State of Nigeria and has an enviable reputation in the international business environment

2.5.2 Technical Sustainability

BOG shall carry out the project development activities by employing Best Available Technology (BAT), which ensures compliance with international standards and global best practice. The technology to be employed would be API 5CTand this has been tested in several countries with similar whether conditions around the world. The project has been designed to meet all requisite local and international engineering codes and standards. All relevant drawing and safety standards shall be strictly adhered to during the project construction and operational phases.

Competent and highly experienced skilled personnel shall be employed to handle and manage the project. Industry projections indicate that the oil services sector will perform well even in the face of declining oil prices and BOG is suitably qualified to exploit the industry’s growth trajectory. While the sector is not immune to slumps and down turns, the Company is well positioned as a pre-eminent service provider, given its focus on support services required to keep exploration and production activities and assets running. Also, BOG shall build strong alliances with international technical partner and this shall be done by establishing strong relationship with End-users i.e. with drilling team and buyers within IOC and E&P companies and continually informed NCDMB of progress and seek their support with appropriate categorization.

2.5.3 Environmental Sustainability

The proposed BOG Steel pipe threading and valve assembly project is envisaged to be environment sustainable and that is why the conduct of this EIA and development of a fit-for purpose Environmental Management Plan (EMP) has been done. The project principles are based on cost reduction, minimisation of negative environmental and social impact and utilization of local skilled manpower. Also, Environmental, public safety and health consideration shall be adequately considered while appropriate mitigation measures and EMP shall be carefully implemented

Implementation of the recommendation of this EIA at appropriate stages of the project development is expected to ensure that the project is environment sustainable. Also strict adherence to the EMP shall ensure that every aspect of the project is sustainable with minimal impact.

2.5.4 Social sustainability

The proposed project is anticipated to bring huge positive impacts on the social life of the people of Ibeju-Lekki LGA, Lagos State and Nigeria and by extension, West Africa sub-region by enhancing ready availability of high quality threaded pipes and valve assembly services. The development of the project shall create job opportunities in form of direct, indirect, temporary and permanent employment. BOG shall consider the recruitment of local people especially those with the required skills and qualifications as skilled labour while those without the required skills shall be considered in the unskilled labour category during the project implementation.

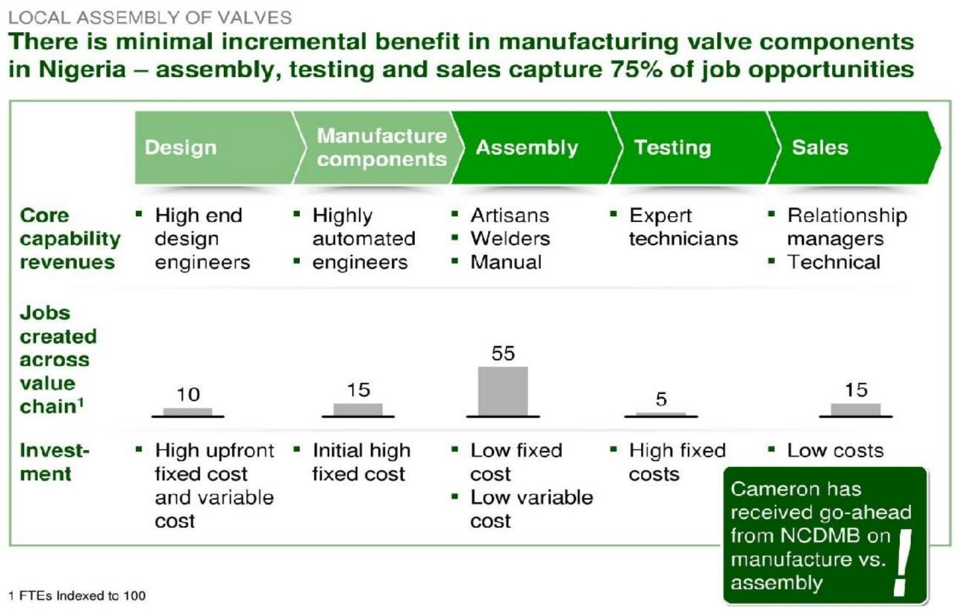


Figure 2.4: Job opportunities in valve assembly in Nigeria.
Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019

The Project proponent BOG FZE intends to establish a grievance redress mechanism where a grievance/ complaint can be submitted. By communicating the grievance/ complaint to the local Authority/ community Development Associations (via letter/note or verbally) who will be responsible for reporting the issue to BOG. There will also be continuous consultation with relevant stakeholders throughout the life span of the project especially with the host communities and this is expected to prevent hostility and foster a cordial working relationship. Also, however, the attitudes of the customers towards new entrants like the proposed facility is one of the social factors BOG will bear in mind at the initial stage. BOG shall adopt market penetration strategies to deal with this.

2.6 Analysis of project alternative

There are usually several alternatives to any project. For this proposed project, Three (3) alternative projects concepts were considered before the proposed concept was eventually selected. Each alternative was assessed using the following risk criteria:

1) Transportation and Security Risks – Assess the challenges of transportation and

likely security risk for transportation vis a viz the situation in the general area.

2) Environmental Pollution – Assess the potential for pollution to the environment from each of the option.

3) Risk to the Neighbouring Communities – Assess the communities, the more engagement required and risk associated with social interactions than less communities.

4) Livelihood impacts – Assess the overall risk to livelihood associated with each option

5) Ease of maintenance – Reviews the ease of maintenance in the event of damage to the pipeline and valves in the oil and gas industry. Also considers resources at risk and typical time frame to complete maintenance.

6) Risk to oil revenue – This assesses the risk to oil revenue based on the anticipated up-time and possible losses from each option.

7) Impact on Foreign exchange earnings – Review the impact on foreign exchange earnings accrued to the country from each of the options.

These three alternatives are as follows:

Concept A: Importation of OCTG Pipes and Valves

This concept will involve the importation of already threaded pipes and valves for sale. This concept will involve sourcing for foreign exchange to import the products. The concept was however rejected as it will not achieve the Company's objective of building local capacity and ensuring production of locally produced high quality threaded pipes and valves. This concept was also rejected in view of the fact that it does not align with the Country's aspiration for local content and industrialization.

Concept B: Shipment of the threaded pipe and valve assembled facilities to Lagos from the Bell Oil & Gas facilities in Port Harcourt

The concept will involve the shipment of the threaded pipe and valves assembled from the Bell Oil and Gas Port- Harcourt facilities to Lagos whenever there is demand for their products. This alternative has its attendant road hazards & lack of employment opportunity in Ibeju Lekki Local Government Area of Lagos State.

Concept C: Construction and operation of BOG Pipe Threading and Valve Assembly facilities Project

This concept seeks to Construct and operate a world-class facility for the production of Pipe threading and Valve assembly products that would facilitate local production of high quality oil and gas transmission pipelines. The selection of this concept is premised on the attendant economic and social benefits. Some of which were already enumerated in section 2.4 of this report

2.7 Project Options

There are usually several options to any project. The selection of a particular option and alternative is premised on several considerations, including the desirability/acceptability of the project, the Government policy or inclinations on the project, as well as the socio-economics impact of the project. For the proposed project, a number of options and alternatives were considered and these include: ***No-Project Option; Delayed Project Option Go Ahead (Implement Project as Planned) Option; Alternative Location Option.***

2.7.1 ‘’ No Project’’ Option

This option assumes that the proposed Pipe threading and Valve Assembly facilities Project will not take place as planned. The implication of this option is that the status quo will remain and continue Importation of the threaded pipes and valves from other countries. The anticipated improvement in the local content participation in the oil and gas industry through the products from the facility will no longer be possible while the expected availability high quality and affordable threading pipes and valves to meet the yearnings of Nigerians oil and gas industry will also be stalled. By extension, it also mean that the businesses, industries and individuals that would have benefited from the operation of the facility would also not have such benefits, while the revenues that would have accrued to the State and Federal Government will also not be possible. This alternative is usually considered either when the environmental implications of the project are too grave to allow, or when the economics are not viable enough. For the proposed project, the negative impacts can be adequately mitigated. In fact the Socio-economic benefits anticipated far outweigh the expected negative impacts. Therefore, the No-project option in this case should not be considered.

2.7.2 Delay Project Option

Sometimes, either as a result of civil unrest or public outcry against a development or project, the implementation of a project may be delayed. Applying this option to this project would mean that the proposed project implementation would be stalled until conditions are favourable. However, none of the above stated conditions currently apply to this project. Therefore, selecting the Delay Project Option would mean that the realization of the immense benefits of the proposed project would be delayed for no justifiable reasons. Thus the option is not viable and should not be considered.

2.7.3 Project Alternative Site/ Location Option

Several alternative locations/ sites were considered for the proposed project. This includes Lagos Deep Offshore Logistics Base (LADOL), Snake Island Integrated Free Zone, Lagos and Onne Free Trade zone, Port Harcourt. After consideration of all alternatives, the location at Lekki Free Zone (LFZ) was chosen due to the advantages it has over all other sites particularly because of the assurance it provides to our

Chinese partners. LFZ offered the most cost effective option of all locations considered in terms of land lease rates and service charge. Aside the tax incentive that is associated with businesses within Free Trade Zone, LFZ fully meets site criteria for selection of location of the proposed facility as illustrated below:

- LFZ is 70 km from Murtala Mohammed International Airport and 10 km from the proposed site of Lekki International Airport.
- The zone is also 50 km from Apapa Port, West Africa's largest port. It offers easy access to the existing international airport and seaport of Lagos.
- Lekki Deep Sea Port which is under construction with an estimated time to complete set at 2022,
- The approved Lekki International Airport and the proposed coastal highway
- An Independent Power Plant (IPP) of 12 MW is in place to meet the requirement of the investors for power consumption in the Zone.
- Water: Several boreholes have been completed as the transitional measure to supply water for the investors in the Zone. The permanent water plant for Phase I with daily capacity of 60,000 tons of purified water is now completed
- There is an ongoing expansion of the Lekki-Epe expressway.
- LFZ will be linked by roads and railway with almost all commercial states of Nigeria and the neighboring countries
- LFZ also established its own independent security outfit which is manned by well-trained security guards and equipped with sufficient security devices and tools, so as to provide full protection and security for the investors' lives and properties in the Zone
- When selling into the domestic market, the amount of import duty on goods manufactured in the Lekki Free Zone is calculated only on the basis of the value of the raw material or components used in assembly, not on the finished products

With the above stated criteria being meet by the LFZ, the proposed project location was selected after critical assessment and evaluation of the space requirements and the proposed project location has been earmark as most appropriate for the project.

2.7.4 'Go Ahead' Option

The need for this project along the proposed corridor outweighs the other options of 'no project' delayed project or alternative locations. It is also clear that if the full potentials of the project are exploited, it should be allowed to go ahead as planned. Adequate mitigation measures shall be put in place to minimize or eliminate potential negative environmental and social impacts of the proposed project.

CHAPTER THREE

PROJECT DESCRIPTION

3.1 Introduction

This chapter describes the proposed project and process. It provides an overview of the of the location, facility design and the various activities that shall be carried out at different phases of the project including production processes, wastes generation, man power requirement, Emergency/ contingency procedure, Health and Safety requirement for the project.

3.2 Proposed Project Concepts

3.2.1 OCTG Threading Concept

The primary purpose of the Oil Country Tubular Goods (OCTG) threading project is to meet the requirements of the Nigerian content Act, which encourages local companies to add value in the industry through investments in equipment/infrastructure, manpower capacity development and skills/technology transfer. On this project, value will be added through the cutting of API & Premium connection threads in-country using Nigerian personnel who will be trained by our Chinese technical partner.

Bell Oil and Gas FZE is desirous of establishing a single threading line for production casings (5’’ to 13-3/8’’) on a parcel of land measuring 4.3hectares at Lekki Free Zone in Ibeju Lekki Local Government Area with future expansion to include lines for production of tubing (2-3/8’’ to 4-1/2’’). The in-country threading plant will position BOG as a key player and will be so categorized by the NCDMB. This will significantly increase BOG chances of winning tenders for OCTG with major International Oil Companies (IOC’s) and smaller E&P companies.

3.2.2 Valve Assembly, Repairs, Painting & Testing Concept

For the valve assembly, testing repair and maintenance plant, BOG intend to develop an assembly facility of smaller valve sizes including testing, repair, painting, and maintenance of OMB valves as well as other Original Equipment Manufacturer (OEM) valves. Other product to be assemble in the facility include the Gate, Globe and Check (GGC) valves (up to 2" forged, all pressure class); floating ball valves (up to 6", all pressure class); Trunnion ball valve (up to 24", pressure class up to 1,500).

3.3 Proposed Project Overview

The proposed project is a threading and valve assembly production facility for steel pipes used mainly in onshore and offshore oil and gas upstream operations. The facility is an integrated state-of-the-art complex with thorough quality control inspection technology. It combines two main plants as follows:

- A plant for threading Oil Country Tubular Goods (OCTG) steel pipes. This component plant shall thread OCTG pipes in accordance to customer's project specific needs either for existing installations or new projects with capability to produce high quality threaded products that meets API international standard and local qualification. The required API specification connections include STC (Short Thread Coupled), BTC (Buttress Thread Coupled), LTC (Long Thread Coupled), EUE (External Upset End), NUE (Non Upset End) and LP (Line Pipe)
- A Valve Assembly plant responsible for wide range of valve services including machining, repair, maintenance (rebuilding), hydro testing, inspection and painting of up to 24".

Essentially, Oil Country Tubular Goods (OCTG) is a family of seamless rolled steel products consisting of drill pipe, well and production casing and tubing. Valves on the other hand are mechanical or electro-mechanical devices that are used to control the movement of liquids, gases, powders, etc. through pipes or tubes, or from tanks or other containers. In most instances, valves rely on some form of mechanical barrier — a plate, a ball, a diaphragm, for example — that can be inserted and removed from the flow stream of the material passing by. Some valves are designed as on-off varieties, while others allow very fine control of the passage of media. The features and uses of the products are presented in **Table 3.1.** For emphasis, the proposed project is focused on threading of production casing and tubing with their accessories.

Table 3.1: Detailed of the pipes and valves to be processed by the proposed facilities

OCTG pipes threading plant	Valves Assembly plant
Drill pipes: These pipes are used to perforate the soil to reach the underground reserve in oil nd gas drilling. It is a heavy and seamless pipe that provides rotations for the down- hole assembly and circulates fluids. Both ends of the pipe are threaded and called tool joints and normally a bigger diameter than the pipe itself. Drill pipe comes in different sizes, but normally less than 6", with various grades of strength, weight and length.	**Gate Valves**: These Valves are also known as sluice valves. They open by lifting a round or rectangular gate/wedge out of the path of the fluid. They are used mainly for blocking fluid flow and are less likely to be employed for flow regulation. A gate valve uses a plate-like barrier that can be lowered into the flow stream to stop the flow. Its operation is similar to that of a globe valve except the gate provides less flow restriction than with a globe-valve plug when the valve is in the fully opened position.
Well Casing: These are used to consolidate the well	

and prepare it for the actual extraction. They are used to stabilize the wellbore and prevent contamination from water sands. There are six (6) types of casing. These are production casing, surface casing, intermediate casing, production casing, liner and liner tieback casing). The project shall handle only conductor, surface and production casing	
Production casing: Normally coming in sizes between 4" and 9 5/8", production casing is required to provide a structural integrity and pressure control of the hydrocarbon bearing sections, during production	
Conductor Casing –These are available in sizes between 18" to 36", conductor casing is the first interface between surface and subsurface. It serves many purposes, such as prevent well collapse, protection against shallow gas pockets, fluid circulation and general support for drilling a well	
Surface Casing - Although varying in sizes depending on application, the common size of surface casing is 13⅜". Surface casing is used mainly for environmental and safety reasons, such as isolating freshwater zones, blowout, protection, supporting a wellhead and blow out prevention (BOP) equipment. It is also required to case off unconsolidated formations and serves as a support for next casing strings. Surface casing is always subject to extremely high safety standards and regulations	
Production Tubing: This is a pipe that is inserted into a cased hole (wellbore), through which hydrocarbons are transported (produced) to the surface. Production tubing comes in various sizes and varies between ¾" to 4 ½" and normally 30ft long. Production tubing also serves as a protection of the well casing against corrosive fluids, sand, paraffinand wear & tear. Together with other completion components, it is also called Production String	**Globe Valves**: Globe Valves constricts flow by closing against a restricting orifice. The most common variety is the Z-style valve, so-called because of the path, which the fluid follows through the valve body. A less restrictive design is the Y-style valve, which orients the valve stem. Globe valves can seal against the fluid flow or with it, depending on the requirements of the installation (i.e. fail closed vs. fail opened) and the choice plays a major role is sizing an actuator. Like gate valves, globe valves can be rising-stem or NRS varieties
	Check Valves: These are uni-directional that automatically open forward flow and close against reverse flow. They efficiently supply a wide variety of application with the closing element in the piston, ball or swing type

Threading on steel pipe's endplay one of the key roles in safety and well integrity. According to the Line Pipe and OCTG value chain in Nigeria, there is a huge gap in the market for quicker response to casings and tubing used for drilling operations, together with valve repair and maintenance. This prompted BOG to enter into a Joint Venture agreement with a major Line Pipe & OCTG Mill for the proposed project. **Figure 3.2** shows a ballpark application guide for OCTG based on API grades classification. There are many more proprietary grades from OCTG manufacturers, but API is the core.

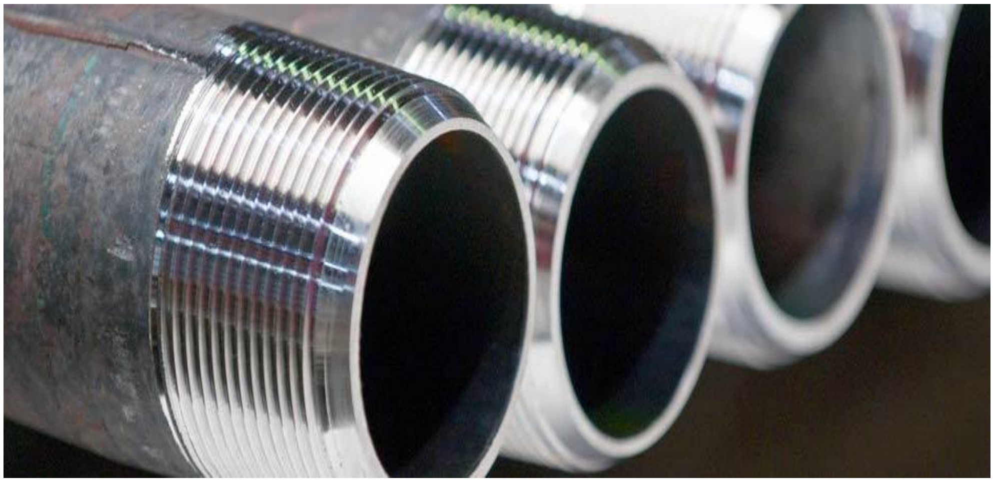


Figure 3.1: Typical OCTG Threaded pipe

Figure 3.2: Nigeria Line pipe and OCTG value chain

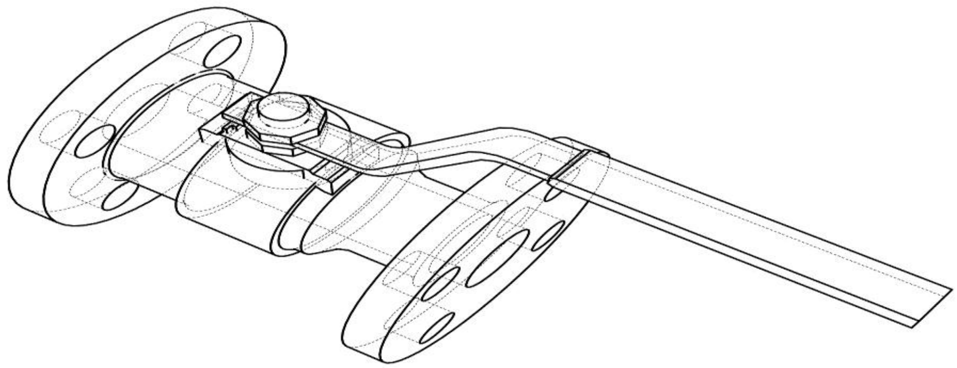


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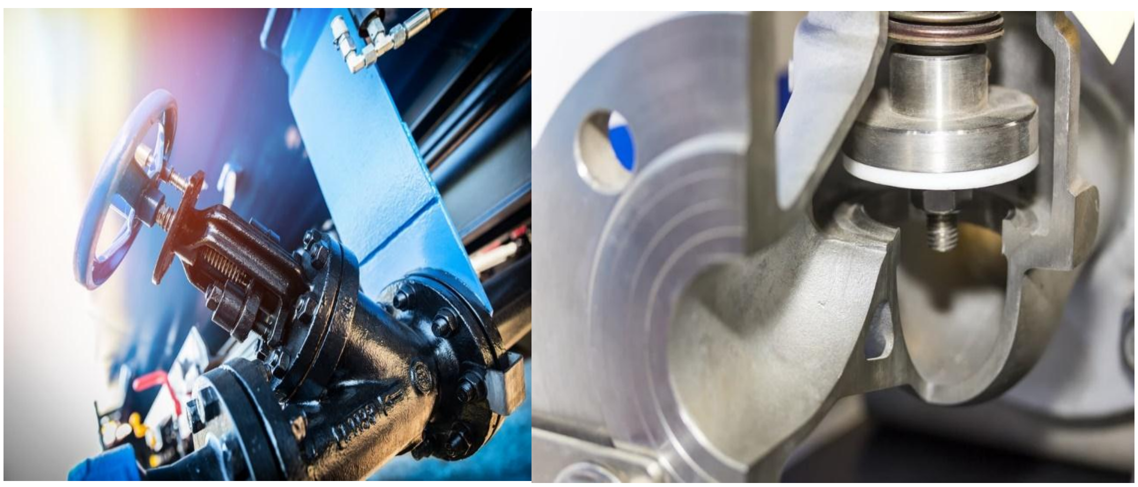
Figure 3.3: Isometric drawing of a typical quarter-turn manual valve with bolted flanges.



Y-Shape **Z-Shape**

Figure 3.4: Typical Y- shape and Z-shape globe valve showing

3.3.1 Design capacity of the proposed project

The proposed Steel pipe threading facility has a design capacity of (Production Tubing between 30,000-40,000 MT/year and Production Casing of 50,000-60,000 MT/year) of OCTG products. In the first two year of production, the plant shall commence with one (1) shift to produce 20,000MT of the products which will gradually increase to three (3) shifts to ramp production to 60,000MT per annul. Although, some of the OTCG products can be used in petroleum product marketing depots, the proposed project is targeted at the exploration and production companies in the Nigeria Oil sector, which have been categorized as below:

- International Oil Companies (IOCs)
- Local Exploration & Production (E&P) companies
- Marginal Field and indigenous Operators

These companies have their business operations in Lagos, Port Harcourt, Benin and Warri and the facility is strategically positioned to service them from proposed location at the Lekki Free zone, Lagos. The proposed facility is first of its kind in Lagos and part of efforts to grow the BOG market reach and sustain the current trade expansion around the world.

3.3.2 Design Technology of the proposed project

The proposed facility is automated and consists of a large number of diversified activities interconnected as a unit with required communication facilities. The proposed facility is an integrated design that satisfies equipment layout requirement, maintenance access requirement, personnel flow, material flow and waste flow. The process units are designed for capacities which allow some additional flexibility scenarios.

The facility is supported by several advanced lathes and advanced Computer Numerically Controlled (CNC) equipment in 15,000sqm of manufacturing space and storage and to thread OCTG pipe up to range 3 length and 13-3/8″ diameter. Also, it is supported by Computer Aided Design (CAD) and Computer Aided Machining (CAM) which enable the facility to program directly from drawings and to customize each job to the needs of customers.

On environmental consideration, the facility shall minimise the negative impacts its activities may have on the environment. The finishing center uses energy-efficient ventilation and heating systems while the facility’s barriers are made of advanced heat and sound insulating material. The production line has a fully closed water circuit. All areas use local air filters systems, and the foundations are treated with special substances that completely protect groundwater from contaminant infiltration which minimizes environmental impact.

3.3.3 **Design Codes and Standards**

The basis for design adopted in the proposed BOG pipe threading and valve assembly production facility combined quality assurance with relevant applicable standards and codes to achieve the most economical and environment friendly project. The facility shall be built in alignment with statutory laws and regulations of Nigeria (as discussed in chapter one), relevant international specifications, standards/Codes of practices and industry-published guideline. The applicable codes and standards for the design are presented in **Table 3.2**:

Table 3.2: Applicable Codes and Standards for the proposed BOG production facility

Codes	Title
API 5CT	Specification for Casing and Tubing
API 5DP	Specification for Drill Pipe
ISO 11960:2004	Petroleum and natural gas industries-Steel pipes for use as casing/tubing for wells
ASME SA106 Grade B	Seamless carbon steel pipe for high temperature service
ASTM A312	Seamless and welded austenitic stainless steel pipe
ASTM C76	Concrete Pipe
ASTM A36	Carbon steel pipe for structural or low pressure use
ASTM A795	Steel pipe specifically for fire sprinkler systems
SAE J518	Society of Automotive Engineers) defines a standard of 4-bolt flanges called
The API range - now ISO 3183	where the number indicates yield strength in MPa
API 5L Grade B - now ISO L245	where the number indicates yield strength in MPa
NBC 2006	National Building Codes
IBC (ICC, 2003a	International Building Code
ICC, 2003c	International Energy Conservation Code

The first three (3) standard specification as listed in **Table 3.2** govern the characteristics of OCTG when it comes to Manufacturing methods, Joints type and Length Range, Wall thickness, Casing Weights, Steel Grades, Connection, Chemical Properties and Tensile Properties.

3.4 Description of Project development phases

The proposed project development will be implemented in four (4) phases involving pre-construction phase, construction phase, operational phase and decommissioning phase. This EIA has taken cognizance of the environmental sensitivities of the existing facilities within the project zone as well as the project area as it concerns each and every project activity that shall be undertaken in the course of implementing the proposed project. This is to as much as possible ensuring the minimization of adverse impacts. The activities that will be carried out at each phase of the project are as highlighted and described below.

Preconstruction phase

- Geotechnical survey of the project site
- Stakeholder engagement
- Mobilization of personnel and equipment to project site
- Setting up of camp site
- Site preparation

Construction Phase

- Transportation of construction materials to the project site
- Excavation of soil for foundation laying
- Civil works (construction of factory and administrative building, plumbing, internal roads and drainage, fence, wide double gate, security house ancillary utilities such as water supply, borehole, sewage systems and electricity supply)
- Electrical Installation
- Installation of production machinery/Equipment
- Landscaping of the project site.

Operation Phase

- Transportation and supply of production/process raw materials
- Pipe Threading Operation
- Valve assembly, repair, painting and testing
- Storage/Stacking of finished products
- Electric power generation using 330kVA/264kW and 66kVA/52.8kW generators working back-to-back;
- Delivery of finished products
- Waste storage, logging, and collection for disposal by contractors
- Maintenance operation works;
- Security and HSE operations.

3.4.1 Pre-construction Activities

In this phase of the proposed project, the activities will be essentially desktop, feasibility, environmental, technical and financial consideration. These investigations are aimed at ensuring the viability and sustainability of the proposed project while having minimal negative impacts on the environment. The results of the investigation will culminate in the preparation of a detailed design, construction and fabrication, installation and commissioning program.

3.4.1.1 Stakeholders consultation

All relevant stakeholders to the proposed project including regulatory bodies, project host community and contractors, management of Lekki Free Zone Development Company etc. shall be identified during the pre-construction phase of the project. Consultation and meeting will be held to discuss the plan of BOG to establish pipe threading and valve assembly production facility at Lekki Free Zone. These consultations will ensure that all stakeholders are notified and carried along while pathways and schedules are clearly defined. The benefits of consultation/meetings are to ensure that the proposed facility is carried out within the minimally possible time frame to ensure society goodwill and social license to execute the project

3.4.1.2 Site preparation

The project site is quite accessible through the existing Coastal road that connects Lekki-Epe Expressway. Therefore, there is no need to construct site access. The proposed site will be zoned/demarcated into different areas such as construction area, fabrication area, camp site, material storage area and utilities area in line with contractor's set of constructions plans which will translate into a physical representation on the project site.

Preliminary investigation conducted at the LFZ shows that 60% of the project area is dominated by freshwater Swamp Forest and a wetland. The site is typically waterlogged during the rainy season and the soil retains most of the water throughout most part of the dry season.

Site preparation will involve clearing of vegetation and removal of topsoil. The vegetal cover, mainly plants and topsoil shall be removed using the appropriate equipment indicated in **Table 3.3**. The topsoil shall be stripped to a depth 150-250mm. Once the vegetal cover, topsoil and unsuitable materials have been removed; the land will be levelled to an elevation, which will include cutting the high areas and filling the lower areas. The fill materials will then be compacted to the required density in layer and will continue until final elevation has been achieved.

- **Site Clearing**

As earlier indicated the proposed project site is a Greenfield and consists predominantly of swamp vegetation). The vegetation will be removed and disposed offs to ensure level, flat and clean land using appropriate levelling equipment as listed in **Table 3.3**.

- **Site Surveying**

The proposed site will then be surveyed by lining out exactly where the administrative building, production factory and other associated infrastructure shall be constructed. The various sections of construction site will be demarcated completely from the nearby facility to prevent unauthorized access for those non-construction workers.

- **Soil Testing**

Soil testing is a vital important task that needs to be considered before the construction works commences on the site in order to determine the bearing capacity of the soil. Soils samples shall be collected at the proposed area and tested in order to examine the ability to withstand structure.

- **Engineering Design**

After the soil testing is done, the next stage is site designing of the engineering plan. At this stage of site preparation, a review and development of Basic Design of the facility shall be carried out and this shall be done in accordance with international standards for OCTG pipe threading and production. Also, to be undertaken at this stage is development, issuance of documents and all specifications, procedures, drawings. Sketches. Diagrams, materials lists and requisitions with requirements for completion of the work, starting from the BOG's basic documents. **Figure 3.5** shows the 3D Dimension Layout of the entire facilities.

Figure 3.5: 3D –dimension of the proposed Steel Pipe threading and Valve Assembly facilities

- **Site Plan Design**

The site plan will be designed to show access roads for construction vehicles and temporary storage areas for raw materials to be delivered. The site plan will also depict where the building, factory and other associated infrastructure shall be located. Unlike other steps taken in site preparation, the contractor handling the construction work may update the site plan in the field during the construction activities.

- **Site Geophysical Investigation**

A preliminary geotechnical investigation of the proposed project site was conducted in order to characterize soil, and groundwater condition of the proposed site. All field and laboratory test was then carried out as per the relevant codes of practices. These results of the investigation which is presented in subsequent chapter of the report indicates that the proposed site is capable of carrying the foundation design for the production plant and infrastructure planned to be built on the site.

- **Installation of camp site**

As part of site preparation, two (2) steel porta cabins shall be provided by the contractor on site to serve as office camp and logistics requirement such as changing rooms and administrative work for the site worker. This will limit human traffic significantly, thus minimizing accident potential. Each equipment has a dimension of 8ft by 20ft. One of the equipment shall be used for office purpose with total capacity to accommodate fifteen (15) persons at a time while the other will serve as storage area for site equipment/working tools.

- **Supplies to the Construction Site**

Material vendors shall be given the permission to supplies food; materials, consumables, fuel, water site workers and this shall be done by road.

3.4.1.3 Mobilisation of Equipment and personnel

The various equipment and personnel for the site preparation and construction work will be mobilized to the site by road. Transportation from the camps to the workers' homes will be scheduled according to the frequency of work shifts .The equipment to be deployed comprises mechanical and hand tools. A specific location within the site as explained earlier shall be identified for holding the equipment to ensure that only authorized personnel have access to them. **Table 3.3** is a list construction of equipment and uses for the construction of the proposed BOG production plant.

Table 3.3: List of construction equipment and for the proposed production plant

Equipment	Number to be Deployed
Excavator crawler	1
Bulldozer cat D6	1
Mobile office camp	1
Wheel Loader- cat 980	1
Mobile Sanitary Toilet	1
Concrete mixer truck	1
Welding/workshop auxiliary tools (light tower, welding tools, generators, hydraulic drop hammer, drill, handsaw, cutting machine	As required

3.4.2 Construction Phase Activities

As explained earlier, the proposed project site is located within the LFZ and is well connected to Coastal road which also connect Lekki-Epe Expressway. Therefore, there is no need to construct any approach road or site access.

3.4.2.1 Construction material

Construction materials for the proposed BOG project shall include, stanchion steel of various sizes, gravel, sharp coarse sand, granite stones, cement, building blocks (9 inches types), water, fuel, electrical cables. All these materials shall be sourced locally. For emphasis, most of the materials shall be sourced from local suppliers around Lekki area because of the proximity to the project site, which will make both economic and environmental sense as it will reduce the negative impact of transportation through reduced distance of travel by materials transport vehicles. A summary of the materials and the anticipated volume for the proposed construction activities is given in **Table 3.4.**

Table 3.4: Summary of the construction materials and the anticipated Volume/quantity to be used

Material	Form	Estimated quantity
Sharp coarse sand	Solid	121 tons
Cement (50kg bag)	Solid	110 tons
Granite stone (3/4", ½", 1")	Solid	245 tons
Structural steel(25mm, 16mm, 12mm and 10mm)	Solid	4.081tons
Wrought iron (70mm by 750mm, 900mm by 1200mm, 1200mm by 1200mm)	Solid	95.3 4tons
Tiles (ceramic, vitrified and walls)	Solid	36 Tons
Molded Block (9'')	Solid	6.7 tons
Electrical cable	Solid	
Water	Liquid	9,304 m^3
Fuel (diesel, petrol)	Liquid	1.4 million liters
Paint (water and oil base)	Liquid	10,000m^3

3.4.2.2 Construction Activities

The construction works for the project will involve a lot of masonry work and related activities and this will be carried out in accordance to the respective structural engineer's detail as provided in the facility layout and architectural drawing. All fabrication shall be done at the site. The project will involve the construction of:

- Administrative building
- Factory building
- Internal roads
- Internal drainage
- Gate house
- Generator house
- Perimeter fence

The proposed building factory is a steel structure. In general, constructions shall be carried out in three phases as explained in sub-section 3.4.2.2.1- 3.4.2.2.7.

3.4.2.2.1 Excavation and Foundation Works

The proposed project area was sandfilled after the zone was acquired for industrial development. The soil cover in the area is thin and sandy with wide range of plants vegetation. The soil is excavated to remove the topsoil and create a flat bottom foundation trench of 20’ 5” depth and 150mm thick using excavator machine. The trench bottom is inspected and the parts are aligned and their compliance with the foundation design is controlled.

- **Excavation Works**

The construction work will begin by setting and pegging out the area for the various components of the proposed project in accordance with site layout. The area for the building is excavated by means of an excavator to create a foundation trench size of 2.5m depth and 1.0m wide. The trench bottom is inspected and the parts are aligned and their compliance with the foundation design is controlled.

- **Foundation Works**

The weight of the building is spread evenly over the entire footprint of foundation base. A piled raft foundation is constructed. This is a composite system in which both the piles and the raft share the applied structural loadings. In such cases, the piles provide the majority of the foundation stiffness while the raft provides a reserve of load capacity. Piled raft foundation is by laying the column and foundation (raft) steel on the floor of the excavated trench. The raft is laid from the bottom to above the height of surface ground. The laying of raft is done as per the building drawings for the project. The pile foundation involves the drilling a pile hole in the soil, which is then poured with concrete and reinforced with steel. The concrete mix specification for he proposed pile is 30N/mm$^{2.}$ This foundation shall be reinforced according to the British standard and subjected to Slump test and comprehensive strength.

Pilling and concrete pouring of plant foundation base construction shall follow land grading (British Standards BS 5930 (1999), BS 1377 (1990) and BS 10175 (2001). Reinforced concrete shall be used in foundation preparation. Bars with external forms shall be used to frame the structure prior to pouring the concrete.

3.4.2.2.2 Administrative Building

The administrative building is a storey building that will accommodate thirty (30) people. The construction will involve assembly and erection of structures that include structures and non-structural components (cladding, roofing, HVAC systems, and electrical systems). Roofing of the building is then carried out to provide external envelope cover for using sheet metals. The roof of buildings shall be installed on a cast parapet placed at the edge of the top of the building using aluminum sheet. In addition, pipe-work for water supply and distribution will be done to connect the building to the sewage treatment plant sewage.

3.4.2.2.3 Factory Building

The factory building will be constructed with a combination of brick and steel frame. The steel frames will be mounted upright on the raft foundation and connected together while the space in the column (the walls which separate sections of the building to prevent fire spread) will be filled with bricks to achieve the desired roofing level. The steel frames will be constructed using closed shaped tubes as columns for sanitation. Primary beams will be constructed from wide flange shapes and the secondary roof framing is of bar joist construction.

The walls of these types of facilities are typically non-load bearing precast and tilt-up or alternatively, insulated metal panels. Standard metal building panels could be used, but insulated metal panels are preferred over standard metal building metal panels because of their greater cleanliness. All the walls in the production building have the same design: 20 cm-concrete block wall plastered and polished up to a certain height, and from there to the roof, galvanized steel undulated sheet. The roof is made of sandwich panel.

3.4.2.2.4 Electrical and Mechanical Installation

Electrical and mechanical work during construction of the premises will include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets and plumbing work. Installation of pipe-work for water supply and distribution will be carried out within the sections of the building factory. In addition, pipe-work will be done to connect the building to the sewage treatment plant sewage**.**

Electrical equipment shall be selected, sized and installed so as to ensure adequacy of performance, safety and reliability. The equipment in general shall conform to relevant Nigeria and other relevant Standards and shall be suitable for installation and satisfactory operation in the service conditions envisaged.

The protective system shall be designed to ensure Protection of Personnel and factory equipment against damage which can occur due to internal or external short circuits, overloading, abnormal operating conditions, switching, lightning surges, etc accordingly, relays and protective devices shall be suitably selected and installed. All the protective relays for the Generator, Transformer, Motors and Switchgears shall be tested at least once in a year and test records maintained.

3.4.2.2.5 Installation of plant machines and equipment

Installation of plant unit will start after the main structural steel of plant building has been completed. The proposed factory is a single floor building and has a number of units operations and machinery. The equipment is mainly threading and valve repair, testing and painting devices and shall be installed in order to fully achieve the objective of the proposed production technology. The units and machines shall be installed in accordance to the manufacturer/supplier specification, process procedures and safety requirements. As earlier explained, the production line is divided into a number of process units. The installations shall be done in accordance with the requirement of each unit as provided in the plant design plan. BOG technical partner, Foryouth shall provide all the equipment while Payment for technology transfer shall be through issue of equity shares. **Figure 3.6: Valve assembly, repair, testing & painting layout.**

For OCTG plant, the size of the equipment ranges from 7”-13 3/8”. The major equipment within the valve assembly plant is Test bench, gas test bunker, manual forklift and crane. The detail of the equipment to be installed at each plant is shown in **Table 3.5** and **Table 3.6** respectively. **Figure 3.7: Detailed Plant Layout and Basic Engineering OCTG Threading Layout.** Details engineering layouts for various sections of the proposed facilities are provided in the **Annex**.

Table 3.5: List of OCTG threading equipment

Equipment List （size range: 7"~13-3/8” ）			
Item	Machine	Qty	Note
1	the shelf before hydraulic test	1	Set
2	The Hydraulic test machine	1	Unit
3	The shelf before drift test	1	Set
4	The Drift test machine	1	Unit
5	The shelf before the 1# threader	1	Set
6	1#CNC threader	1	Unit
7	The transfer table for 1# threader	1	Unit
8	The shelf before 1# thread inspection	1	Set
9	The rolls for 1# thread inspection	1	Set
10	The shelf before the 2# threader	1	Set
11	2#CNC threader	1	Unit
12	The transfer table for 2# threader	1	Unit
13	The shelf after the 2# threader	1	Set
14	The rolls for 2# thread inspection	1	Set

15	The storage frame	1	Set
16	The shelf before the coupling make up machine	1	Set
17	the coupling tight machine	1	Unit
18	The transfer table for the coupling make up machine	1	Unit
19	The shelf after the coupling make up machine	1	Set
20	The rolls for the thread protector tight	1	Set
21	The rolls before coating	1	Set
22	The Coating machine	1	Unit
23	The rolls after coating	1	Set
24	The shelf for pipe drying	1	Set
25	The weight and length measuring machine	1	Set
26	The color ring printing machine	1	Unit
27	The machine of information printing and stamping	1	Set
28	The shelf before bundling	1	Set
29	The bundling frame	1	Set
30	The Hydraulic system	1	Set
31	The sawing machine	1	Set
32	API master gauges	1	Set
33	API gauges set	1	Set
34	Other small scale equipment	1	/

Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019

Table 3.6: List of valve assembly machinery/equipment

Area	Area Description	Equipment code	Equipment Description
1	General Equipment	AAI	Air compressor (7-8 bar)
1	General Equipment	AAA	Bridge Crane 10T
1	General Equipment	AAL	Compressor distribution system (7-8 bar)
1	General Equipment	ADG	Electric cabin
1	General Equipment	AAG	Electrical Wiring system
1	General Equipment	AAH	Electric plugs (2 380V+ 2 220V)
1	Internal Logistic Loading units std:	AAQ	Europallets
1	General Equipment	ADD	Firefighting system
1	Internal Logistic Loading units std:	AAT	Hard plastic 40x40x30 (or similar)
1	General Equipment	AAM	Light System (21)
1	General Equipment	AAN	Ventilation system workers)
1	Internal Logistic Loading units std:	AAR	Woden case max 1Ton (OMB Code 110x60x56)
2	Receiving & Stock area	AAC	Forklift 2T
2	Receiving & Stock area	ABD	Light Weight Working table (80cmx150cm)
2	Receiving & Stock area	AAF	Manual Forklift
2	Receiving & Stock area	AAO	Rack System (1 ton x bay), GF+3 level
2	Receiving & Stock area	AAU	Trash
3	Cleaning area	ABC	Drain pump (if needed)
3	Cleaning area	ABA	Fresh water tank (if needed)
3	Cleaning area	ABD	Light Weight Working table (80cmx150cm)
3	Cleaning area	AAF	Manual Forklift
3	Cleaning area	AAV	Pressure Washer
3	Cleaning area	AAU	Trash
3	Cleaning area	AAZ	Valve Washing

			station
3	Cleaning area	ABB	Wastewater tank(if needed)
4	Workshop area	AAB	Column crane 1T
4	Workshop area	ABH	Gate lapping machine
4	Workshop area	ABI	Grindstone
4	Workshop area	ABP	Heavy duty working table (1Mx1M)
4	Workshop area	ABL	Large Ball lapping machine (*)
4	Workshop area	AAF	Manual Forklift
4	Workshop area	ABE	Manual Horizontal Lathe (°)
4	Workshop area	ABQ	Portable tools cabin
4	Workshop area	ABM	Set of large lapping ball Tools
4	Workshop area	ABO	Set of small lapping ball Tools
4	Workshop area	ABN	Small Ball lapping machine (*)
4	Workshop area	ABG	Small Drill
4	Workshop area	ABF	Small Mill
4	Workshop area	AAP	Small rack system (100Kg bay), 6 level
4	Workshop area	ABR	Standards Tools kit
4	Workshop area	AAU	Trash
5	Welding area	ACT	Cabin With locker
5	Welding area	ABE	Exhaust filtering unit
5	Welding area	ABP	Heavy duty working table (1Mx1M)
5	Welding area	AAF	Manual Forklift
5	Welding area	ABT	MIG welding machine
5	Welding area	AAP	Small rack system (100Kg bay), 6 level
5	Welding area	ABS	TIG Welding machine
5	Welding area	AAU	Trash
5	Welding area	ACU	Welding Screen
6	Small Valve Disassembly/Assembly Stations	ABZ	Coupling Kit 1/2" to 2"
6	Small Valve Disassembly/Assembly Stations	ADH	Medium Weight Working table (80cmx80cm)

6	Small Valve Disassembly/Assembly Stations	ABU	Seat Press
6	Small Valve Disassembly/Assembly Stations	AAP	Small rack system (100Kg bay), 6 level
6	Small Valve Disassembly/Assembly Stations	ABR	Standards Tools kit
6	Small Valve Disassembly/Assembly Stations	ABV	Valve testing (Hydro/Air)
6	Small Valve Disassembly/Assembly Stations	ADI	Working (80cmx80cm) with air gun
7	Large Valve Disassembly/Assembly Stations	AAB	Column crane 1T

Large Valve Disassembly/Assembly Stations	ABP	Heavy duty working table (1Mx1M)
Large Valve Disassembly/Assembly Stations	ACF	Hydraulic Torque keys
Large Valve Disassembly/Assembly Stations	ACG	Hydraulic pump
Large Valve Disassembly/Assembly Stations	ACD	Large tools kit
Large Valve Disassembly/Assembly Stations	ACB	Long Heavy duty Table (1Mx2Mx0,5)
Large Valve Disassembly/Assembly Stations	AAF	Manual Forklift
Large Valve Disassembly/Assembly Stations	ABQ	Portable tools cabin
Large Valve Disassembly/Assembly Stations	AAP	Small rack system (100Kg bay), 6 level
Large Valve Disassembly/Assembly Stations	ABR	Standards Tools kit
Large Valve Disassembly/Assembly Stations	ACE	Torque keys
Large Valve Disassembly/Assembly Stations	AAU	Trash
Large valve testing area & Gas test area	ACH	Blind Flange Holding dock
Large valve testing area & Gas test area	ACI	Blind flange set 2" to 24" cl 150-300-600)
Large valve testing area & Gas test area	AAB	Column crane 1T
Large valve testing area & Gas test area	ACO	External large water tank
Large valve testing area & Gas test area	ACN	External Nitrogen tank set

Large valve testing area & Gas test area	ACL	High Pressure Gas test Unit
Large valve testing area & Gas test area	ACM	High Pressure plug & piping connection
Large valve testing area & Gas test area	ACP	Large valve testing dock station
Large valve testing area & Gas test area	ADH	Medium Weight Working table (80cmx80cm)
Large valve testing area & Gas test area	ABQ	Portable tools cabin
Large valve testing area & Gas test area	AAP	Small rack system (100Kg bay), 6 level
Large valve testing area & Gas test area	ABR	Standards Tools kit
Large valve testing area & Gas test area	AAU	Trash
Medium valve testing area	ACR	Coupling Kit 3" to 8"
Medium valve testing area	ABP	Heavy duty working table (1Mx1M)
Medium valve testing area	ACS	Horizontal test Bench 3"to 8" (*)
Medium valve testing area	ABQ	Portable tools cabin
Medium valve testing area	AAP	Small rack system (100Kg bay), 6 level
Medium valve testing area	AAU	Trash
Staging area	ACU	Large Rubber protections
Staging area	ADH	Medium Weight Working table (80cmx80cm)
Staging area	ACT	Rubber protection cover kit 1/2" to 6" (by meters)
Staging area	AAP	Small rack system (100Kg bay), 6 level
Sand Blast area	ACZ	Large Sand blast unit with sand filtering system
Sand Blast area	AAF	Manual Forklift
Sand Blast area	ADH	Medium Weight Working table (80cmx80cm)
Sand Blast area	ACV	Small sand blast unit
Sand Blast area	AAU	Trash
Painting area	ADC	External Paint storage
Painting area	ADA	Large paint cabin with wall filtering system
Painting area	ABD	Light Weight Working table (80cmx150cm)

Painting area		Paint tools (mixer, gun, etc.…)
Painting area	ADB	Painting racks (30x2000x1200)
Painting area	ADL	small AC unit
Painting area	AAU	Trash
Shipping area	AAE	Forklift 4T
Shipping area	ABD	Light Weight Working table (80cmx150cm)
Shipping area	ADF	Manual Strapping machine
Shipping area	AAO	Rack System (1 ton x bay), GF+3 level
Shipping area	ADE	Wood cutter
Shipping units std:	AAR	Woden case max 1Ton (OMB Code CA01 110x60x56)
Shipping units std:	AAS	Woden case max 1Ton (OMB Code CA03 28x22x15)

Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019.

3.4.2.2.6 Construction of ancillary infrastructures

The project ancillary infrastructures for the project are internal roads, gatehouse, drainage and perimeter fence. These infrastructures shall be constructed in accordance in accordance to the respective structural detail as provided for in the layout plan for the project.

- **Surface Drainage system**

A total of 1400m length of surface drainage system of 1m deep and 0.5m wide shall be constructed to connect the various section of the proposed factory premises to discharge the stormwater runoff into Lekki Lagoon. In order to facilitate the flow of excess water toward the drains

- **Internal roads**

A single road network spanning about shall be constructed within the facility premises. The roads are to be connected together to provide access for vehicles and pedestrians from one part of the facility premises to another. The roads are to be built with asphalt .The placement of asphalt will be done such that the retaining stormwater on the road will be directed to the open drains on the rear side

- **Perimeter Fence**

The entire Lekki Free Trade Zone has already been provided with security fencing by the Lekki Free Zone Development Company (LFZDC) to ensure a sealed environment for security management of the zone. However, a perimeter fence shall be constructed to demarcate the footprint boundary of the project site from other industrial facilities within the Zone. This is also to keep unauthorised members of public from gaining access to the factory premises. The proposed project perimeter fence will be 3m high and this will be constructed to join the gatehouse using moulded block and wire mesh. The later shall be mounted on the former.

- **Waste Treatment Plant (WTP)**

Sewage collection tank shall be built in accordance to specification as provided in the facility layout. The system shall be used for the collection of human and associated liquid wastes generated from the proposed project. The collection tank is designed with capacity to collect an estimated 920 m^3 of wastewater. As part of the guideline for wastewater management within the zone, operator of each facility is expected to channel her liquid waste to the Central Treatment Plant (CTP) provided by the Lekki Free Trade Zone Company. In this connection, the proposed sewage facility shall be connected to the CPT through the existing infrastructure.

3.4.3 Operational phase

The OCTG threading plant will commence with a single threading line for production casings (5’’ to 13 3/8’’) with future expansion to include lines for production tubing (2-3/8’’ to 4-1/2’’). For the valve assembly, testing repair and maintenance plant, production will commence with assembly of smaller valve sizes including testing, repair, painting, and maintenance of OMB as well as other OEM valves.

3.4.3.1 Process Raw material and supply

The raw materials for OCTG threading are of two types. These are plain end carbon steel pipes and steel billets. There are two sources of material input for process operation. The first involves delivery of new or damaged OCTG pipes to the plant complex by BOG customers (oil companies) in Nigeria either through the land or sea for threading according to customer project needs. The second involves the supply of new OCTG pipes from China by one of the BOG’s technical partner, Foryouth to produce the desired threaded. This company is an expert with track record in production of various sizes of pipes including line pipes, production casings, production tubing and seamless steel tubes used in oil and gas drilling and exploration. In this option, customers shall place order for the threaded pipes after which the products will be supplied to them for operational use. The steel billets will be used for fabrication of crossovers, pup joints, couplings and other OCTG accessories. They are produced in countries outside of Nigeria by pipe mill and will also be sourced directly from Foryouth in China.

On the other hand, the input raw materials for the valve assembly includes valve components, accessories, paints etc. The valve components shall be sourced from BOG’s valve manufacturer/partner, OMB based in Italy Other consumable raw materials are paints, cleaning fluids such as acetone, Methyl Ethyl Ketone (MEK), Methyl Isobutyl

Ketone (MIBK) etc. These will be sourced locally. The API specification for the various grades of OCTG casing and tubing pipes is given in **Tables 3.7** and **Table 3.8**

Table 3.7: Materials chemical composition of OCTG casing and tubing

Group	OCTG pipe material	Types	C		Mn		Mo		Cr		Ni	Cu	P	S	Si
			min	Max.	min	Max.	min	max	min	max	Max.	max	max	max	max
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	H40	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03	
	J55	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03	
	K55	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03	
1	N80	1	-	-	-	-	-	-	-	-	-	-	0.03	0.03	
	N80	Q	-	-	-	-	-	-	-	-	-	-	0.03	0.03	
	R95	-	-	0.45c	-	1.9	-	-	-	-	-	-	0.03	0.03	
2	M65	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03	
L80	1	-	0.43a	-	1.9	-	-	-		0.25	0.35	0.03	0.01	0.45	
L80	9Cr	-	0.15	0.3	0.6	0.9	1.1	8	10	0.5	0.25	0.02	0.01	1	
L80	13Cr	0.15	0.22	0.25	1	-	-	12	14	0.5	-0.25	0.02	0.01	1	
C90	1	-	0.35	-	1.2	0.25b	0.85	-	1.5	0.99	-	0.02	0.01	-	
195	1	-	0.35	-	1.2	0.25b	0.85	0.4	1.5	0.99	-	0.02	0.01	-	
C110	-	-	0.35	-	1.2	0.25	1	0.4	1.5	0.99	-	0.02	0.005	-	
3	P110	e	-	-	-	-	-	-	-	-	-	-	0.03e	0.030e	
4	Q125	1	-	0.35		1.35	-	0.85	-	1.5	0.99	-	0.02	0.01	

Source: API 5CT

a-The carbon content for L80 may be increased up to 0.50 % maximum if the product is oil-quenched.
b-The molybdenum content for Grade C90 Type 1 has no minimum tolerance if the wall thickness is less than 17.78 mm.
c-The carbon content for R95 may be increased up to 0.55 % maximum if the product is oil-quenched.
d-The molybdenum content for T95 Type 1 may be decreased to 0.15 % minimum if the wall thickness is less than 17.78 mm.
e-For EW Grade P110, the phosphorus content shall be 0.020 % maximum and the sulfur content 0.010 % maximum.
NL = no limit. Elements shown shall be reported in product analysis

Table 3.8: OCTG Pipe material – Mechanical properties

Group	OCTG pipe material	Type	Total elongation under load (%)	Yield strength mpa		Tensile strength Min. mpa	Hardness a max		Specified wall thickness mm	Allowable hardness variation b HRC
				Min.	Max.	HRC	HBW			
1	2	3	4	5	6	7	8	9	10	11
	H40	-	0.5	276	552	414	-	-		
	J55	-	0.5	379	552	517	-	-		
	K55	-	0.5	379	552	655	-	-		
	N80	1	0.5	552	758	689	-	-		
	N80	Q	0.5	552	758	689	-	-		
	R95	-	0.5	655	758	724	-	-		

	M65	-	0.5	448	586	586	22	235		
	L80	1	0.5	552	655	655	23	241		
	L80	9Cr	0.5	552	655	655	23	241		
	L80	13Cr	0.5	552	655	655	23	241		
	C90	1	0.5	621	689	689	25.4	255	≤ 12.70 12.71 to 19.04 19.05 to 25.39 ≥ 25.40	3.0 4.0 5.0 6.0
	T95	1	0.5	655	724	724	25.4	255	≤ 12.70 12.71 to 19.04 19.05 to 25.39 ≥ 25.40	3.0 4.0 5.0 6.0
	C110	-	0.7	758	793	793	30	286	≤ 12.70 12.71 to 19.04 19.05 to 25.39. ≥ 25.40	3.0 4.0 5.0 6.0
	P110	-	0.6	758	862	862	-	-	-	-
	Q125	1	0.63	862	931	931	b	-	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0

a- In case of dispute, laboratory Rockwell C hardness testing shall be used as the referee method.
b- No hardness limits are specified, but the maximum variation is restricted as a manufacturing control in accordance with 7.8 and 7.9 of API Spec. 5CT

3.4.3.2 Specification of Requirement

As earlier indicated, the proposed facility is designed to thread OCTG pipes and assemble wide range of valves mainly for use oil and gas upstream sector of Nigeria. The products from the facility and the required specifications is shown in **Table 3.9**

Table 3.9: Specification of the finished product from the proposed BOG facility

S/N	Raw material	Specifications
A	**OCTG threading plant**	
1	Production Tubing	2-3/8" to 5"
2	Production Casing	7" to 13-3/8"
B	**Valve Assembly plant**	
3	Gate, Globe and Check (GGC) valves	Up to 2" forged, all pressure class)
4	Floating ball valves	up to 6", all pressure class);
5	Trunnion ball valve	(up to 24", pressure class up to 1,500
6	Design	2 pieces, 3 pieces side entry, 1 piece top entry
7	Seat configuration	Soft seated (metal seated excluded)
8	Temperature range	+25°C to 200°C

3.4.3.3 Threading operation

Pipe threading is a process of creating screw thread on a pipe to prevent leakage of fluid when pipes are connected together. The process technology adopted for threading in the proposed project uses Computer Numerically Controlled (CNC) equipment to produce desired thread. The stages are explained as follows:

Step 1: The OCTG pipes shall first undergo ultrasonic non-destructive testing both of the pipe body and the ends to determine damages. All damaged pipes shall be separated and quarantined from good ones to avoid unintentional use. The pipe is then filled with water and pressurized to test whether the strength of the steel pipe meets the requirements of the API standard as listed in **Table 3.0**. The pipes that meet all the requirements of API standards are transported to the threading area where their quality is checked by visual inspection and measurement.

Step 2: The pipes are subjected to drift Testing to determine whether the inner diameter of the pipe meets the requirements of the API standard with drift mandrel.

Step 3: The pipe is transported to the magnetic particle inspection (MPI) of pipe end, which identifies longitudinal and transverse OD and ID defects as per the standard. After MPI, prime pipe is fed into the buck-on/torque-down machine. Threading is carried out on pipe ends as per thread size requirements of the latest API standard and in accordance to customer requirement.

Step 4: After threading the pipe ends, the pipe is inspected by measuring the dimensions of threads with special the inspection instruments.

Step 5: The pipe is sent to thread finisher for threading the pipe-end with CNC machine tool in accordance with the thread size requirements of the API standard.

Step7: Tighten thread protector of the pipe’s pin end.

Step 8: The pipe end is tightened by applying thread compound noting the dosage of threaded compound for each metric ton steel pipe, which is 0.15 KG.

Step 9: Tight thread protector of the box: Tighten thread protector of the pipe’s box end.

Step10: Measure the length and weight of pipe: Measuring the pipe's length and weight with Laser Range Finder and Electronic Scale.

Step11: Coating the pipe: To get the rust prevention, the pipe is coated on the surface with anti-corrosive paint, the dosage of paint for each Metric Ton of steel pipe is 1.5 KG.

Step 12: Once they have cleared all the production areas, the pipes are delivered to the length measurement and weighing station and have markings applied to them. Following the weighing and the length measurement, the pipes are sent to the automation and tracking system which checks that the size fits within the range and the requirements specified in API/ISO

Step12: Print and Stamp some information on the pipe: The pipe is marked on the surface to indicate the length and weight data using coated paint. The dosage of paint for each metric ton steel pipe is 0.06KG.

Stacking of finished products: The finished threaded pipes are carried from the factory and stacked at the area designated for the purpose from where they are delivered upon customer request

3.4.3.4 Maintenance Activities

Maintenance is the activity undertaken to allow continued use of buildings and equipment over a desired life expectancy. BOG wants full productivity from the production facilities at the minimum cost necessary to ensure their safe use. The key for efficient maintenance is a good management of the resources invested in this activity. Inadequate maintenance results in lost production time from breakdown failure, inefficient production, accelerated depreciation of plant facilities and increased insurance premiums. BOG will deal with the specific maintenance needed to guarantee product quality. BOG will keep a shutdown report that records lost production and the causes, e.g., mechanical, electrical, scheduling. Maintenance activities shall be carried out on all the factory equipment including storage facilities and generator. It is expected that the project plants will work for at least 50years project lifespan before decommissioning. This will be after the plant has repair and parts problems.

3.4.3.5 Utility Requirement

The proposed BOG steel pipe threading and valve assembly plants shall require some utilities in order to ensure smooth operation of the plants. The utility includes power, natural gas, diesel, water, fuel and Sewage storage plant and manpower.

Power

Diesel generating set(s) shall be installed at the site to provide electricity/energy needed during construction. Noise and emissions shall be managed to stay within the allowable limits and BOG shall ensure contractor's compliance, through effective supervision and audits.

An estimated 2,000kw of energy is required for the proposed project. Electricity supply shall be obtained through direction of the complex to an existing Independent Power Plant (IPP) of 12 MW put in place to meet the requirement of the investors for power consumption in the zone. There will also be installation of one 500KVA diesel generators as back-up to meet emergency power requirement during power failure from the zone. The generator shall have a total installed capacity of 2000K with total output of 380AC. All the machines on the production line will use the energy with 380AC only. The generator will be enclosed in a soundproofing material to reduce the emission level. The energy requirement of the various units operation of the proposed plant is given in **Table 3.10.**

Table 3.10: The details of energy consumption of units operation of the proposed project

Equipment code	Equipment Description	Details	Power consumption	Unit Cost	Total Qty	Total cost	Lead time	Installation	Notes	Qty Phase 1	Total cost Phase 1	Qty Phase 2	Total cost Phase 2
AAI	Air compressor (7-8 bar)		7,5KW		1	- €		1W			- €	1	- €
AAA	Bridge Crane 10T		50 Kw		1	- €		2W			- €	1	- €
AAL	Compressor distribution system (7-8 bar)				1	- €		1W			- €	1	- €
ADG	Electic cabin				1	- €		1W			- €	1	- €
AAG	Electrical Wiring system				1	- €		2W			- €	1	- €
AAH	Elettric plugs (2 380V+ 2 220V)				10	- €		1W			- €	10	- €
AAQ	Europallets				20	- €					- €	20	- €
ADD	Firefighting system				1	- €		2W			- €	1	- €
AAT	Hard plastic 40x40x30 (or similar)				100	- €					- €	100	- €
AAM	Light System (21)		21 Kw		1	- €		2W			- €	1	- €
AAN	Ventilation system (for workers)				1	- €		2W			- €	1	- €
AAR	Woden case max 1Ton (OMB Code CA01 110x60x56)				20	- €					- €	20	- €
AAC	Forklift 2T		1,5 Kw		1	- €					- €	1	- €
ABD	Light Weight Working table (80cmx150cm)				1	- €					- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
AAO	Rack System (1 ton x bay) , GF+3 level	76 bay			1	- €		2W			- €	1	- €
AAU	trash				2	- €					- €	2	- €
AAB	Column crane 1T		2,5 Kw		1	- €		1W			- €	1	- €
ABC	Drain pump (if needed)		1 Kw		1	- €		1W			- €	1	- €
ABA	Fresh water tank (if needed)				1	- €		1W			- €	1	- €
ABD	Light Weight Working table (80cmx150cm)				1	- €					- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
AAV	Pressure Washer		2 Kw		1	- €					- €	1	- €
AAU	trash				2	- €					- €	2	- €
AAZ	Valve Washing station				1	- €		1W			- €	1	- €
ABB	Waste water tank (if needed)				1	- €		1W			- €	1	- €
AAB	Column crane 1T		2,5 Kw		1	- €		1W			- €	1	- €
ABH	Gate lapping machine		8 kw		1	- €		1W			- €	1	- €

ABI	Grindstone		2 Kw		1	- €					- €	1	- €
ABP	Heavy duty working table (1Mx1M)				2	- €		1W			- €	2	- €
ABL	Large Ball lapping machine (*)		8 kw		1	- €					- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
ABE	Manual Horizzonthal Lathe (°)		8 Kw		1	- €					- €	1	- €
ABQ	Portable tools cabin				1	- €					- €	1	- €
ABM	Set of large lapping ball tools				1	- €					- €	1	- €
ABO	Set of small lapping ball tools				1	- €					- €	1	- €
ABN	Small Ball lapping machine (*)		5 Kw		1	- €					- €	1	- €
ABG	Small Drill		2 kw		1	- €		1W			- €	1	- €
ABF	Small Mill		5 kw		1	- €		1W			- €	1	- €
AAP	Small rack system (100Kg bay), 6 level				2	- €		1W			- €	2	- €
ABR	Standards Tools kit				1	- €					- €	1	- €
AAU	trash				2	- €					- €	2	- €
ACT	Cabin With locker				2	- €					- €	2	- €
ABE	Exaust filtering unit		3,5 Kw		1	- €		1W			- €	1	- €
ABP	Heavy duty working table (1Mx1M)				4	- €					- €	4	- €
AAF	Manual Forklift				1	- €					- €	1	- €
ABT	MIG welding machine		2 kw		1	- €					- €	1	- €
AAP	Small rack system (100Kg bay), 6 level				1	- €		1W			- €	1	- €
ABS	TIG Welding machine		2 kw		1	- €					- €	1	- €
AAU	trash				2	- €					- €	2	- €
ACU	Welding Screen				3	- €					- €	3	- €
ABZ	Coupling Kit 1/2" to 2"				2	- €					- €	2	- €
ADH	Medium Weight Working table (80cmx80cm)				8	- €					- €	8	- €
ABU	Seat Press		15 kw		2	- €					- €	2	- €
AAP	Small rack system (100Kg bay), 6 level				5	- €		1W			- €	5	- €
ABR	Standards Tools kit				2	- €					- €	2	- €
ABV	Valve testing unit (Hydro/Air)				2	- €					- €	2	- €
ADI	Working table (80cmx80cm) with air gun				2	- €					- €	2	- €
AAB	Column crane 1T		2,5 Kw		1	- €		1W			- €	1	- €
ABP	Heavy duty working table (1Mx1M)				2	- €					- €	2	- €
ACF	Hydraulic Torque keys				1	- €					- €	1	- €

ACG	Hydraulik pump		3,5 Kw		1	- €					- €	1	- €
ACD	Large tools kit				1	- €					- €	1	- €
ACB	Long Heavy duty Table (1Mx2Mx0,5)				1	- €					- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
ABQ	Portable tools cabin				1	- €					- €	1	- €
AAP	Small rack system (100Kg bay), 6 level				2	- €		1W			- €	2	- €
ABR	Standards Tools kit				1	- €					- €	1	- €
ACE	Torque keys				1	- €					- €	1	- €
AAU	trash				2	- €					- €	2	- €
ACH	Blind Flange Holding dock				2	- €		1W			- €	2	- €
ACI	Blind flange set (2" to 24" cl 150-300-600))				2	- €		1W			- €	2	- €
AAB	Column crane 1T		2,5 Kw		1	- €		1W			- €	1	- €
ACO	External large water tank				1	- €		1W			- €	1	- €
ACN	External Nitrogen tank set	usually rented			1	- €					- €	1	- €
ACL	High Pressure Gas test Unit		5 kw		1	- €					- €	1	- €
ACM	Higt Pressure plug & piping connection				1	- €					- €	1	- €
ACP	Large valve testing dock station				1	- €					- €	1	- €
ADH	Medium Weight Working table (80cmx80cm)				1	- €					- €	1	- €
ABQ	Portable tools cabin				2	- €					- €	2	- €
AAP	Small rack system (100Kg bay), 6 level				3	- €		1W			- €	3	- €
ABR	Standards Tools kit				2	- €					- €	2	- €
AAU	trash				2	- €					- €	2	- €
ACR	Coupling Kit 3" to 8"				1	- €					- €	1	- €
ABP	Heavy duty working table (1Mx1M)				1	- €					- €	1	- €
ACS	Horizzontal test Bench 3"to 8" (*)		5 kw		1	- €					- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
ABQ	Portable tools cabin				1	- €					- €	1	- €
AAP	Small rack system (100Kg bay), 6 level				1	- €		1W			- €	1	- €
AAU	trash				2	- €					- €	2	- €
ACU	Large Rubber protections				1	- €					- €	1	- €
ADH	Medium Weight Working table (80cmx80cm)				1	- €					- €	1	- €
ACT	Rubber protection cover kit 1/2" to 6" (by merters)				50	- €					- €	50	- €

AAP	Small rack system (100Kg bay), 6 level				1	- €		1W			- €	1	- €
ACZ	Large Sand blast unit with sand filtering system		40 kw		1	- €		2W			- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
ADH	Medium Weight Working table (80cmx80cm)				1	- €					- €	1	- €
ACV	Small sand blast unit		9 Kw		1	- €		1W			- €	1	- €
AAU	trash				2	- €					- €	2	- €
ADC	External Paint storage				1	- €					- €	1	- €
ADA	Large paint cabin with wall filtering system		9 Kw		1	- €					- €	1	- €
ABD	Light Weight Working table (80cmx150cm)				1	- €					- €	1	- €
AAF	Manual Forklift				1	- €					- €	1	- €
	Paint tools (mixer , gun, ect…)				1	- €					- €	1	- €
ADB	Painting racks (30x2000x1200)				2	- €		1W			- €	2	- €
ADL	small AC unit		2 kw		1	- €					- €	1	- €
AAU	trash				2	- €					- €	2	- €
AAE	Forklift 4T		15 kw		1	- €					- €	1	- €
ABD	Light Weight Working table (80cmx150cm)				1	- €					- €	1	- €
ADF	Manual Strapping machine				1	- €					- €	1	- €
AAO	Rack System (1 ton x bay) , GF+3 level	12 bay			1	- €		2W			- €	1	- €
ADE	Wood cutter		3 kw		1	- €					- €	1	- €
AAQ	Europallets				20	- €					- €	20	- €
AAR	Woden case max 1Ton (OMB Code CA01 110x60x56)				20	- €					- €	20	- €
AAS	Woden case max 1Ton (OMB Code CA03 28x22x15)				20	- €					- €	20	- €
			242			**- €**					**- €**		**- €**

Source: Bell Oil and Gas Feasibility Report for OCTG threading Plant with Valve Assembly, 2019.

Fuel

Diesel will be required to operate the forklifts and the electric power generator. The project diesel requirement is given in **Table 3.11**. Diesel will be transported to the facility by truck and stored in a 5,000liter capacity surface tank, which shall be mounted at the designated area within the facility.

Water supply

Water will be used for domestic and firefighting purposes as well as cooling activities at the threading plant and this shall be provided through borehole system. The borehole water will complement water supply plant, which have been completed as the transitional measure to supply water for the tenants in the Zone. The permanent water plant for Phase I with daily capacity of 60,000 tons of purified water is now completed. The total water requirement for the operation of pipe threading plant is estimated at 5m^3 per day while domestic activities including, washing and toilet use is estimated to be in the range 750m^3 per day. Water dispenser shall be made available for human consumption and BOG vendor will supply these.

Table 3.11: Summary of the anticipated main utility of the proposed project during operation phase

Utility	Uses	Consumption per day
Electricity	Energy supply	242 kw
Diesel	To operate the forklift and generator	250m^3
Water	Domestic activities,fire fighting and cooling	755 m^3
Effluent Treatment Plant	Treatment of domestic waste/effluent	I42 m^3

3.4.4 Decommissioning and Abandonment

This is the last phase of the project implementation phase. Decommissioning of the complex and the ancillary infrastructure will be effected when the active life of all the facilities and structures have expired. The phase will involve the removal of all the installed facilities and restoring the land where necessary. Facilities to be removed include:

- Factory installations including process equipment, machines, boilers and tanks,
- Perimeter fence
- Administrative building
- Utilities such as water and fuel storage tanks, concrete structures, storm water drainage channel
- Generators
- Sewage Treatment Facilities

The guideline outlined under the Federal Ministry of Environment and NESREA

Environmental protection guidelines for manufacturing industry will be applied for the decommissioning of the project. This include:

- Assessing the soil
- Protecting the environment during decommissioning activities
- Ensuring that the site is reclaimed to pre-disturbance land capability and is compatible with adjacent land use

3.5 Waste Generation and Management

Wastes refer to any material (solid, liquid, gaseous or mixture) that is surplus to requirement. Effective and responsible handling and disposal of waste are key elements of environmental management system. Typically, a lot of waste will be generated during the site preparation, construction, operation and decommissioning phases of the proposed oil storage terminal facility. This will include solid, liquid and gaseous emission**.** Waste management for the proposed project shall be carried out in consultation and in line with the waste management guidelines of BOG.

3.5.1 Waste Generation

The waste streams shall be generated from different phases of the proposed Pipe threading and Valve Assembly project are given below:

3.5.1.1 Site preparation/Pre-construction phase Activities

- **Solid waste**: This include excavated materials, paper, water plastic containers and food wastes

- **Liquid waste**: The liquid wastes include human waste, oil and grease (from equipment maintenance)

- **Atmospheric Emission**: The atmospheric emission will include gaseous substances such as: carbon monoxide (CO), Oxides of Nitrogen (NO_X), particulate matter. These wastes are expected to be generated as result of diesel combustion by equipment/machinery and movement of trucks during site preparation.

3.5.1.2 Construction/Installation phase activities

Waste materials that shall be generated during the project activities construction of the project include:

- **Solid wastes:** Steel and metal scrap, rejected materials, surplus materials, excavated materials, paper bags, disused/wire cut, nylon wrapper, empty cartons, empty paint and solvent containers, waste from foodstuffs, empty plastic containers, cartons, sanitary waste among others, particulate matter.

- **Liquid waste:** This include, oil and grease, waste water from kitchen, washing activities and cement sludge.

- **Atmospheric Emission:** These include carbon monoxide (CO), Carbon dioxide (CO_2), Oxides of Nitrogen, and Suspended Particulate Matter (SPM). These wastes are anticipated as result of diesel combustion by equipment/machinery and movement of trucks during construction activities.

3.5.1.3 Operational phase

Solid Waste: This include kitchen wastes, wood, plastics containers, pipe off-cut, degreasers, painting filters, used nose masks, adhesive packs, glass fiber dust/chips, emery cloth, inner sander and flapper wheel, paper cover-all, leather hand glove, used rags, used laminating kits. These wastes shall be generated during threading process. Other type of waste materials include Electronic and Electrical wastes (EEW such as broken hard drives, cracked monitors, dysfunctional keyboard, mouse, Central Processing Unit (CPU), toner and ink cartridge, printer, photocopier, disused cables, lead-acid batteries, TV sets, cables.

Liquid waste: This include dye penetrant solvent, cooling water

Atmospheric emission: These include dust and Particulates (PM_{10}), VOCs, CO, CO_2, SO_2, NO_x. The air pollutants shall be generated during the combustion of fuel by tucks and operation of electric generator.

3.5.1.4 Decommissioning and closure phase

During the decommissioning activities waste shall be generated from demolition works and equipment dismantling. The waste materials are:

- **Solid Waste**; This include rubbles from demolition of buildings such broken blocks, door, steel and metal scrap, piping systems, paper, tiles, wood. The proponent will provide measures for recycling, reuse or disposal of such wastes.
- **Liquid Waste**: This includes oil and grease, wastewater from fuel storage tanks, water storage tanks, remnants of products from disconnected piping systems and tanks, sewage and stagnant water on the drains. The water and fuel waste shall be properly collected and recycled.
- **Atmospheric Emission**: This includes gaseous pollutants such CO, CO_2, NO_X, SO_2. These emissions will occur from the use of heavy machinery used for demolition work.

Table 3.12: Summary of wastes and sources anticipated in the proposed Steel Pipe threading and Valve Assembly project

Project phase	Project activities	Type of emission/waste/pollutant	Quantity
Preconstruction phase	Mobilization of equipment and transportation of workers to the site	• CO, NO_X, SO_X	123.7 μg/m^3
	Site preparation	• CO, NO_X, SO_X,	0.11 μg/m^3
		• paper, plastic bottles, sewage, oil grease	1.11 tons
Construction phase	Transportation of construction material to the site	• CO,, NO_X, SO_X	202.6 μg/m^3
	Excavation;	Excavated soil, rubbles	100.8 tons
	Civil works (building, roads, utilities etc)	• CO,NO_X, SO_X, • Metal scraps, cement sludge, paper, plastic bottle container, nylon	381.4 μg/m^3
	Fabrication of steel and iron parts and assemblage	• Metal scrap, • Ethylene	29.7 tons 107 ps
Operational Phase	Transportation of material inputs	• CO,NO_X, $SO_{X,}$ • Particulate matter (PM_{10})	1.19 μg/m^3
	Domestic activities	Kitchen waste, wastewater, sewage, plastic wastes	
	Pipe threading	Pipe off-cut, degreasers, painting filters, used nose masks, adhesive packs, glass fiber dust/chips, emery cloth, inner sander and flapper wheel, paper cover-all, leather hand glove, used rags, used laminating kits	3.11 tons/annum
	Hydro testing of threaded pipes and repaired valve	Wastewater	50.24/annum
	Cooling activities	High temperature/ Contaminated water	
	Storage of raw materials (chemical/solvents, adhesive)	VOCs, nylon	30.2
	Maintenance operation	Metal scraps, VOCs, oil and grease, effluent,	1.11MT
Decommissioning	Dismantling of structures and ancillary utilities	Metal scrap and cutting VOCs, plastics, oil and grease, TSS, particulate matter (PM_{10})	1.11MT
	Transportation of waste material out of the decommissioned site	CO, NO_X, $SO_{X,}$ particulate matter ($PM_{10)}$	1.02 MT

3.5.1.5 Hazardous waste

The hazardous wastes from the proposed project include adhesive cans, chemical gloves, glass fiber dust/chips, used laminating kits. They are generated mainly during cleaning, maintenance and treatment operations. The details of the hazardous waste and the mode of disposal is given in **Table 3.13**.

Table 3.13: Anticipated hazardous waste and mode of disposal for the Proposed project

Type of waste	Estimated quantity per annum (MT)	Mode of disposal
Adhesive cans	0.001	To be reused or sold to recycler
Chemical gloves	0.021	To be disposed at Epe landfill site
Glass fiber dust/chips	1.19	To be disposed at Epe landfill site
Used laminating kits	2.7	To be disposed at Epe landfill site
Oil contaminant waste	3.1	Co-processing
Contaminated rags or other cleaning materials	0.45	To be disposed at Epe landfill site

Waste Management Strategy

BOG shall take all practical and cost effective measures to minimize the generation of wastes, by employing the four R's (Reduce, Reuse, Recycle and Recovery) through process of optimization or design, efficient procedures and good housekeep. Waste shall be managed in the following ways:

- Waste stream identification
- Proper waste categorization
- Waste segregation
- Appropriate handling and disposal practice; and
- Recommended Management practices

Solid and hazardous wastes shall be stored in different coloured containers with labels defining them. These wastes shall be evacuated and disposed at Epe Landfill site by LAWMA accredited waste contractor.

3.6 Pre-commission/Commission of the facility

The commissioning of the proposed facility shall be done after the completion of all construction and installation work. The commissioning process certifies that all requirement have been met, the facility complex complies with statutory requirement as well as safety requirements. This includes final systematic check of equipment and systems prior to energizing/power-up. Commissioning shall commence when the Pre-Start-up Technical Safety Audit has been completed and BOG have addressed all recommendations (if any) and satisfied that all systems are fit and safe for energizing and/or Power-Up.

3.7 Manpower Requirement

An estimated ninety-five (95) personnel comprising skilled and unskilled is to be engaged during the project implementation. The workforce consists of thirty-five (35) personnel during the construction phase and sixty(60) workers during operational phase. At the operational phase, the worker comprises operative and management staff. After the installation of the equipment and commission of the facility, seventeen (17) staff will be employed and trained in Lagos, Nigeria on how to use the installed machines and threading processes.

To operate the Steel pipe threading plant to full capacity, there will be a line of three shifts. Each shift will have 30 staffs made up of twenty-four (24) operatives and six (6) management staff. It is proposed to start with one shift per day, while management will be shared by all shifts. In case of valve assembly plant, the projected staffing shall be done in phases. It is envisaged that the staff population shall grow from nine (9) in the first six months to twenty-seven (27) in the 3 third quarters of the year.

Priority shall be given to the local community for the recruitment of unskilled workers and where skilled workers are also available in the local community, recruitment consideration shall be given to them.

3.8 Emergency and Contingency Procedure

Bell Oil and Gas shall throughout the life of the project, continue to assess possible risks to the communities as it relates to emergency incidents. Specific and timely information on appropriate behaviour and safety measures shall be adopted in the event of an accident. Communities and other stakeholders shall have access to information necessary to understand the nature of the possible effect of an accident and an opportunity to contribute effectively, as appropriate, to decisions concerning hazardous installations. Specific attention shall be given to the transportation of any hazardous materials. A procedure shall be developed to ensure compliance with local laws and international requirements relating to the transportation of hazardous materials, including waste classification and hazard analysis, labeling, emergency response approach, vehicle and container specifications, training of the drivers, risks associated with the transportation route etc.

Where the consequences of emergency events are likely to extend beyond the project boundary (e.g. hazardous material spill during transportation on public roads), emergency response plans shall be developed based on the risks to the health and safety of the affected community and other potentially affected stakeholders.

Emergency plans shall address the following aspects of emergency response and preparedness:

- Specific emergency response procedures.
- Communication strategy.
- Trained emergency response teams.
- Emergency contacts and communication systems/protocols.

3.9 Proposed Project Schedule

The proposed BOG steel pipe threading and valve assembly facilities project is designed to operate for minimum of 50 years. The overall time estimated for procurement, delivery, installation, testing and commissioning of the proposed project is estimated 18months. The proposed project implementation schedule is presented in **Table 3.14**.

CHAPTER FOUR

DESCRIPTION OF THE EXISTNG ENVIRONMENT

4.1 INTRODUCTION

This section covers the Biophysical, and Social baseline status of the study area. Information for this section was obtained primarily from field data gathering exercise and Secondary from literature reviews including EIA and other environmental studies carried out particularly within the project area. The Federal Ministry of Environment approved the conduct of one season data collection due to several EIAs that had been conducted in the area **(See Annex 1).** This is to be augmented with a secondary data obtained from and existing approved EIA project(s). The secondary data was obtained from the Proposed Yulong Steel Pipe Production facilities Project at Lekki Free Zone in Ibeju Lekki Local Government Area, Lagos State Final EIA Report in November 2017. The project is within less 100m radius of the proposed project area.

4.2 STUDY APPROACH

4.2.1 ***Pre–Field Investigation Visit***

Reconnaissance field visit was made to the proposed project location on 14th Novemeber 2019 prior to field investigation. During the visit in presence of the FMEnv and LMEnv and Ibeju Lekki LGA representatives, visual observations were made to identify and record important environmental features and in some instances, photographs of some important features within and around the proposed project locations were taken.

Plate 4.1: View of the pre-field investigation in the presence of FMEnv, LMEnv and Ibeju Lekki LGA representatives (November 2019)

4.2.2 Mobilization

On securing an approval from the Federal Ministry of Environment to undertake a one season (dry season) sampling activities (**See Annex**). The team mobilized to the site in 6th March 2020. Access to the site was through Lekki - Epe Expressway.

Field sampling and data collection (wet season) for the purpose of this EIA was conducted in the week of March 6th – 8th, 2020 in the presence of the FMEnv representative (**See Plate 4.2**). To assess the extent of project influence, the spatial boundary of 500meters to the project area was considered. Consultation with the project-affected communities was carried out, and in fulfillment of the local content requirements, local hands within the project area were hired to work with the field team as field assistants.

Plate 4.2: Field data gathering exercise conducted in the presence of FMEnv representative (Photographed March 2020)

4.2.3 Stakeholders Scoping Workshop

In demonstration of project proponent's commitment to public participation in the project's EIA process and in compliance with regulatory requirement, a Stakeholders Screening and Scoping Workshop was held at JATA Event and Resort on Tuesday, 21st January 2020. Present at the workshop were representatives of the project's host communities, regulators from the Federal Ministry of Environment, Lagos State Ministry of Environment and Water Resources, as well as Lekki Worldwide and Lekki Free Zone Development Company. Also, in attendance were representatives of the Ibeju Lekki Local Government and other interested parties.

Table 4.1: Summary of Stakeholder Engagement Participation

Stakeholder Category: Government Stakeholders	**Representation**
Federal Government	Representative, Federal Ministry of Environment
Lagos State Government	Representative, Lagos State Ministry of Environment and Water Resources;
Local Government	Representative of Chairman, Ibeju Lekki Local Government Area
Community Leadership	Representatives of traditional leaders; - Imobido community - Tiye Community
Community Residents	Cross-section of residents of Imobido and Tiye Communities
Consultants	Global Impact Environmental Consulting Limited team of Consultant
Project Proponent	Representatives of Bell Oil & Gas and Project Financier from synergy capital

The highlights of the workshop included:

- Presentation on the Proposed Threading Pipe and Valve Assembly Facilities Project details
- Comments, Contributions and Questions by Stakeholders
- Response by the project proponent
- Expression of expectations from project host communities.

Plates 4.3 – 4.7: View of the consultation in progress during the scoping workshop

4.2.4 Desktop Studies

Desktop data were sourced from other publicly available documents, internet, Federal Survey Office, etc. Twelve years (2000 -2013) meteorological data were obtained from the meteorological stations in Lagos especially from the Nigeria Institute of Meteorology, (NIMET). In addition secondary data was sourced from the Federal Ministry of Environment approved Yulong Steel Pipe Investment EIA Studies conducted in November 2017 (Wet season data) in order to assess the seasonal variation of the planned project.

4.2.5 Field Activities

Field data were collected during the wet season (March 6th – 8th, 2020) period. The seasonal variation was performed using the already approved secondary data from the project within the project area after seeking approval from the FMEnv.

Field studies involved quantitative sampling as well as recording of observations of the environmental components of the study areas that were likely to be affected by the proposed project development. Sampling activities were conducted based on a pre-determined sampling plan **(See Figure 4.1)** Field observations and sampling covered the following environmental attributes: ground water, geology, soil, land use, biological resources, air quality, noise level, vegetation and social, economic indicators. Sampling locations were geo-referenced using a handheld Global Positioning System (GPS) (**See Table 4.2**).

The objectives of the sampling activities were to:

a) Establish the existing state of the environment.
b) Appraise the existence of sensitive environmental components.
c) Evaluate the sensitivities of the various environmental components to the planned project activities.

Table 4.2: Coordinates for the sampling locations

Sample Code	Theme	Longitude	Latitude	Location Description
Air Quality & Noise level				
AQ1	Air Quality	3.969882	6.460320	Project South-west Flank
AQ2	Air Quality	3.970633	6.460195	Project South-east Flank
AQ3	Air Quality	3.970308	6.461016	Project Mid-point
AQ4	Air Quality	3.970809	6.461936	Project North-east Flank
AQ5	Air Quality	3.970058	6.461987	Project North-west Flank
AQ6	Air Quality	3.972304	6.465237	Project Upwind direction
AQ7	Air Quality	3.970494	6.449160	Project site Downwind direction
AQ8	Air Quality	3.962903	6.434052	At Tiye Community
Control 1	Air Quality	3.974067	6.474066	At about 2km away from the project site
Soil Samples				
SL1	Soil	3.96699	6.46092	Fresh water swamp forest
SL2	Soil	3.96685	6.46005	Fresh water swamp forest
SL3	Soil	3.96909	6.46076	Sand Filled Area
SL4	Soil	3.96928	6.46146	Sand Filled Area
SL5	Soil	3.97015	6.46055	Sand Filled Area
Ground Water				
GW1	Ground Water	3.962591	6.434629	At Imodibo, adjacent Community to the site
GW2	Ground Water	3.974847	6.432465	At Tiye, adjacent Community to the site.

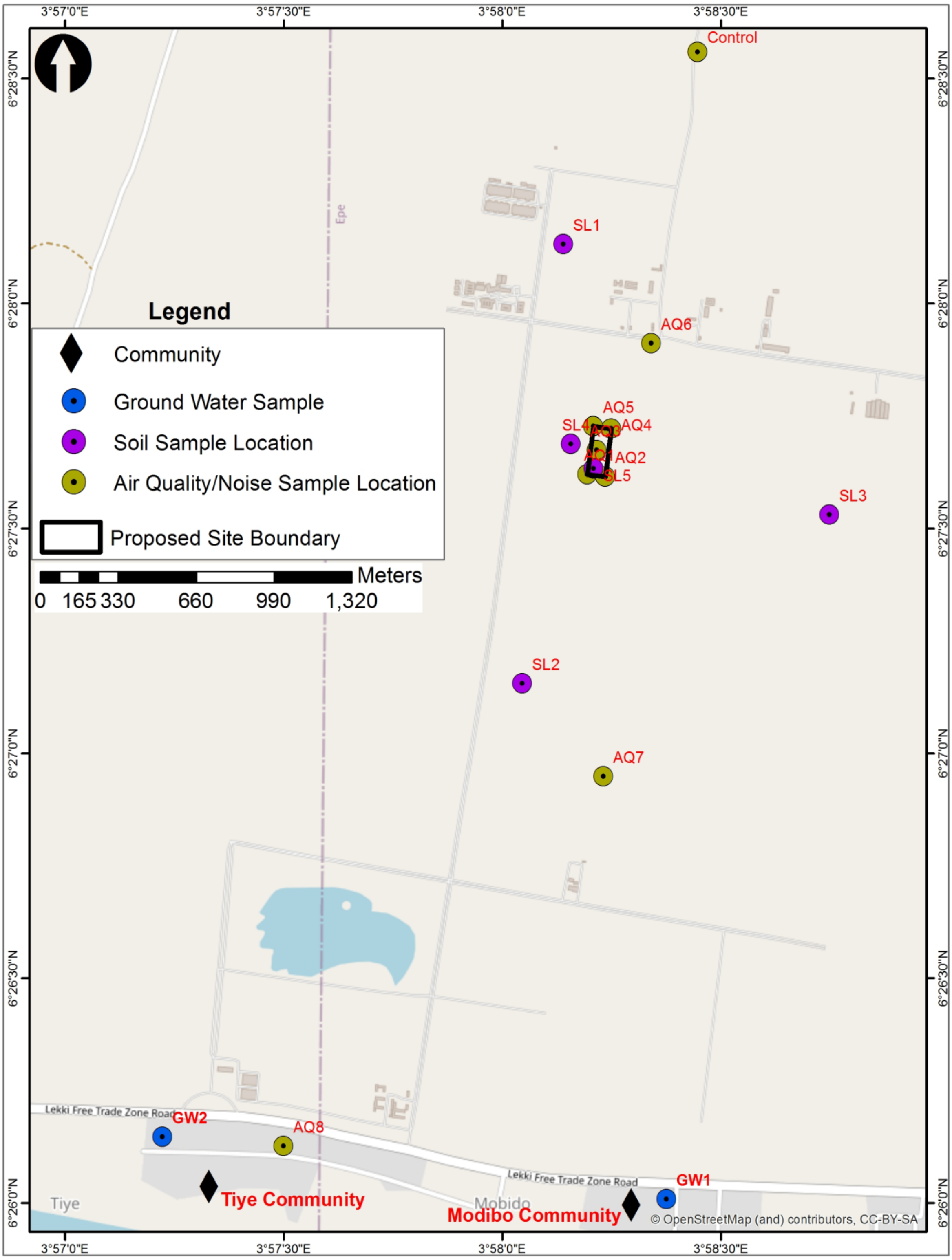


Fig 4.1: Sample Location Map of the Proposed Project Site

The methodology applied for samples collection for each environmental component is described below:

4.2.5.1 Air Quality and Noise Level

Sampling locations were chosen in compliance with the approved Terms of Reference. These include the four flanks of the project site, its central area, upwind and downwind. Sampling took place on 6th March 2020 at nine (9) different locations including the control location (**Table 4.3**) strategically located both within and around the project site. The control location was selected to understand the peculiar characteristics of the airshed, if any.

Table 4.3: Air Quality Sampling Locations during the Study

Sample Code	Theme	Longitude	Latitude	Location Description
Air Quality & Noise level				
AQ1	Air Quality	3.969882	6.460320	Project South-west Flank
AQ2	Air Quality	3.970633	6.460195	Project South-east Flank
AQ3	Air Quality	3.970308	6.461016	Project Mid-point
AQ4	Air Quality	3.970809	6.461936	Project North-east Flank
AQ5	Air Quality	3.970058	6.461987	Project North-west Flank
AQ6	Air Quality	3.972304	6.465237	Project Upwind direction
AQ7	Air Quality	3.970494	6.449160	Project site Downwind direction
AQ8	Air Quality	3.962903	6.434052	At Tiye Community
Control 1	Air Quality	3.974067	6.474066	At about 2km away from the project site

On-line monitors were deployed to monitor all the parameters including meteorological, air pollutants and ambient noise levels. While the EXTECH 45170 Weather Tracker was used for meteorological parameters, Met one AEROCET 531S particle Mass/ Particle counter was used for particulates. The Aeroqual Series 200 and WolfPackTM Modular Area Monitors were used for gaseous pollutants while the EXTECH Instrument US Model 407750 sound meter was deployed for ambient noise levels. Status of air quality was assessed using the measured concentrations and National Ambient Air Quality Standards (NAAQS) while the airshed was classified using the World Bank method. Detailed sampling methodology (**Plate 4.8**) is reported in **Annex**.

Plate 4.8: Typical Air Quality/Noise Monitoring Setup during the Study (Photographed March 2020)

4.2.5.2 Soils and Landuse Study

Study Approach - Mobilization

Field sampling and data collection for the purpose of this EIA was conducted in the week of March 6^{th} – 8^{th}, 2020. Consultation with the project-affected communities was carried out, and in fulfillment of the local content requirements, local hands within the project area were hired to work with the field team as field assistants.

Field Soil Investigation and Sampling

Field sampling covered the land area within the project location and its area of influence. The objective of the soil investigation and sampling activity was to establish the existing state of soils in the project environment. In view of the deep sandy nature of the environment, at each soil sampling location, representative soil samples were collected at two depths (0-30cm and 30 – 60cm), representing the topsoil and subsoil (Brady, 2012), respectively. These soil-sampling depths were considered adequate in view of the deep sandy nature of the soils (SSSN, 1981). To ensure the collection of representative soil samples, 10 core soil samples taken within 5-10m radius of the sampling location were composited/ bulked in plastic bucket, and thoroughly homogenized before sub-sampling for laboratory analysis. The soil sampling locations were geo-referenced on the field using handheld GPS. Brief description of the sampling locations was also undertaken.

Soil samples collected were for the following:

- Physico-chemical characterization;
- Heavy metals determination;
- Organics (oil & grease/ THC); and
- Soil microbiology.

Field QA/QC Measures

- To ensure that representative soil samples were collected on the field, several core soil samples were bulked to give one composite/bulk soil sample per sampling location. Collection of composite/ bulk soil sample eliminates micro-variability on the field (Thien and Graveel, 1997).
- Dutch Soil Auger with Stainless Steel at the Tip was used for soil sampling to prevent contamination of the samples with the sampling equipment.
- The soil sampling equipment was thoroughly cleaned and rinsed with tissue paper after the completion of soil sampling at every soil sampling location so as to prevent cross-contamination of the soil samples.
- Bulking of soil samples was carried out in a plastic bucket lined with aluminum foil sheet, and the homogenization of the core samples was achieved using stainless steel spatula.

- Soil samples meant for physico-chemical properties and heavy metals were kept in polyethylene bags, while those meant for microbiological analysis were kept in sterilized bottles. Soil samples to be used for oil & grease/total hydrocarbon content (THC) determinations were stored in glass bottles.
- All the soil samples collected for various laboratory analyses were properly labeled to indicate sampling location, soil depth, sample number and date of sampling.
- Chain of Custody Form was also kept to track soil sample movement.

Laboratory Study

The summary of the various laboratory analytical methods for the soil samples collected is presented in the table below:

Table 4.4: Summary of the methods employed for the analysis of the soil samples.

Parameter	Method
Physical	
Grain Size Distribution	Hydrometer (Bouyoucos, 1951)
Organics	
Total Hydrocarbon Content (THC)	Xylene extraction followed by the use of Spectrophotometer
Metals	
Exchangeable Bases (K, Na, Ca, Mg)	Ammonium Acetate Extraction, followed by the use of Flame Photometry and Atomic Absorption Spectrophotometry (Jones, 1988)
Chemical Properties	
pH	Glass electrode pH meter
Total Nitrogen	Macro Kjedahl (Jackson, 1962)
Available phosphorus	Colorimetric (Jones, 1998; Murphy and Riley, 1962)
Sulphate	Turbidimetric (Tabatabi, 1974)
Chloride	Titrimetric method (Jones, 1998)
Exchangeable acidity	Spark *et al.* (1996)
Microbiology	
Diversity and Population density	Standard Plate Count Technique

Laboratory Quality Control (QC) and Quality Assurance (QA)

Soil sample handling, preservation and analysis in the laboratory were in accordance with the provisions in the Environmental Guideline and Standard in Nigeria by the FMEnv and as in other internationally acclaimed publications such as the "Methods of Soil Analysis by Page *et al*. (1996). Analytical methods used were those that are specified in ASTM and some other Internationally Published Methods and Procedure.

4.2.5.3 Groundwater

To determine the likely impact of the proposed project on the groundwater resources, water samples was collected from the dug well located within the two host communities to assess the quality of groundwater.

Plate 4.9: Groundwater sample collection at Imobido community in progress by GIEC team

The samples were collected into clean plastic and glass[1] bottles, properly labeled and stored in a cooler for preservation. To avoid contamination, part of the water body to be sampled was used to rinse the container prior to collection at every sampling location. All the water samples collected for heavy metals analysis were acidified to about pH_2 using 4N nitric acid.

Some in-situ measurements of water parameters were made using portable water quality monitoring meters. These parameters included pH, conductivity, salinity, dissolved oxygen, and temperature. In the laboratory, parameters such as pH, salinity and conductivity etc. were cross check and the results compared with what was obtained on the field.

The values of physico-chemical parameters obtained from laboratory analyses of groundwater samples collected from two within the host communities were compared with the regulatory requirements of the Federal Ministry of Environment (FMEnv), the World Health Organization's (WHO) Drinking Water Standards, and NIS = Nigerian Industrial Standards, 2015.

4.2.5.4 Vegetation Studies

Methodology

Sampling for vegetation studies involved detailed assessment of plant characterization and identification, pathological assessment, biomass estimation and an inventory of economic crops within the study area.

[1] Glass bottles were used to collect samples for hydrocarbon and metal analysis while plastic containers were used to collect samples for other physico-chemical parameters such as cations, TDS, TSS, etc.

Structural attributes and floristic composition of vegetation communities was investigated at the Lekki Free Trade Zone of Lagos State. Biometric field inventory method; involving morphometric measurements, enumeration and application of allometric equations was employed for data collection. Vegetation variables including tree density, species diversity, basal area, diameter at breast height, plant crown cover, were measured within six sampling plots (with two replicates within each plot); distributed over the two vegetation physiographic units found in the area including riparian forest, rainforest woodland, degraded forest, mangrove wetland and grassland.

Plotless sampling or distance-based (point-center quarter) techniques method was employed to determine cover. The basic idea of these distance techniques is that density can be calculated if the average space occupied by individual plants can be determined. These techniques assume: i. Plants occupy circular areas ii. Plants are randomly distributed (**Plate 4.10**).

Plate 4.10: Vegetation sampling in progress by GIEC team

It is not surprising that the distances between plants or between a selected point and plants in the area are related by basic principles of geometry. Therefore, all distance based techniques are related by this general equation:

$$D = \frac{A}{(X\bar{d})^2}$$

D = Density
A = Area of interest (like meter squared)
d = Distance measured in the field

The term "**X**" in these equations varies depending on assumptions about distance between plants or points to a plant.

The sampling points were divided up into sub-areas depending on topography and apparent floristic differences; and these were sampled separately; within sub-areas, quadrats were located randomly. This type of sampling approach ensures a representative sample of the different physical and floristic features of the study areas.

To determine the proportional representation of each species relative to the entire plant community, **relative cover**, **relative density** and **relative frequency** values were then computed. For example, relative cover is the proportional cover of an individual species as a percentage of total plant cover; hence, it is expressed as a percentage, ranging from 0 – 100%. “Importance” is a measure of overall influence of a plant species in the community. An Importance Value (IV) for each species is derived from the combined contribution of the relative cover, relative density and relative frequency of each species in the community. Because it combines relative cover, density and frequency, importance values range from 0 – 300.

Abundance (*Ai*) = total number of individuals of species *i*

Cover (*Ci*) = Total % cover of species *i*

Relative cover (*RCi*) = $\frac{Cover\ of\ species\ i}{Total\ plant\ cover}$

Density (*Di*) = $\frac{Ai}{\text{Area}}$

Relative density (*RDi*) = $\frac{Di}{\text{Total plant density}}$

Frequency (*Fi*) = $\frac{\text{Number of quadrats with species } i}{Total\ number\ of\ quadrats\ sampled}$

Relative frequency (*RFi*) = $\frac{Fi}{Total\ plant\ frequency}$

Importance value (*IV*) = *RCi* + *RDi* + *RFi* *IV* ranges between 0 - 300

4.2.5.5 Wildlife and Endangered Species

Field observations were carried out in the project area, and surroundings in order to acquire data on the animal and wildlife resources within the study area. Observations during evening and early morning in each habitat were made while walking along footpaths and slowly walking along waterbodies in the study area. Animal and wildlife resources were taxonomically identified. Wherever possible, pictures of the wildlife, their paths, footprints, nesting sites, and fecal droppings were taken as evidence of their presence. In addition, information was obtained through interviews, focus group discussions and other interactive sessions. These interactions involved hunters, trappers, traders in wildlife materials, and farmers from settlement and village locations around the study area. Visits were also paid to wildlife (bushmeat) markets in Epe, where animals available for sale were photographed and documented. Keys used in identification included those provided by Booth (1960); Happold (1973); and Nason (1993).

4.2.5.6 Land use/cover Mapping

This was carried out first by interpreting the available Satellite Imagery of the study area and followed by ground-truthing. A printed copy of the interpreted imagery of the study area served as the background for the soil sampling location map. To ground thruthing, visual observations at all the soil sampling locations was made and documenting the various field observations. Photo-documentation of the salient features was also carried out. Photo-documentation of the salient features was also carried out.

4.2.5.7 Quality Assurance and Quality Control (QA/QC)

In order to ensure quality control, sampling, sample treatment and handling were carried out in accordance with scientifically proven and acceptable standard methods where these were not possible either due to logistic or safety reasons.

The Quality Control and Quality Assurance Procedures adopted during the field study covered all aspects of the work, including sample collection, handling, sample chain of custody, chemical analysis, data coding, and manipulation of statistical analysis and preparation of results.

(i) Sample Collection and Handling

The following sample collection and handling procedures were adopted, in accordance with international best practice:

- Only standard field procedure and method approved by LASEPA (1996), DPR (2002) and Federal Ministry of Environment (FMEnv) 1995 were adopted.
- All sampling equipment was maintained in excellent condition, calibrated against international standards and adequate steps were taken to ensure that they function normally.
- Only new and thoroughly washed, rinsed and sterilized sampling containers were used.
- For heavy metal determination, sampling bottles were used and were rinsed with a solution of one part nitric acid to four parts water, followed by copious amounts of distilled water. Water samples for BOD_5 determination were collected in black oxygen bottles and kept away from light source.
- All parameters without holding time were measured in situ on the field.
- Samples for other parameters were preserved as soon as they were collected. Dissolved oxygen samples were fixed with Winkler's Reagents; oil and grease and heavy metal samples were acidified to a pH of about 2 with concentrated H_2SO_4 respectively.
- All samples were adequately labeled to preserve their identity. Label included sample reference code number, source, sampling date, etc.
- All samples were safely packed and transported to the laboratory base

(ii) Sample Preservation

To avoid sample contamination and deterioration, sampling tools and containers were pre-sterilized. Pre-treating and preserving samples in transit in ice-cooled chests to the laboratory and stored at that temperature in refrigerators pending subsequent analysis was also carried out. All parameters with short holding time such as pH and temperature were measure in situ on the field, while samples for delayed analyses were preserved by refrigeration (for general water chemistry), pH adjustment or chemical pre-treatment (for heavy metals, Total Hydrocarbon, Dissolved oxygen). Dissolved oxygen were acidified to a pH 2 with concentrated H_2SO_4 and NHO_3 respectively and samples for microbiology and benthos were stored immediately in ice-cooled chest (at 4^oC) in transit to the laboratory base where they were stored in refrigerators. Summary of the preservation methods for various samples are presented in **Table 4.5**.

Table 4.5: Field Sample Handling

Parameters	Volume required, ml	Container	Maximum Holding Time	Preservation
pH	25	P, G	6 hrs	In situ determination
Conductivity	100	P, G	24 hrs	In situ determination
Colour	50	P G	24hrs	In situ determination
Odour	200	G	24hrs	In situ determination
Turbidity	100	P, G	7 days	In situ determination
TDS	50	P, G	6 months	Filter on site
TSS	50	-	6months	Filter on site
Salinity (Cl)	50	P, G	7days	In situ determination
COD	50	P, G	7 days	2ml H_2SO_4 per litre
BOD	1000	P, G	6days	Refrigeration at 4^0C
DO	300	G	No holding	In situ determination
Ammonia	400	P, G	24hrs	Cool at 4^0C H_2SO_4 to pH<2
Oil & Grease	1000	G	24hrs	Cool at 4^0C H_2SO_4 to pH<2
NO_3	100	P, G	24hrs	Cool at 4^0C H_2SO_4 to pH<2
Heavy metals	100	P, G	-	HNO_3 to pH<2
Calcium	100	P, G	7days	None required
Magnesium	100	P, G	6 months	HNO_3 to pH<2

1. P = Plastic sample container G = Glass sample container

Laboratory Analysis.

Samples collected were analyses in Federal Ministry of Environment accredited laboratory (Central Science Laboratory, Obafemi Awolowo University) located in Ile-Ife, Osun State. Sample analyses were carried out within the holding time of the respective parameters, and only functional and calibrated equipment was employed. FMEnv representatives witnessed the analyses**. Table 4.6** presents the summary of laboratory analytical methods used for the analysis of soil samples collected within the study area.

Table 4.6: Summary of the Analytical Methods used for Soil Samples from the Study Area

PARAMETER	METHOD EMPLOYED
Physical	
Grain Size (Particle Size) Distribution	Hydrometer (Bouyoucos, 1951)
Organics:	
Total Hydrocarbons (THC) (or " Oil and	n-Hexane extraction/UV

Grease") Content	Spectrophotometer set at 420nm wavelength
Total Organic Carbon (TOC)	Dichromate Wet Oxidation (Walkley and Black, 1934; Page *et al.*, 1996)
Metals:	
Alkali & Alkaline Metals (K, Na, Ca, Mg)	Digestion/Flame Photometry & AAS (Jones, 1988)
Heavy Metals: (Cd, Cr, Cu, Fe, Pb, Zn, Ni, Co, V)	Digestion/Atomic Absorption Spectrophotometry (AAS) (Jones, 1998; Allen 1974)
Physical / Chemical Properties/ Nutrients:	
pH	Glass electrode meter (Page *et al*., 1996)
Total Nitrogen	Macro Kjedahl (Jackson, 1962; Black, 1965; Page *et al*., 1996)
Exchangeable Acidity	Titration (Black, 1965; I.I.T.A., 1979)
Total Phosphorus	Colorimetric (Jones, 1998; Murphy and Riley, 1962; Page *et al.,* 1996)
Sulfate – Sulfur	Turbidimetric (Tabatabi, 1974)
Chloride	Titrimetric method (Jones, 1998)

4.3 ENVIRONMENTAL BASELINE INFORMATION

4.3.1 Atmospheric Conditions of the Investigated Airshed

The gathered data during this fieldwork are combined with other relevant information from the literature and past studies on the study area to describe its atmospheric conditions. These are herein presented:

4.3.1.1 Climate and Meteorology

From the thirty-year meteorological data (1989 – 2018) of the proposed project area (NIMET, 2019), the meteorology of the proposed project area is discussed using long-term data measurements taken at the nearest synoptic station located in Lagos. Lagos is located in the same air basin as the proposed project site. Generally, Nigeria's climate is characterized by the hot and wet conditions associated with the movement of the Inter-Tropical Convergence Zone (ITCZ) north and south of the equator. This Inter-Tropical Convergence Zone (ITCZ) appears as a band of clouds, usually thunderstorms that circle the globe near the equator and Nigeria is located just north of the equator. When the ITCZ is to the south of the equator, the north-east winds prevail producing the dry-season condition and whenever it moves into the Northern Hemisphere, the south westerly wind prevails to bring rainfall and the rainy (wet) season thus giving the proposed project area both the dry and wet seasons.

Rainfall

In the proposed project area as represented by Lagos, the two (2) dominant rainfall regimes are the longer Wet Season (between March and November) and a shorter Dry Season of December to February with a total rainfall of about 2400 mm. The lowest rainfall of about 20 mm is recorded in January and the maximum of 350 mm around July and September (**Figure 4.2**). Its rainfall regime is characterized by double maxima that occur in July and September. A "short break" usually experienced in August is associated with the brief southward retreat of the ITD during the period. The relatively high rainfall relates to the contiguity of the area with the Atlantic Ocean. The water body also complements the ITD-initiated rainfalls

Relative Humidity

Relative humidity in the area ranges between 60 and 83% at 16:00 hours and 81.5 – 87% at 10:00 hours with respective mean of 72.9% and 84.4% as represented by the climatic data (**Figure 4.3**). The month of June through September have the highest relative humidity with the lowest in December and February. The high relatively humidity in the proposed project area is attributed to its closeness to the Atlantic Ocean and the direct impact it receives from the ocean. During this study, Relative Humidity levels were 80% - 84% (**Table 4.6**) which could be due to influence of Tropical Continental air mass prevailing over the region at this period.

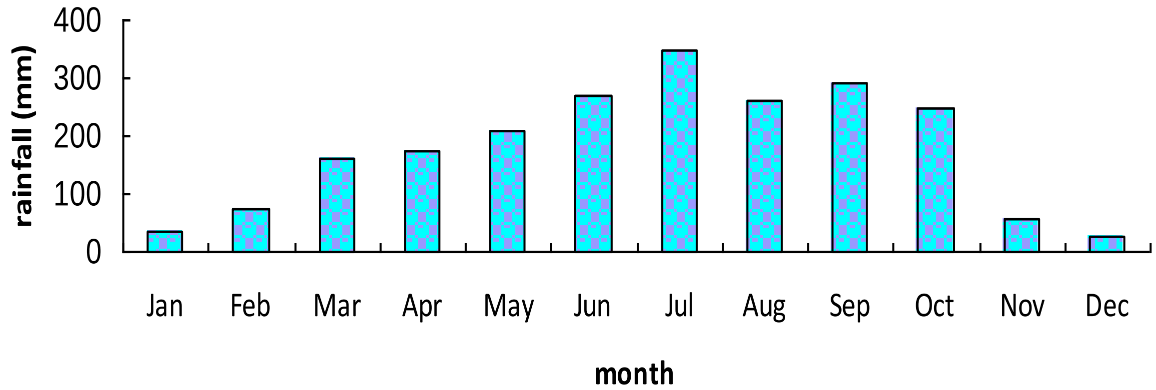


Fig. 4.2 Monthly Rainfall Distributions in the Area (NIMET, 2019)

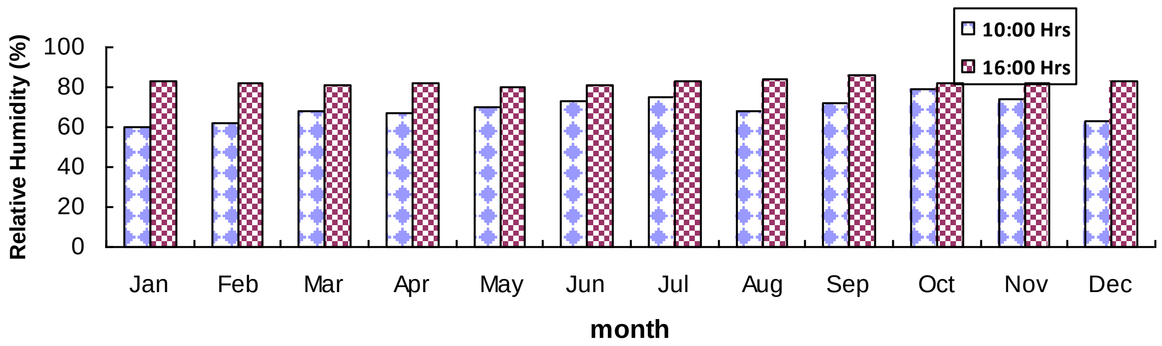


Fig. 4.3: Monthly Relative Humidity Distributions in the Study Area (NIMET, 2019)

Table 4.7: Field Measured Meteorological Parameters in the Area during the Study

Level	Temperature (°C)	Relative Humidity (%)	NE Wind (m/s)	SW Wind (m/s)
Minimum	26.9	80.3	3.2	4.1
Maximum	27.5	83.7	3.4	4.2
Mean	29.2	81.1	3.3	3.6

Air Temperature

Being in the coastal zone of the tropics, the proposed project area experiences uniformly high temperatures throughout the year with mean temperature of 22.5 –

33.7 °C (**Figure 4.4**). Usually the highest mean monthly temperature occurs between February and April at the peak of the dry season with the lowest in July, the peak period of the wet season. The air temperatures are subjected to both diurnal and seasonal variations, though temperature variations are not very large. The lowest temperature during the wet season is attributed to the depletion of incoming solar radiation by greater cloud cover. This study measured air temperature of 26.9 – 27.5 ºC with an average of 29.2 °C (**Table 4.7**) compared well with the climatic data of the area.

Sunshine Pattern

As reported in **Figure 4.5**, the annual sunshine period in the study area about 1500 hours with monthly period of 51.2 – 165.7 hrs and an average of 121.9 hrs (**Figure 4.5**). It receives the minimum sunshine period between July and September while its maximum is between December and January. The short sunshine period in July is associated with the greater amount of cloudiness and rainfall characteristic of the period. Conversely, the higher December sunshine period is due to the prevalent clear skies accompanying the ITCZ movement in its northward migration.

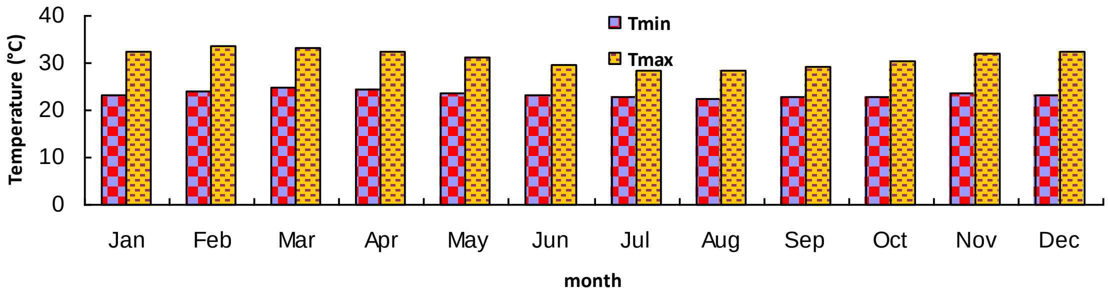


Figure 4.4: Mean Monthly Air Temperature in the Study Area (NIMET, 2019)

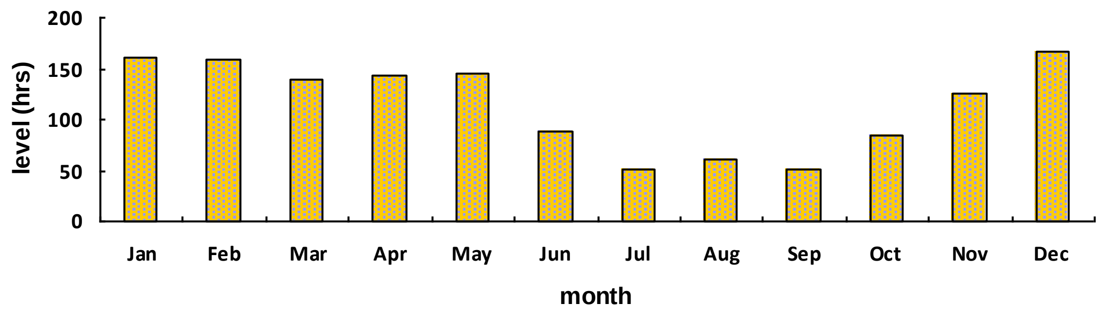


Fig. 4.5: Sunshine Pattern in the Study Area (NIMET, 2019)

Atmospheric Pressure

The mean atmospheric pressure in the climatic data is 1015 – 1020 mbar with the minimum and maximum in January and June respectively (**Figure 4.6**).

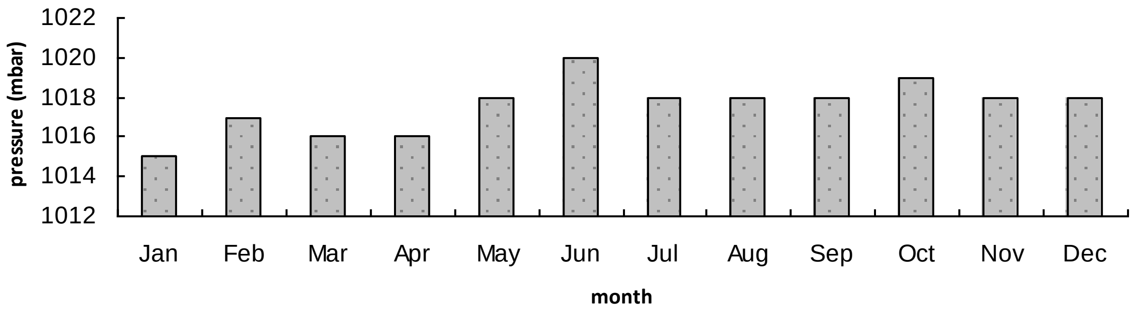


Fig. 4.6: Atmospheric Pressure Pattern in the Study Area (NIMET, 2019)

Cloud cover

Cloud cover in the area appears high throughout the year with very little variations. It is higher in May and October but low in June and July with average monthly levels of 6.7 – 6.9 Oktas, indicating a generally overcast sky with some bits of blue sky (**Figure 4.7**).

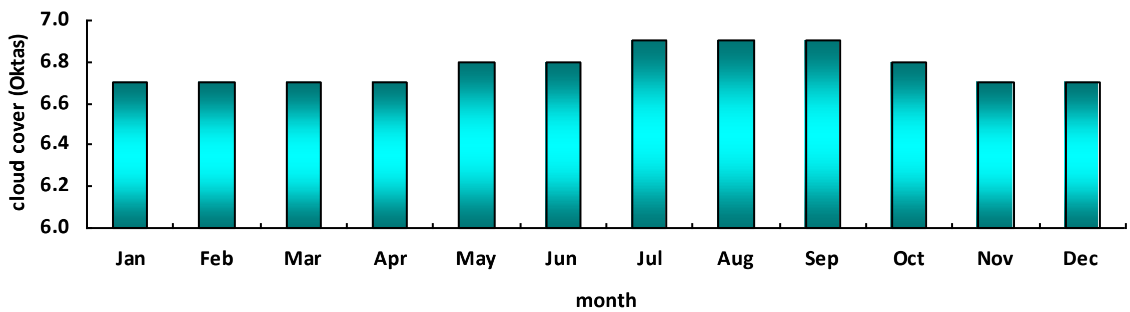


Fig. 4.7: Cloud Cover Distribution in the Study Area (NIMET, 2019)

Wind Speed and Direction

Surface wind speed in the area is characterized by small diurnal variation influenced by both land and sea breezes resulting from their alternate warming. It reaches maximum level during the night due to radiation cooling leading to instability in the surface layer. The two major wind regimes are the northeast and the southwest Trade Winds (**Figure 4.8**). Its wind speeds generally vary from 0.5 to 2.0 m/s in the night, and increases to between 2 and 6 m/s during the day. The onshore south-westerly winds which are predominant during May to September are characterized by higher wind speeds varying between 6 and 9.5 m/s, with gusts that could reach up to 18 m/s.

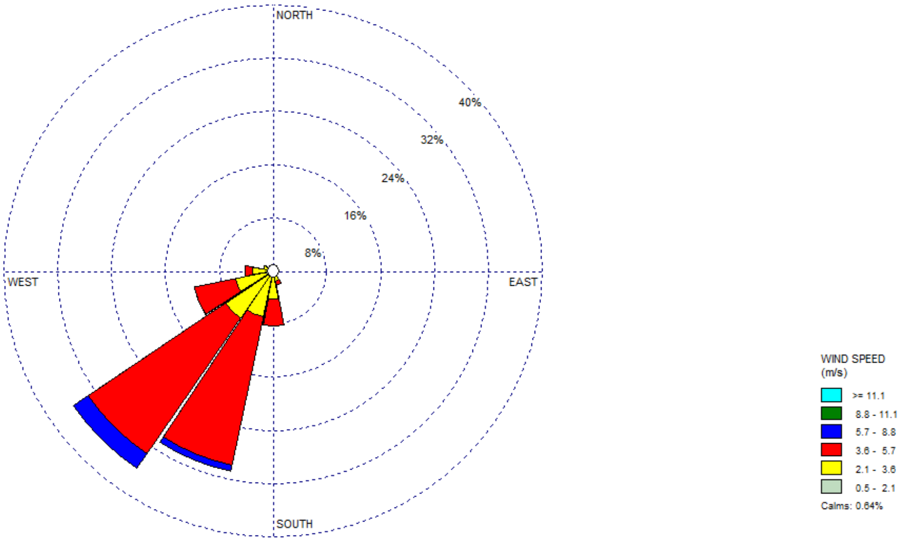


Fig. 4.8: Windrose of the Proposed Project Area (NIMET, 2018)

4.3.2 Baseline Air Quality Status of the Proposed Project Site and Area of Influence

The baseline ambient air quality of the project area investigated at selected locations during the fieldwork included Ammonia (NH_3), Methane (CH_4), Nitric Oxide (NO), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Volatile Organic Compounds (VOCs), Sulphur Dioxide (SO_2), Hydrogen Sulphide (H_2S), Ozone (O_3) and Suspended Particulate Matter (SPM). Summarized in **Table 4.8** are the measured gaseous pollutants.

While CO was measured to be 1.5 – 2.0 ppm with SD of 0.82 ppm, NO_2 was 0.05 ppm with SD of 0.03 ppm. Also VOCs, SO_2, NH_3 and O_3 were 0.02 – 0.04 ppm (with SD of 0.18 ppm), 0.04 ppm (with SD of 0.01 ppm), 6.2 - 8.4 ppm (with SD of 3.38 ppm) and 0.04 – 0.05 ppm (with SD of 0.02 ppm) respectively. Nitrogen dioxide (NO_2) and SO_2 were detected in one of the sampling locations while CO, NH_3 and O_3 were detected in two locations with VOCs detected in three locations. Nitric Oxide (NO), CH_4 and H_2S were not detected in any of the locations. Only SO_2 and NH_3 breached their respective 1-hour standards and only CO was detected at the control station but within its limit. These are all similar to the previous study in the area where none of these monitored gaseous pollutants was detected (Yulong, 2017).

Table 4.8: Measured 1-Hour Concentrations of Gaseous Pollutants during the Fieldwork

Sampling Codes	Concentration (ppm)								
	CO	NO	NO_2	CH_4	VOCs	H_2S	SO_2	NH_3	O_3
AQ1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.03
AQ2	0.0	0.0	0.05	0.0	0.02	0.0	0.0	0.0	0.0
AQ3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ4	2.0	0.0	0.0	0.0	0.03	0.0	0.0	6.2	0.0
AQ5	0.0	0.0	0.0	0.0	0.04	0.0	0.0	0.0	0.0
AQ6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AQ7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ8	1.5	0.0	0.0	0.0	0.0	0.0	0.04	0.0	0.06
Mean	0.44	0.00	0.01	0.00	0.01	0.00	0.01	1.83	0.01
Standard Deviation	0.82	0.00	0.03	0.00	0.18	0.00	0.01	3.38	0.02
Control 1	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Previous Study* (Wet Season)	1.45	-	0.03	-	0.31	0.0	0.0	0.0	-
1-Hour Limit	20	0.04 – 0.06		-	5.0	0.1	0.1	0.2	0.2

Source: GIEC Fieldwork (March 2020) and * Yulong Aug. 2016

As presented in **Table 4.9**, the daily equivalents of the measured CO were 0.75 – 1.0 ppm with NO_2 level of 0.02 ppm while VOCs became 0.02 – 0.23 ppm. The measured SO_2, NH_3 and O_3 became 0.01 ppm, 2.0 -3.0 ppm and 0.01ppm daily equivalents respectively. Only the daily SO_2 and NH_3 breached their respective FMEnv limits. None of these were detected in the study area during the previous study (Yulong, 2017).

Table 4.9: Extrapolated Daily Concentrations of Gaseous Pollutants during the Fieldwork

Sampling Codes	Concentration (ppm)								
	CO	NO	NO_2	CH_4	VOCs	H_2S	SO_2	NH_3	O_3
AQ1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.01
AQ2	0.0	0.0	0.02	0.0	0.02	0.0	0.01	0.0	0.0
AQ3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ4	1.0	0.0	0.0	0.0	0.02	0.0	0.0	2.0	0.0
AQ5	0.0	0.0	0.0	0.0	0.23	0.0	0.0	0.0	0.0
AQ6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ8	0.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
Control 1	0.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Daily Limit	10.0	0.04 – 0.06		-	1.6	0.01	0.01	0.28	0.1

Source: GIEC Fieldwork (March 2020)

Presented in **Table 4.10** were the 1-hour measured particulates concentrations obtained during the fieldwork. While $PM_{2.5}$ concentrations were 4.4 – 10.0 µg/m^3 (with SD of 1.7 µg/m^3), PM_{10} levels were 14.0 – 47.3 µg/m^3 (with SD of 10.6 µg/m^3) with TSP levels of 23.2 – 71.9 µg/m^3 (with SD of 15.2 µg/m^3). In all the sampling locations where detected, the 600 µg/m^3 1-hour FMEnv limit of TSP was not exceeded. Similarly their respective daily equivalents of 1.7 – 3.8 µg/m^3 (SD of 0.6 µg/m^3), 5.4 – 18.1 µg/m^3 (with SD of 4.1 µg/m^3) and 8.9 – 27.6 µg/m^3 (with SD of 5.8 µg/m^3) were all within limits (**Table 4.11**.). However these were higher than 0.1 µg/m^3, 0.8 µg/m^3 and 5.1 µg/m^3 earlier reported for $PM_{2.5}$, PM_{10} and TSP respectively in the study area (Yulong, 2017). This could be attributed to more anthropogenic activities in the area during this study than in the earlier study.

Table 4.10: Measured Particulates in and around the Study Area

Sampling Codes	Concentration (ppm)								
	CO	NO	NO_2	CH_4	VOCs	H_2S	SO_2	NH_3	O_3
AQ1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0
AQ2	0.0	0.0	0.09	0.0	0.04	0.0	0.04	7.3	0.0
AQ3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04

AQ4	1.9	0.0	0.0	0.0	0.06	0.0	0.0	0.0	0.0
AQ5	0.0	0.0	0.0	0.0	0.60	0.0	0.0	0.0	0.05
AQ6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AQ8	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean	0.39	0.00	0.01	0.00	0.09	0.00	0.01	1.83	0.01
Standard Deviation	0.74	0.00	0.03	0.00	0.21	0.00	0.01	3.38	0.02
Control 1	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Previous Study*	0.0	-	0.0	-	0.0	0.0	0.0	0.0	-
1-Hour Limit	20	0.04 – 0.06		-	5.0	0.1	0.1	0.2	0.2

Source: GIEC Fieldwork (March 2020) and * Yulong Aug 2016

Table 4.11: Extrapolated Daily Particulates in and around the Study Area

Sampling Locations		Concentrations (µg/m^3)		
Code	Designation	$PM_{2.5}$	PM_{10}	TSP
AQ1	Southwest Flank	2.2	8.4	15.3
AQ2	Southeast Flank	1.8	5.5	9.5
AQ3	Mid-point	1.7	5.4	8.9
AQ4	Northeast Flank	2.1	6.9	13.3
AQ5	Northwest Flank	2.3	8.4	13.6
AQ6	Upwind	2.2	7.1	11.7
AQ7	Downwind	2.3	8.7	14.0
AQ8	Nearest Community – Tiye	3.8	18.1	27.6
Mean		2.3	8.6	14.2
Standard Deviation		0.6	4.1	5.8
Control	Control	5.1	15.7	25.7
1-hour Limit		25	80	250

Ammonia (NH_3) is one of the nitrogenous compounds with high impacts on ambient air quality due to its potential for secondary particle formation. Its main local problem when released into air is the unpleasant odour, which is detectable even at low concentrations. At particularly high concentrations it can also harm vegetation. The harm caused by Ammonia in water bodies can be serious due to its toxicity to aquatic organisms. On a wider scale, ammonia plays a role in the transportation and enhanced deposition of acidic pollutants, resulting in acidification of ground and water bodies, which can harm plant and animal life. Exposure to high concentrations of Ammonia in air causes immediate burning of the nose, throat and respiratory tract. This can cause bronchiolar and alveolar edema, and airway destruction resulting in respiratory distress or failure. Inhalation of lower concentrations can cause coughing, and nose and throat irritation. The main sources of Ammonia detected in the proposed project area could be natural, from decaying organic matter, and the excreta of humans and animals. It can also be from use of fertilisers and waste disposal sites or industrial processes.

Oxides of Nitrogen (NO_X) that are of concern in atmospheric pollution are Nitric Oxide (NO) and Nitrogen Dioxide (NO_2). Breathing air with a high concentration of NO_2 can irritate airways in the human respiratory system which can aggravate respiratory diseases including asthma, leading to respiratory symptoms such as coughing, wheezing or difficulty breathing. In the air, NO_2 along with other NO_X reacts with other chemicals to form Particulate Matter and Ozone, which could also be harmful when inhaled. The present detected NO_2 could be from combustion of fossil fuels in the mobile plants around the proposed project site.

Carbon Monoxide (CO) is a colourless and odourless gas that can be harmful when inhaled. Breathing air with high CO concentration reduces oxygen that can be transported in the blood stream to critical organs like the heart and brain. Its main source during the fieldwork could be combustion activity in the mobile plants.

Volatile Organic Compounds (VOCs) are organic chemical compounds whose composition makes it possible for evaporation under normal indoor atmospheric conditions of temperature and pressure. Many VOCs form ground-level ozone, a constituent of photochemical smog, by “reacting” with sources of oxygen molecules such as NO_X, and CO in the atmosphere in the presence of sunlight. Their health effects may include eye, nose and throat irritation; headaches, loss of coordination and nausea; damage to liver, kidney and central nervous system. Outdoors, VOCs are volatized or released into the air mostly during manufacture or use of products (including hydrocarbon products) and materials. The presence of VOCs during the fieldwork could be from hydrocarbons evaporation and combustion the mobile plants working around the proposed project site.

Exposures to Sulphur Dioxide (SO_2) can harm the human respiratory system and make breathing difficult. It can react with other compounds in the atmosphere to form small particles, which may contribute to SPM pollution. At high concentrations, gaseous SO_2 can harm trees and plants by damaging foliage and decreasing growth. It can also contribute to acid rain which can harm sensitive ecosystems. It is mainly a product associated with combustion of sulphur containing compounds, including fuels thus the mobile plant around the proposed project site could be the source during the fieldwork.

Hydrogen Sulphide (H_2S) is colourless, flammable and extremely hazardous gas. It is both an irritant and chemical asphyxiant with effects of both oxygen utilisation and central nervous system. Its health effect can vary depending on the level and duration of exposure. Low concentration irritates eyes, nose and throat and respiratory system. Repeated or prolonged exposure may cause eye inflammation, headache, fatigue, irritability, insomnia, digestive disturbances and weight loss. Moderate concentration can cause more severe eye and respiratory irritation, dizziness, nausea, vomiting and staggering. High concentration can cause shock, convulsion, inability to breathe, extremely rapid unconsciousness, coma and death. Hydrogen sulphide (H_2S) occurs naturally in crude petroleum, natural gas and hot springs. In addition, it is produced by bacterial breakdown of organic materials and human and animal waste (i.e. sewage), petroleum/natural gas drilling and refining, wastewater treatment, coke ovens, tanneries and kraft paper mills. Its sourced during this fieldwork could be bacterial breakdown of organic materials, human and animal wastes.

Suspended Particulate Matter (SPM) is a complex mixture of organic substances, present in the atmosphere as solid particles and liquid droplets. They include fumes, smoke, dust and aerosols. Health impacts of PM vary depending on the size and the concentration of particles. For regulatory purposes and for estimating health impacts, PM is measured and classified by what is called the respiratory fraction of particles including $PM_{2.5}$ and PM_{10} as monitored in this study. Suspended Particulate Matter causes respiratory morbidity, deficiencies in pulmonary (lung) functions including decreased lung function (especially in children), and lung cancer with the consequence of increased mortality, among others. They can also contribute to acid deposition and may absorb solar radiation and impair/reduce visibility. Particulates are formed during fuel combustion. This and dust re-suspension could be the major sources of particulates detected during the fieldwork because some mobile plants were observed working around the project site.

Classification of the Proposed Project Site Airshed

Using the World Bank Group Airshed Classification as basis and the previous reported air quality parameters concentrations in the study area (Yulong, 2016) the present air quality status of the proposed site can be classified as un-degraded with respect to all the fieldwork measured air quality parameters. It is therefore classified as having an un-degraded airshed.

Ambient Noise Levels

In **Table 4.12** is summarized the ambient noise levels of the proposed project site and its surroundings as obtained during the fieldwork. The daytime minimum levels (L_{min}) were measured to be 28.7 – 55.0 dB (A) with maximum levels (L_{max}) of 42.3 – 79.0 dB (A) with night-time measured levels of 32.2 – 55.0 dB (A) and 38.9 – 76.4 dB(A) for L_{min} and L_{max} respectively. The background noise levels (L_{90}) in the study area were 35.5 – 56.0 dB (A) and 33.7 – 55.6 dB(A) for day-time and night-time respectively. As shown in **Figure 4.10**, both the day-time and night-time noise limits were not breached in any of the sampling locations at the proposed project site. Similarly the 70 dB (A) industrial area noise limit of the World Bank was not breached. These are also similar to the mean day-time minimum noise level of 49.4 dB (A) with maximum level of 52.6 dB (A) earlier reported for the study area (Yulong, 2017). Mobile plants observed working around the proposed project site and vehicular movements were the main anthropogenic sources of noise during the study. Others sources are natural which include wind and birds, among others.

Table 4.12: Measured Ambient Noise Levels in and around the Proposed Project Site

Sampling Locations	Daytime (07:00 – 22:00)			Nighttime (22:00 – 07:00)		
	L_{min}	L_{max}	L_{90}	L_{min}	L_{max}	L_{90}
AQ1	28.7	48.3	38.4	33.1	38.9	33.9
AQ2	44.8	60.7	45.8	32.3	39.2	36.0
AQ3	38.4	50.4	39.5	33.9	38.9	34.0
AQ4	37.1	50.1	37.4	34.7	39.7	36.6

AQ5	34.5	42.3	35.5	32.2	39.7	34.3
AQ6	36.2	44.2	36.7	33.5	39.6	33.7
AQ7	36.3	42.8	37.0	33.1	39.1	34.7
AQ8	55.0	79.0	56.0	55.0	76.4	55.6
Mean	46.7	70.1	47.7	46.2	67.4	46.8
Previous Study*	49.4	52.6	50.6	-	-	-
Control	49.7	51.9	50.0	41.2	48.4	45.5

Source: GIEC Fieldwork (March 2020) and * Yulong Aug 2016

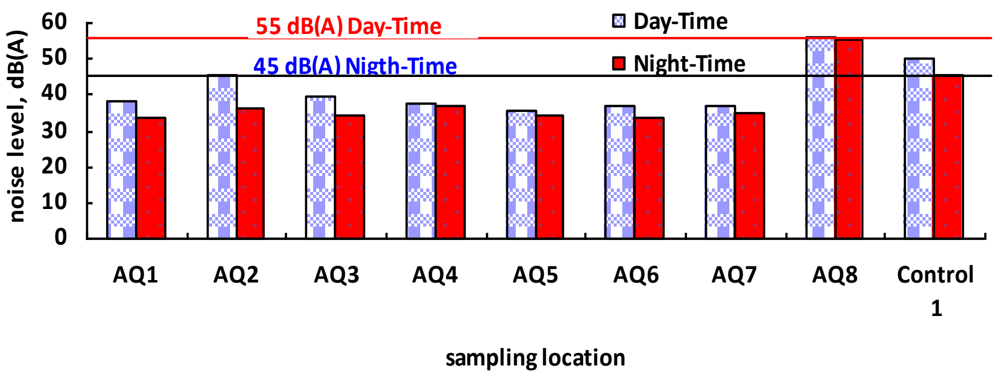


Fig. 4.9: Background Noise Levels in the Proposed Project Area

4.3.3 Geology and Hydrogeology

4.3.3.1 Regional Geology and Hydrogeology

The Lekki Free Zone area of Lagos state is within the eastern part of the Dahomey basin. The basin extends from the eastern part of Ghana through Togo and Republic of Benin to the western margin of the Niger/Delta basin, just before the Mahin mud coast in Nigeria (**Figure 4.10**). The basin is separated from the Benue trough by a basement ridge, the Okitipupa ridge, paleographic highland (Omatsola and Adegoke, 1981). It is bounded in the east by Benin hinge line, a major regional fault structure marking the western limit of the delta basin (Adegoke, 1969). The regional fault consists of horst and grabens (Omatsola and Adegoke, 1981) and confirmed by gravity and aeromagnetic studies (e.g. Adighije, 1981; Ofoegbu, 1984; Nur *et. al*., 1994).

Stratigraphy

The stratigraphy of the Dahomey basin, based on Jones and Hockey (1964) and Omatsola and Adegoke (1981) is as indicated in **Table 4.13.** The stratigraphy consists of six different formations namely:

Table 4.13: The Stratigraphy of the Dahomey Basin

Geologic Age		Jones and Hockey (1964)	Omatsola and Adegoke (1981)
Quaternary	Recent Oligocene to Pleistocene	Alluvium coastal Plain Sands	Alluvium coastal Plain Sands
Tertiary	Eocene Paleocene-Lower Eocene	Ilaro formation Ewekoro formation	Ilaro formation Oshosun formation Akinbo formation Ewekoro formation

Cretaceous	Cretaceous	Abeokuta formation	Araromi formation Aofowo formation Ise formation
Pre-Cambrian	Pre-Cambrian	Basement complex	Basement Complex

Source: Jones and Hockey (1964); and Omatsola Adegoke (1981)

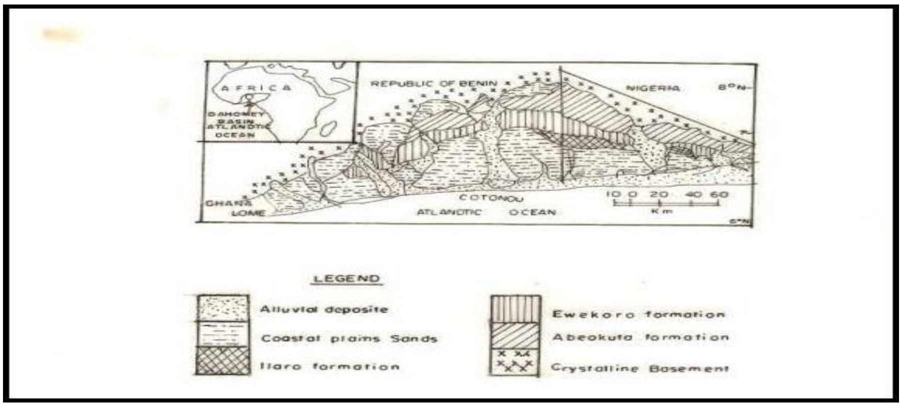


Figure 4.10: Geological Map of Dahomey Basin (from Adegoke and Omatsola, 1981)

Local Geology of the Project Location

Geologically, Lagos state lies in the alluvium, littoral and lagoonal deposit and Coastal Plains Sand (**Figure 4.11**). The project location is within the Coastal Plain Sand unit and comprises soft, very poorly sorted clayey sand, pebbly sand, sandy clay and rare thin lignite. There are also sediments consisting mainly of unconsolidated sands, clays and muds with a varying proportion of vegetative matter. The sediments were probably deposited under littoral and lagoonal conditions and reflect continual shifting lagoon and sea beach patterns as well as varying sedimentation conditions within the lagoon.

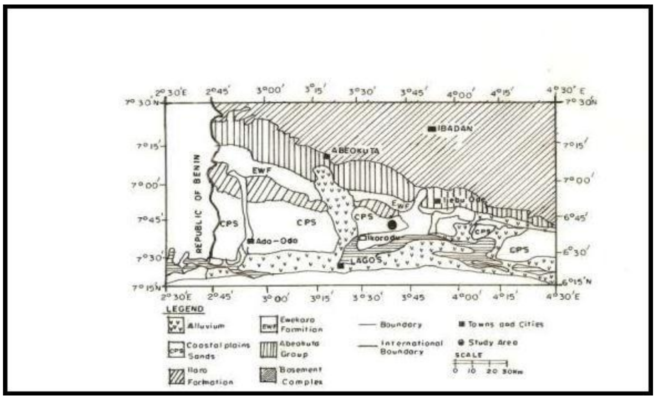


Figure 4.11: Geological map of Lagos area (Coode Blizard *et al.*, 1997)

Geomorphology of the Project Location

Topographically, Lagos state lies within the coastal plain sandwich that is characterized by sand bars, lagoons and creeks (**Figure 4.12**). The land does not rise very much above sea level anywhere in the state. At the project location, the average elevation is about 7-m above mean sea level.

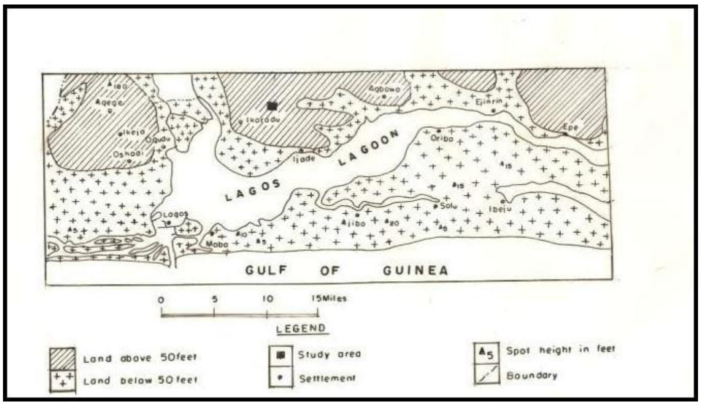


Figure 4.12: Relief of Lagos State showing the Project Location

The rivers, creeks and lagoons in the state ramify and join each other in a rather intricate fashion. From the west, the Badagry creek enters from the Republic of Benin and the Yewa River joins it in the north, about 24 km from the Nigerian - Benin border. There is also Ologe lagoon, looking almost like the Caspian Sea in shape. The Lagos lagoon dominates the rest of the state. Draining into the lagoons are numerous streams and rivers flowing in from the north, the more important ones being the Owo, Ogun, Solode-Baare, Owa and Osun rivers. The interconnecting pattern of these water bodies creates a large number of islands of varying sizes.

4.3.3.2 Hydrology and Hydrogeology

Hydrology

The project area is drained largely by the Lekki lagoon and network of man-made creeklets and freshwater swamps in dendritic fashion.

Regional Hydrogeology

The existing aquifers in the stratigraphic units that make up the Dahomey basin is as shown in **Table 4.14**. The aquifers of the Abeokuta Formation are essentially confined and sometimes artesian as encountered in boreholes at Itoikin and Igbonla. It has also been exploited for industrial water supply in Ikeja area. It has proven to be more prolific than the widely exploited coastal plain sand. Both Ilaro and Ewekoro Formations may be considered regional aquitard/aquiclude unit separating the underlying Abeokuta Formation aquifers from the overlying Benin Formation aquifers. The Ewekoro Formation is known to be aquiferous only where limestone members are present. No significant aquiferous zones have been reported in this formation in Lagos area. The Coastal Plain Sand Formation is the most significant because it is the major source of groundwater for private and public water supply, including industrial and commercial water usage. The majority of the boreholes and dug wells in Lagos State are in this formation's aquifers. Three major aquiferrous zones have been identified and are separated by thick layers of clay aquicludes. They include:

- The uppermost water-bearing horizon that is mostly tapped for domestic water supplies via private dug wells or boreholes. This aquifer is highly prone to external influence as it is directly exposed to open recharge by precipitation and surface run-off from streams and drainage channels, including effluents from factories, homes as well as toilet septic tanks (otherwise known as soakaway).
- The middle aquiferous zone usually consisting of two water-bearing horizons separated by clay, implying the aquifers is confined at the top and bottom.
- The lower aquiferous zone comprises three water-bearing horizons and separated by clay layers. The first horizon is usually a layer of fine white sand, while the second and third water bearing horizons are made of white coarse sands.

Table 4.14: Aquifer Distribution in the Eastern Dahomey Basin (Source: Coode Blizard et al, 1997)

Age	Formation	Lithology	Provenance	Hydrogeological Significance
Recent	Alluvium	Sands, Clays	Continental	aquiferous
Oligocene – Pleistocene	Benin Formation	Sands, Clays, Silts, Sandy Cays	Continental	aquiferous
Eocene	Ilaro Formation	Predominantly Shale, Clays	Marine/Lacustrine	Non-aquiferous
Palaeocene	Ewekoro Formation	Limestone, Shale, Clay	Marine	Aquiferous (Limestone)
Cretaceous	Araromi Formation	Shale, Fine/Medium Sands	Marine/Continental	Aquiferous
	Afowo Formation	Shale, Medium/Coarse Sandstone, Silts	Marine	Aquiferous
	Ise Formation	Sands, Grits, Sandstone	Continental	Aquiferous

4.3.4 Soil Studies

4.3.4.1 Soil Quality and Land Use

Physical Setting

On the field, the exact project location had been cleared of its natural vegetation and already sand-filled as at the time of field investigation and sampling. To the immediate eastern side of the project location is a freshwater swamp forest while the southern and western sides were built up. The project location is bounded on the northern end by the access tarred-road. The soil type is deep sand but in varying degrees of coarseness and internal drainage. As at the time of field investigation and soil sampling, depth to ground water varied from 30cm to 50cm within the freshwater swamp forest, therefore, standard soil profile pit could not readily be established.

Soil Type

Soil in the study area developed from sandy material that was historically considered to have worked out of the lagoon and sea (Omatsola and Adegoke, 1981). Morphologically, the topsoils are light gray (10YR 7/3) to dark brown (10YR 3/3) and become generally dark brown in the subsoils. They are loose or non- coherent (i.e., mostly single grained), generally non-sticky, non-plastic, friable moist and very porous. The implication of these features is that the soil can be worked when wet without the fear of puddling and compaction with the attendant potential soil erosion. From the previous study by GIEC (Yulong EIA, 2017) in the proposed project location and its area of influence, it was reported that the grain size distribution in the representative soil profile pits established during the field investigations were as indicated in **Table 4.15a**. Generally, the soils are homogeneously deep sand.

Table 4.15a: Particle Size Distribution (%) of representative Soil Profile in the Study area (Yulong EIA 2017)

Genetic Horizon	Soil Depth (cm)	Grain Size (%)			Texture
		Sand	Silt	Clay	
Lowland Rain Forest					
A	0-30	94	4	2	Sand
AB	30-60	95	2	3	Sand
Bw	60-100	95	4	1	Sand

The genetic horizons (A & B) are weakly developed, (i.e., no clear horizonation other than the surface A layer) and the subsoils (B) are commonly weakly developed (Bw). Presence of Bw genetic soil horizon is indicative of young soils (Entisols) or soils at the beginning of their formation (Inceptisols) (Soil Survey Staff, 2014). The distribution of organic carbon in the soil does not show evidence of stratification, therefore, it could not be ascertained whether or not the sandy parent material (i.e. the genetic C horizon) was deposited over different geologic time periods. However, on the basis of morphology and other field characteristics, soil in the project location would classify as - tropical young, deep sandy soil i.e., Tropsamment in the USDA Soil Taxonomic System (Soil Survey Staff, 2014), and Arenosol (FAO/UNESCO, 1996). Information from other study in the study area (OKLNG EIA, 2008) indicated that seasonal variations in the morphology and particle size distribution of the soils were not statistically significant.

Physical Characteristics of Soil in the Project Location

The spatial distribution of soil particle sizes for the soil samples from the study area as obtained from the field investigation and soil sampling in March, 2020 are presented in **Tables 4.15b** and **c** for the topsoil and subsoil respectively. Sand constitutes 95-96% of the total fine earth fraction of the topsoil and subsoil samples. Furthermore, from the soil profile pits that were established during the previous recent studies, it was noted that the soils are sandy on top, in the subsurface and deeper subsoil genetic horizons. This shows that the content of silt and clay particles in soils of the study area is low, generally less than 5%. Consequently infiltration, permeability, and hydraulic conductivity of the soils would be high. As indicated earlier, data from similar environment showed that seasonal variations in morphology and particle size distribution of the soils were not statistically significant. Brady (2002) similarly noted that soil morphology, texture and particle size distribution are not seasonally dependent.

The physical setting, soil morphological and physical data indicated that the project location is homogeneous with regard to soil morphology, particle size distribution, porosity, hydraulic conductivity, physical setting and drainage pattern. The low value of the bulk density is indicative of non-compaction of the soil. Grain size distribution data obtained in 2020 GIEC field study are not significantly different from the documented data from the previous study (Yulong EIA, 2017).

Table 4.15b: Spatial Particle Size Distribution (%) in Topsoils (0 – 30cm) of the Study Area

Soil Sampling Location & Its Coordinates			Grain Size Distribution (%)			Texture	Bulk Density
Location Description	**Latitude (^oN)**	**Longitude (^oE)**	**Sand**	**Silt**	**Clay**		**(g/cm^3)**
2020 GIEC/Bell Fieldwork							
Fresh water swamp forest	06.46092	003.96699	96	2	2	Sand	1.54
Fresh water swamp forest	06.46005	003.96685	95	3	2	Sand	1.52
Sand Filled Area	06.46076	003.96909	95	3	2	Sand	1.51
Sand Filled Area	06.46146	003.96928	96	2	2	Sand	1.52
Sand Filled Area	06.46055	003.97015	96	2	2	Sand	1.52
Min			95	2	2		1.51
Max			96	3	2		1.54
Mean			95.6	2.4	2		1.522
Std			0.55	0.55	0.0		0.01
Previous Study Data (Yulong EIA, 2017)							
	06.46476	003.97550	96	3	1	**Sand**	**1.5**
	06.46316	003.97800	96	3	1	**Sand**	**-**
	06.46285	003.97220	96	3	1	**Sand**	**1.65**
		Mean	**96**	**3**	**1**		
		Std	**0**	**0**	**0**		

Table 4.15c: Particle Size Distribution (%) in Subsoils (30 - 60-cm) of the Study Area

Soil Sampling Location & Its Coordinates			Grain Size Distribution (%)			Texture	Bulk Density
Location Description	**Latitude (°N)**	**Longitude (°E)**	**Sand**	**Silt**	**Clay**		**(g/cm³)**
2020 GIEC/Bell Fieldwork							
Fresh water swamp forest	06.46092	003.96699	96	3	1	Sand	1.50
Fresh water swamp forest	06.46005	003.96685	96	3	1	Sand	1.50
Sand Filled Area	06.46076	003.96909	96	3	1	Sand	1.51
Sand Filled Area	06.46146	003.96928	96	3	1	Sand	1.50
Sand Filled Area	06.46055	003.97015	96	3	1	Sand	1.51
Mean			96	3	1		**1.50**
Std			0	0	0		**0.005**
Previous Studies Data (Yulong EIA, 2018)							
	06.46476	003.97550	96	3	1	**Sand**	**1.5**
	6.46316	003.97800	96	3	1	**Sand**	**-**
	06.46285	003.97220	96	3	1	**Sand**	**1.65**
		Mean	96	3	1		
		Std	0	0	0		

Chemical Characteristics of Soil in the Study Area

Soil Profile data in **Table 4.16a** from the previous study (Yulong EIA 2017) in the area, show the chemical properties of typical representative soil profile within the study area. The soil is near neutral to very slightly acidic probably due to their coastal nature. Similar pH values were recorded for soils occupying similar geomorphic surface in previous studies (OKLNG, 2008). The high values obtained were considered to be probably due to the nearness of the study location to the Atlantic Ocean. However, Cl^- (0.5 – 2.6 ppm) and sulphate (4 –6 ppm) concentrations in soils of the study area were considerably low compared with about 350 ppm chloride and 125 ppm sulphate recorded in previous study (Yulong EIA, 2017), in similar environment. Soils having sulphate and chloride concentrations higher than 500ppm and 250ppm respectively are considered as being potentially chemically aggressive. Specifically, high concentrations of sulphate and chloride in soils coupled with poor internal soil drainage condition could enhance external corrosion of metals in such soils. Therefore, based on these criteria, soil in the study area is considered to be chemically non-aggressive in the light of low concentrations of chloride and sulphate coupled with their high hydraulic conductivity.

Table 4.16a: Chemical Properties of Representative Soil Profile in the Study Area

Genetic Horizon	Soil Depth (cm)	pH	Cond.	NO_3^-	SO_4^{2-}	PO_4^{3}	Cl^-	THC	TOC
			mS/cm	(mg/kg)					%
Lowland Rain									
A	0-30	6.5	0.16	0.109	6.0	0.121	2.6	85.2	2.09
AB	30-60	7.2	0.08	0.066	5.0	ND	1.3	46.7	2.32
Bw	60-100	7.1	0.08	0.070	5.0	ND	1.3	36.5	2.01
Data from Yulong EIA 2017									

ND= Not Detected

The total organic carbon (TOC) values for the soil in the study area are low, varying from 2.01 – 2.32% (**Table 4.16a**). TOC is related to the organic matter content and it is generally assumed that the TOC measure is about 58 percent of the organic content (Brady, 2012). Further, organic matter is regarded as the store for plant nutrients, hence, organic matter (OM) is considered as the main source of organic nitrogen (N) and phosphorus (P) in soils. Low TOC levels indicate that soil OM content, as well as corresponding nitrogen and phosphorus content, will also be very low. Build-up of organic matter under the project location‘s environmental and edaphic conditions is difficult because decomposition and humification are rapid in well-drained, tropical sandy soils. In such soils, oxygen is generally not limiting given the high soil porosity (particularly the abundance of macro-pores, otherwise called the air-filled pores). The optimal soil temperature required for effective microbial activities is also not limiting because soils in the coastal region in Nigeria have isohyperthermic soil temperature regime (i.e. average annual soil temperature at about 50-cm depth or shallower is not less than 22^oC and does not fluctuate by more than 5^oC). Furthermore, the relatively high annual rainfall within the Nigeria coastal region (annual average of about 2000 to 2500mm) provides the much-needed moisture for optimum microbial performance. Sandy soils are thus envisaged to be low in organic matter (OM), hence low in organic carbon, N and P, which is reflected in the soil of the study area. The 36.5 – 85.2 ppm THC recorded for the THC were considered to be high. However, it is envisaged that the major constituent of the THC will be biogenic. Similar observations were reported in similar coastline environment (OKLNG Global EIA, 2003).

Details of spatial distribution of the chemical properties of soil samples within the study area are provided in **Tables 4.16b** & **c** for the topsoil (0 – 30cm) and subsoil (30 - 60–cm) respectively as obtained for the March 2020 field study. In terms of distribution and concentrations of each of the soil chemical parameters earlier documented from the previous studies, there were no statistically significant differences in the various chemical data obtained from the March 2020 GIEC field study when compared with data obtained from past environmental studies in similar environment.

Table 4.16b: Spatial Chemical Characteristics of Topsoils (0 – 30 cm) in the Study Area.

Sampling location coordinates		pH	Cond.	NO_3^-	SO_4^{2-}	PO_4^{3-}	Cl^-	TOC	THC
Latitude (^oN)	Longitude (^oE)		mS/cm	mg/kg				(%)	(mg/kg)
2020 GIEC/Bell Fieldwork									
06.46092	003.96699	5.8	0.086	0.09	6.0	0.016	0.92	2.31	2.33
06.46005	003.96685	5.8	0.086	0.09	6.0	0.017	0.92	2.30	2.31
06.46076	003.96909	5.7	0.085	0.07	4.0	0.014	0.67	1.55	0.86
06.46146	003.96928	5.7	0.085	0.07	4.0	0.014	0.66	1.45	0.34
06.46055	003.97015	5.7	0.086	0.07	4.0	0.014	0.67	1.45	0.25
Mean		5.74	0.0856	0.078	4.8	0.015	0.768	1.812	1.218
Std		0.055	0.001	0.011	1.095	0.001	0.139	0.452	1.033
Previous Study Data (Yulong EIA, 2017)									
06.46476	003.97550	5.80	0.088	0.09	5.0	0.015	0.90	2.22	2.15
06.46316	003.97800	6.00	0.062	0.09	6.0	0.014	0.92	2.22	3.22
06.46285	003.97220	5.82	0.08	0.09	6.0	0.016	0.90	2.30	8.90
Mean		5.90	0.74	0.09	5.60	0.015	0.91	2.22	4.46
Std.		0.20	0.02	0.0	0.12	0.03	0.02	0.02	1.23

Table 4.16c: Spatial Chemical Characteristics of Subsoils (30 – 60 cm) in the Study Area.

Sampling location coordinates		pH	Cond.	NO_3^-	SO_4^{2-}	PO_4^{3-}	Cl^-	TOC	THC
Latitude (^oN)	Longitude (^oE)		mS/cm	mg/kg				(%)	(mg/kg)
2020 GIEC/Bell Fieldwork									
06.46092	003.96699	5.4	0.096	0.08	8.0	0.014	0.94	2.11	0.11
06.46005	003.96685	5.4	0.096	0.08	8.0	0.016	0.94	2.20	0.12
06.46076	003.96909	5.2	0.093	0.05	6.0	0.012	0.54	1.32	0.11
06.46146	003.96928	5.2	0.093	0.05	6.0	0.012	0.56	1.32	0.00
06.46055	003.97015	5.2	0.094	0.05	6.0	0.012	0.53	1.30	0.00
	Mean	5.28	0.0944	0.062	6.8	0.0132	0.702	1.65	0.068
	Std	0.110	0.002	0.016	1.095	0.002	0.218	0.462	0.062
Previous Study Data (Yulong EIA, 2017)									
06.46476	003.97550	5.80	0.09	0.07	8.01	0.06	0.95	2.00	2.00
06.46316	003.97800	5.80	0.09	0.07	8.01	0.08	0.95	2.02	3.00
06.46285	003.97220	5.82	0.08	0.09	6.0	0.016	0.90	2.30	8.90
Mean		5.80	0.08	0.08	7.31	0.05	0.91	2.10	4.30
Std.		0.01	0.02	0.03	0.02	0.02	0.03	0.02	0.04

5.28	0.0944	0.062	6.8	0.0132	0.702	1.65	0.068
0.110	0.002	0.016	1.095	0.002	0.218	0.462	0.062

Further, when compared, the soil chemical data in **Table 4.16b** and **Table 4.16c** both in magnitude and spread are not significantly different from one and the other. The implication of this is that probably due to the homogeneity of the soils in the study area, the topsoils, 0 – 30-cm, are essentially the same as those of the subsoils, 30 – 60-cm, soil depth.

It was also observed that in the soil chemical data obtained, there was no evidence of soil pollution and or contamination from the chemical properties of the soils in the study area as at the time of field investigation and sampling in March 2020. Furthermore, from the previous studies, it was established that differences in values of the various soil chemical parameters obtained during the dry season period were not statistically significantly different from those of the rainy season period.

Basic and Heavy Metal Content of Soils in the Study Area

Table 4.17a shows the distribution of basic and heavy metals in the representative soil profile pit samples established in the study area during the field investigations for the Global EIA study. The concentrations of the various basic metals in the soils are generally low except for Ca. The relatively high content of Ca compared to other basic metals was considered to be due to the coastal location of the study area. It was further stated that the concentration of Ca obtained was not indicative of Ca pollution of the soils because similar values were recorded in soils within similar but pristine environment (OKLNG Global EIA, 2003). Further, data presented in **Table 4.17a** indicated that vertically within the soils of the study area, there was no evidence of basic metals accumulation.

Tables 4.17b & c present the spatial distribution of the basic metal concentrations in the soils studied. For both the topsoil (0– 30 cm) and subsoil (30 – 60 cm) samples, concentrations of the basic metals were generally low, and there was no evidence of basic metal contamination and/ or pollution in the soils.

Tables 4.17b&c also indicate the vertical and spatial distribution of the heavy metal content of the soils as recorded during the March 2020 field and laboratory studies. To make sound judgment about the extent of heavy metal contamination or otherwise of the soils, references were made to metal content in unpolluted soils as reported for different countries of the world by Alloway (1991) and Brady (2012). **Table 4.17d** shows the normal range of the heavy metals that were considered in unpolluted mineral soils. The concentration levels recorded in the surface and subsurface soils for all the metals within the entire study area were within the normal range of values in unpolluted mineral soils. Furthermore, there was no significant difference between the values reported for the surface and subsurface soils. From the heavy metal concentration data reported for soils in the study area, there was no evidence of heavy metal accumulation and/or bioaccumulation in the soils as at the time of field investigations in March 2020. This is because the heavy metal concentrations in soils of the study area were significantly lower ($p < 0.05$) than the concentrations that were reported as the trigger levels (**Table 4.17d**) for the various heavy metals that were investigated. Therefore, in soils of the study area, there were no evidences of soil contamination and or pollution with regards to the heavy metals that were investigated. For Fe, the normal range in soils was not provided by Alloway (1991), however, Brady (2012) indicated that Fe concentrations that are considerably higher than 10,000 mg/kg in soils are not unusual.

Table 4.17a: Metals' Distribution in Representative Soil Profile in the study Area Source: Yulong EIA (2017)

Genetic Horizon	Soil Depth (cm)	Heavy metals (mg/kg)							Basic metals (mg/kg)			
		Cd	Pb	Ni	Cu	Fe	Mn	Zn	Ca	Mg	Na	K
Lowland Rain												
A	0-30	ND	0.28	ND	0.34	11.44	0.35	0.26	32.30	8.33	1.75	2.10
AB	30-60	0.01	ND	ND	0.30	9.76	0.25	0.14	26.12	6.73	1.62	1.04
Bw	60-100	ND	ND	ND	0.28	9.74	0.28	0.13	26.01	6.72	1.60	1.02

Table 4.17b: Average Spatial Distribution of Metals (mg/kg) in Topsoil Samples (0-30 cm) in the Study Area

Sampling Location Coordinates		Heavy metals (mgkg)							Basic metals (mg/kg)			
Latitude (N)	Longitude (E)	Cd	Pb	Ni	Cu	Fe	Mn	Zn	Ca	Mg	Na	K
2020 GIEC/Bell Fieldwork												
06.46092	003.96699	0.03	0.05	0.02	0.96	18.12	2.33	0.06	29.00	12.51	8.53	10.34
06.46005	003.96685	0.03	0.05	0.02	0.95	18.66	2.33	0.06	28.00	12.50	9.62	10.33
06.46076	003.96909	0.02	0.03	0.02	0.42	2.61	0.67	0.04	20.11	3.16	4.63	8.23
06.46146	003.96928	0.02	0.03	0.02	0.39	2.61	0.66	0.03	16.00	3.14	4.25	7.88
06.46055	003.97015	0.02	0.03	0.02	0.41	2.55	0.53	0.03	16.11	4.11	3.89	8.11
	Mean	0.024	0.038	0.02	0.626	8.91	1.304	0.044	21.844	7.084	6.184	8.978
	Std	0.005	0.011	0.000	0.301	8.656	0.938	0.015	6.308	4.964	2.680	1.245
Previous Studies Data (Yulong EIA, 2017)												
06.46476	003.97550	0.03	0.05	0.023	0.99	7.86	0.058	0.03	19.00	2.50	1.51	0.32
06.46316	003.97800	0.03	0.05	0.025	0.96	7.46	0.072	0.06	20.00	2.52	1.60	0.33
06.46285	003.97220	0.01	0.54	0.02	0.98	66.12	0.08	0.04	20.11	3.12	1.60	0.32
Mean		0.025	0.05	0.022	0.98	26.7	0.063	0.043	19.81	2.41	1.53	0.32
Std.		0.02	0.02	0.03	0.03	3.23	0.04	0.02	0.64	0.13	0.03	0.02

Table 4.17c: Average Spatial Distribution of Metals (mg/kg) in Subsoil Samples (30 – 60 cm) in the Study Area

Sampling Location Coordinates		Heavy metals (mg/kg)							Basic metals (mg/kg)			
Latitude (N)	Longitude (E)	Cd	Pb	Ni	Cu	Fe	Mn	Zn	Ca	Mg	Na	K
2020 GIEC/Bell Fieldwork												
06.46092	003.96699	0.04	0.04	0.02	0.95	18.22	2.35	0.07	39.00	12.51	9.13	11.34
06.46005	003.96685	0.04	0.054	0.02	0.95	18.34	2.36	0.05	30.00	12.50	9.64	11.33
06.46076	003.96909	0.02	0.03	0.02	0.42	2.61	0.67	0.03	20.13	3.16	4.61	7.23
06.46146	003.96928	0.02	0.03	0.02	0.39	2.61	0.66	0.03	16.00	3.14	4.20	7.84
06.46055	003.97015	0.02	0.03	0.02	0.41	2.55	0.53	0.03	16.12	4.11	3.84	8.10
	Mean	0.028	0.0368	0.02	0.624	8.866	1.314	0.042	24.25	7.084	6.284	9.168
	Std	0.011	0.011	0.000	0.298	8.594	0.952	0.018	10.022	4.964	2.850	2.003
Previous Studies Data (Yulong EIA, 2017)												
06.46476	003.97550	0.03	0.05	0.025	0.99	17.86	0.058	0.03	20.00	2.50	1.51	0.32
06.46316	003.97800	0.03	0.05	0.025	0.96	17.46	0.072	0.06	20.00	2.52	1.51	0.33
06.46285	003.97220	0.01	0.54	0.02	0.98	66.12	0.08	0.04	20.11	3.12	1.70	0.33
Mean		0.025	0.05	0.023	0.98	33.63	0.065	0.045	20.03	2.41	1.51	0.32
Std.		0.03	0.02	0.02	0.02	4.33	0.03	0.03	0.03	0.13	0.03	0.03

Table 4.17d: Background Levels of Heavy Metals (mg/kg) in Soils of Different Countries

Metals	Countries of the World			Normal range in unpolluted soils
	Netherlands	UK (former GLC)[1]	FRG (NOEL)[2]	
Fe	-	-	-	-
Cr	100	0-100	100	5-1500
Ni	50	0-20*	50	2-750
Pb	50	0-500	100	2-300
Zn	200	0-250*	300	1-900
Cu	50	0-100*	100	2-250
Cd	1	0-1	3	0.01-2.0
V	-	-	-	3-500

[1]GLC= Greater London Council; [2]FRG/NOEL= Federal Republic of Germany; No Effect Limit. Source: Alloway (1991)

Microbiology of the Soil

The various species of micro-organisms isolated from the soil samples collected from the study area are presented in **Table 4.18a**. A total of 7 bacterial species and 7 fungal species were isolated from the soil samples. ***Enterobacter Agglomerance, Pseudomonas fluorescens*** and *Pseudomonas aeruginosa*, had the highest frequency of occurrence among the bacterial species with percentage frequencies of 72 each. *Cephalosporium* sp and *Trichoderma* sp had the highest percentage of 45 each.

The diversity and population distribution of bacteria and fungi isolated from the soil samples collected from the study area are presented in **Table 4.18b**. The percentage hydrocarbon-utilizing bacteria (HUB) otherwise called the hydrocarbon degraders were low with mean values that were significantly less than 1.0%. Similarly, the % hydrocarbon degrading fungi (HUF) was equally below 1.0%. Using the hydrocarbon population of the bacteria and fungi as indices of pollution and or contamination with hydrocarbon, the low values of HUB and HUF obtained were interpreted to mean that soils in the study area were neither contaminated nor polluted with respect to hydrocarbon as at the time of the field investigations and soil sampling in March 2020.

Table 4.18a: Microbial species isolated in soils of the project area

Bacteria	% Frequency	Fungi	%
Pseudomonas aeruginosa	**72**	***Trichoderma spp***	**45**
Enterobacter agglomerance	**72**	***Penicillium camemberti***	**8**
Klebsiella edwardsii	**23**	***Cladosporium wemeckii***	**7**
Klebsiella pneumoniae	**44**	***Cephalosporium sp***	**45**
Pseudomonas fluorescens	**72**	***Penincillium***	**13**
Escherichia intermedium	**15**	***Rhizopus japanicus***	**15**
Enterobacter cloacae	**22**	***Absidia sp.***	**24**

Source: GIEC/ Bell Fieldwork March (2020).

Table 4.18b: Summary of the Microbial Population in Soil of the Study Area

Parameter	Microbial Population (cfu/g)			
	Min	**Max.**	**Mean**	**Std**
Heterotrophic bacteria (x10^4 cfu/g)	2.3	10	7.1	1.10
Hydrocarbon degrading bacteria (x 10^4 cfu/g	1.1	2.0	1.6	0.11
Heterotropic fungi (10x^{4}cfu/g)	1.0	6.0	3.4	1.01
Hydrocaarbon degrading fungi, x10^2 (cfu/g)	0.1	1.0	0.12	0.21

Source: GIEC/ Bell Fieldwork March (2020).

4.3.5 Vegetation

Vegetation Studies of Lekki Free Zone (LFZ) Community

The LFZ community and its environment are located around the wetland of Lagos Lagoon and Atlantic Ocean within the south-western part of Nigeria. It used to be a very rich community in term of flora density and composition; it is more of a rainforest swamp forest vegetation based on the types of plant community therein, although many parts of the main forest still remained disturbed and look more or less like a secondary vegetation. Most of the important woody species, shrubs, lianas and trees as well as grasses that are present are those described by Hopkins, 1965 for rain forest zones of Nigeria.

It is interesting to note that the plant components of the vegetation that were encountered in some of the sites are less densely populated. This, of course, is largely influenced by lot of anthropogenic activities in the area. This will undoubtedly affect the flora community in years to come. The densely populated plant community will, undoubtedly, affect the composition and population of the animal communities since their habitats are quite protected. This vegetation also provides homes for remarkable wild flowers, beasts and birds that would perish if the forest disappeared (Herbert, 1976).

The impacts of construction of this type of factory would be considerable on the vegetation of the study area. Thus, we need to look at mitigation of impacts and the enhancement of the natural features of the vegetation and the total environment in order to make this project an asset. Several invasive species of plants may infiltrate habitats some will be lost locally too.

Vegetation Structures and Physiognomy of the Project Areas

The variation in nature of plant cover on both global and local scales is mostly determined by the amount of precipitation, which is often influenced by closeness to ocean (Continentality) in such area. Based on the stratification in the falling of rain in Nigeria, for example, the nature of plant cover varies from one area to another, hence given rise to different vegetation zones. The physical structure is one of the most obvious ways to describe a forest, and it is important because it can help determine the types of species present. The description of the study areas follows that of Sanford (1986).

This region contains plants that typically are adapted to swampy forest zone. However, some plants that are adapted to derive rainforest zones are also present. The trees and shrubs form a sparse canopy, which is less dense in some areas and very dense in others. Where the canopy is very dense, under storey flora include mosses and ferns. The dominant plant species of the herb stratum are the sunflower family (Asteraceae), the grass family (Poaceae) and the sedges (Cyperaceae), which range in height from 1 m to about 4 m. The tall trees reached up to 50 m whereas diameter at breast height (DBH) of trees is between 65 cm and 210 cm; woody climbers (lianas) and palm trees (Raffia palm and Palm tree), a typical characteristic of a rain forest belt, are also abundant.

The vertical structure of the study areas is a quite less complex vegetation type. The profile shows a tree stratum 12 - 50 m high with a generally dense canopy. Below this tree stratum is a stratum of shrub also with an irregular canopy, between 5-11 m high. Finally is the herb stratum consisting mainly of members of the Asteraceae, Cyperaceae, Convolvulaceae and Poaceae, growing up to about 2 m high. The lianas (woody climbers) are found either trailing the ground or twining around the trees and shrubs.

Actually, during the raining season, there exist distinct heterogeneity in the physiognomy and spatial structure of the vegetation of LFZ and its environs. The most common plants include woody and herbaceous vegetation was herb dominated, in terms of individuals, during the raining season. It is to be noted that during this period, larger hectares of lands within the project area are occupied by water. There are very minimal agricultural activities within the project site.

Floristic Composition, Distribution, Density and Diversity of Vegetation in LFZ

Different types of habitats tend to habour different plant types; these habitats also influence the habits of those plant species. Trees, shrubs, lianas and herbs are present in their numbers. There is also a complete forms of interaction among the flora community in some of the habitats; commensalism and parasitism was observed where ferns (commensals) were growing on palm tree (host) and mistletoe (parasite) growing on another palm tree (host) **Plate 4.11.**

A

B

Plate 4.11: A: Commensalism between ferns and palm tree B: Commensalism between *Platycerium angolensis* (an epiphytic fern) on a tree

The coordinates i.e. longitudes and latitudes of the sampling points as well as the characteristics of the habitats are presented in **Tables 4.19** and **4.20** respectively. The habitats ranged from typical swampy, rain forest, secondary vegetation where anthropogenic activities were highly felt; through a thick forested raining habitat with flat topography to a moderately disturbed mesophytic habitat where tall trees and understory phyto-communities are also abundant. Some of these areas are like secondary or derived forests. Most of the topography is flat; undulating topography are also common. Due to the variation in the habitat types as well as soil compositions, there exist high variability in the floristic compositions of the study areas.

Table 4.19: Coordinates of the transect sites at the study area

Transect	Latitude (^{o})	Longitude (^{o})	Altitude (m)
A	6.46092	3.96699	21
B	6.46005	3.96685	11
C	6.46119	3.96947	10
D	6.46014	3.97021	-4
E	6.46305	3.98704	2

Source: GIEC/ Bell Fieldwork March (2020).

Table 4.20: Habitat Type and Plant Species Composition in the Study Area

S/N	**Sampling Location (Plots)**	**Habitat Type/ Description**	**Plant Species Composition**
1	A	A Riparian vegetation, wetland area comprising of typical rainforest and mangrove plant communities	This region contains plants that typically are adapted to rain forest and mangrove forest zones. The types of plants that are present include trees, shrubs, lianas and herbs. Different species of sedges and grasses are quite much. Species of plants recorded include: *Laguncularia racemosa, Commelina diffusa, Ipomoea aquatic, Cyperus ustulatus Kyllinga erecta, Alchornea cordifolia, Anthocleistia vogelli* etc

2	B, C, D, E and F	A typical disturbed rain forest, secondary vegetation where anthropogenic activities were highly felt. There are fewer trees, but herbaceous floras abound.	These regions contain plants that typically are adapted to disturbed forest/derived savannah zones. Species of plants recorded include: *Chromonaela odorata, Tradescantia* sp, *Ipomoea purpurea, Mariscus ligularis, Cyperus difformis, Dioscorea* sp, *Alchornea laxiflora, Euphorbia heterophylla, Centrosema pubescens* etc

Source: GIEC/ Bell Fieldwork March (2020).

Classification and distribution of plant species as well as habitat type and plant species composition in the study area are presented in **Tables 4.21** and **4.22**. The tables revealed some interesting information about the plants as well as their compositions. The floristic composition of the project area is highly diverse in species even over a seemingly homogenous area. Where there are changes in the environment, most especially along the riparian vegetation, this variation is further increased. Interestingly, a total of fifty-nine (59) plant species belonging to twenty-eight (28) families were recorded in transects areas and comprising of both woody and herbaceous flora. Forty-one (41) species representing 70% of the encountered species were herbs, one (1) species representing 2% are lianas, five (5) species representing 8% are shrubs while twelve (12) plant species representing 20% were trees (**Figure 4.13**). Most of the herbaceous members encountered are those known to grow in secondary forest, savannah woodlands and disturbed habitats (Daniel, 2001). The number of species encountered or occurred per sight, their habits, botanical names, common names and local names are presented in **Table 4.21**.

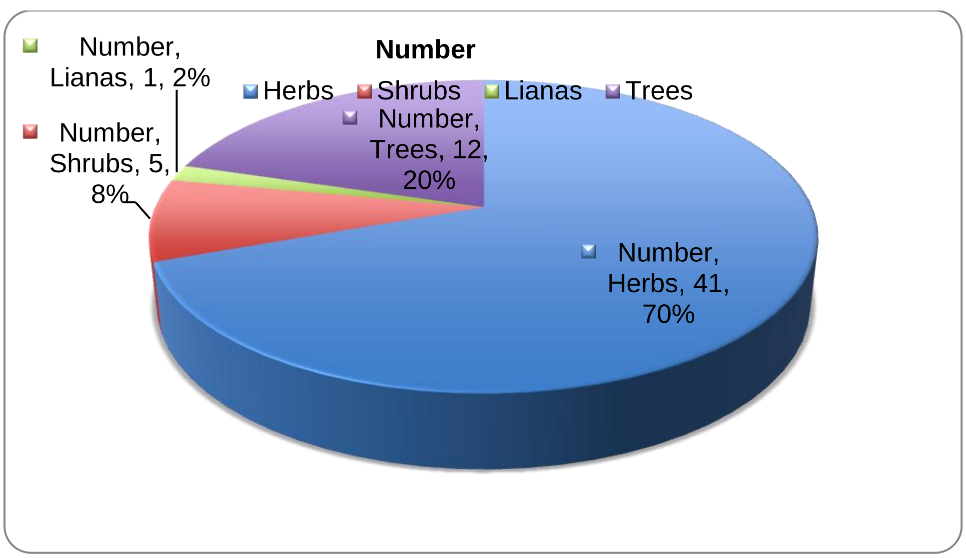


Figure 4.13: Percentage Composition of the habits of the sampled plant species in Phase A LFZ community

Table 4.21: Classification and Distribution of Plant Species in the Study Area

SPECIES BOTANICAL NAME	LOCAL NAME	COMMON NAME	HABIT	A	B	C	D	E	Total
Ageratum conyzoides	Imi Esu	Goat Weed	Herb	120	123	119	0	0	**362**
Alchornea cordifolia	Esinsin	Christmas Bush	Shrub	25	52	0	0	23	**100**
Alchornea laxiflora	Pepe	Bead String	Shrub	18	43	0	0	54	**115**
Alstonia boonei	Ahun	Stool Wood	Tree	2	2	0	0	0	**4**
Anchomanes difformis	Abirisoko	Anchomanes	Herb	8	9	0	0	6	**23**
Andropogon gayanus	Esunsun	Gamba Grass	Herb	17	27	15	12	0	**71**
Anthocleistia vogelli	Agboogbo/ Shapo	Cabbage Tree	Tree	6	11	0	0	11	**28**
Aspilia africana	Yunrunyun	Haemorrhage plant	Herb	123	92	129	43	54	**441**
Athyrium otophorum		Large leaf Fern	Herb	45	54	0	0	45	**144**
Bidens pilosa	Abere Oloko	Black Jar	Herb	121	111	22	39	28	**321**
Centrosema pubescens	Ewa Ahun	Fodder Pea	Herb	33	112	131	0	0	**276**
Chloris sp		Finger grass	Herb	0	47	33	17	0	**97**
Chromolaena odorata	Akintola	Siam Weed	Herb	135	153	198	159	143	**788**
Cissus populnea	Ogbakiiki	Stemmed Vine	Liana	8	12	0	0	0	**20**
Commelina diffusa	Itopere	Day Flower	Herb	125	129	122	0	114	**490**
Cyperus difformis	Aya	Nut Grass	Herb	43	27	117	32	118	**337**
Cyperus ustulatus	Aya	Nutsedge	Herb	69	89	144	68	145	**515**
Dioscorea sp	Isu Igbo	Wild Yam	Herb	18	14	0	35	19	**86**
Dracaena sp	Peregun	Dracaena	Tree	11	9	0	0	0	**20**
Elaeis guineensis	Ope	Oil Palm tree	Tree	16	17	0	0	0	**33**
Eleusine indica	Ese Kanakana	Bermuda Grass	Herb	43	33	53	34	32	**195**
Erigeron floribundus	Olowoeja		Herb	44	123	124	0	0	**291**
Euphorbia heterophylla	Iwoo Bairo	Milk Weed	Herb	19	24	23	0	0	**66**
Ficus platyphylla	Odan	Wild Fig	Tree	3	3	0	0	1	**7**
Imperata cylindrica	Aga	Spear Grass	Herb	37	41	21	23	0	**122**
Ipomoea aquatica	Odukun Odo	Water Potato	Herb	123	112	0	0	123	**358**
Ipomoea purpurea	Ododo-oko	Morning glory	Herb	124	117	0	128	117	**486**
Kyllinga erecta	Aya	Nut Grass	Herb	54	44	123	57	129	**407**
Laguncularia racemosa	Ofun	White Mangrove	Tree	**5**	4	0	0	2	**11**
Mariscus ligularis	Aya Igbo	Wild Sedge	Herb	47	39	121	40	127	**374**
Melanthera scandens	Abo Yunyun	Melanthera	Herb	145	172	0	0	123	**440**
Mitragyna stipulosa	Ewe Obi		Tree	16	14	0	0	5	**35**
Mucuna pruriens	Werepe	Cow-hage	Herb	0	14	23	0	0	**37**
Musa sapientum	Ogede	Banana	Herb	0	0	6	0	14	**20**
Musanga cecropioides	Agbawo	Corkwood	Tree	10	9	0	0	3	**22**
Nephrolepis undulata		Fern	Herb	37	43	0	0	0	**80**
Osteospermum sp		African daisies	Herb	0	0	0	143	146	**289**
Panicum maximum	Esunsun	Elephant Grass	Herb	62	45	32	54	0	**193**

Platycerium angolensis		Staghorn Fern	Herb	8	11	0	0	0	**19**
Pteridium aquilinum		Eared Fern	Herb	28	44	0	0	32	**104**
Raphia hookeri	Ope Oguro	Raffia Palm	Tree	28	27	0	0	2	**57**
Setaria sphacelata	Oko Esin	Setaria	Herb	44	33	23	16	248	**364**
Sida acuta	Iseketu	Hornbean-leaf Sida	Herb	139	123	0	0	134	**396**
Solanum erianthum	Ewuro Ijebu		Shrub	0	0	0	3	7	**10**
Sphagneticola trilobata		Singapore daisy	Herb	122	122	119	0	0	**363**
Spigelia anthelmia	Aparan	Worm Weed	Herb	122	122	137	0	0	**381**
Spondias mombin	Iyeye	Hog Plum	Tree	2	1	0	0	3	**6**
Sporobolus pyramidalis		Giant rat's tail grass	Herb	24	72	30	34	28	**188**
Stachytarpheta angustifolia	Iru Alangba	Brazilian Tea	Herb	4	7	0	0	11	**22**
Terminalia superba	Afara	White Afara	Tree	4	2	0	0	0	**6**
Tithonia diversifolia	Agbale	Tree Marigold	Herb	76	67	0	0	45	**188**
Tradescantia sp		Spiderwort	Herb	133	125	98	0	0	**356**
Trema orientalis	Afefe	Charcoal Tree	Tree	12	11	0	0	23	**46**
Tridax procumbens	Igbalode	Tridax	Herb	0	0	122	134	0	**256**
Triumfetta cordifolia	Abiko		Shrub	88	55	32	43	0	**218**
Typha latifolia	Owu-Egungun	Cat-Tail	Herb	0	0	32	45	23	**100**
Urena lobata	Ilasa-Omode	Congo Jute	Shrub	38	12	31	0	6	**87**
Waltheria indica	Ewe Epo	Sleeping Morning	Herb	14	32	17	38	8	**109**
Xanthium strumaniunm		Rough Cocklebur	Herb	11	9	0	0	22	**42**
TOTAL				**2609**	**2845**	**2197**	**1197**	**2174**	**11022**

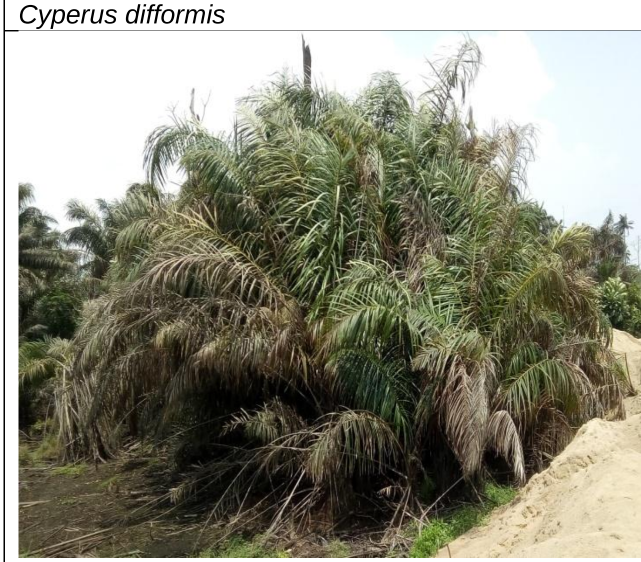
Source: GIEC/ Bell Fieldwork March (2020).

The five most abundant species across the proposed project areas at LFZ community and its environs include: *Chromonaela odorata, Aspilia africana, Ageratum conyzoides, Cyperus ustulatus, and Kyllinga erecta.* However, five of the species that had the least abundance are: *Alstonia boonei, Spondias mombin, Terminalia superba, Ficus platyphylla, Solanum erianthum* (**Table 4.22**). Meanwhile, the five least important species are: *Musa sapientum*, *Dracaena* sp, *Solanum erianthum*, *Cissus populnea*, *Platycerium angolensis*. However, the five most important species are *Chromonaela odorata, Cyperus ustulatus, Trema orientalis, Raphia hookeri, Musanga cecropioides.* Some of the plant species encountered are presented in **Plate 4.12.**

Table 4.22: Species Floristic Indices of the Study Area

Floristic Features			Result
Species Attributes	Species Diversity		59
	Species Abundance		11,022
	Five most abundant species		*Chromolaena odorata, Aspilia africana, Ageratum conyzoides, Cyperus ustulatus, and Kyllinga erecta*
	Five least abundant species		*Alstonia boonei, Spondias mombin, Terminalia superba, Ficus platyphylla, Solanum erianthum*
	Five most important species		*Chromolaena odorata, Cyperus ustulatus, Trema orientalis, Raphia hookeri, Musanga cecropioides*
	Five least important species		*Musa sapientum*, *Dracaena* sp, *Solanum erianthum*, *Cissus populnea*, *Platycerium angolensis*
	Species Habit	Herb	70%
		Lianas	2%
		Shrub	8%
		Trees	20%
Family Attributes	Family Diversity		28 (Anacardiaceae, Apocynaceae, Araceae, Arecaceae, Arthyriaceae, Asteraceae, Combretaceae, Commelinaceae, Convolvulaceae, Cyperaceae, Dennstaedtiaceae, Dioscoreaceae, Dracaenaceae, Euphorbiaceae, Fabaceae, Loganiaceae, Malvaceae, Moraceae, Musaceae, Nephrolepidaceae, Poaceae, Polypodiaceae, Rubiaceae, Solanaceae, Typhaceae, Ulmaceae, Verbenaceae, Vitaceae)
	Five most abundant family		Asteraceae, Poaceae, Cyperaceae, Commelinaceae, Convolvulaceae
	Five least abundant family		Anacardiaceae, Araceae, Asparagaceae, Gentianaceae, Moraceae
	Families with most species		Asteraceae (12), Poaceae (7), Cyperaceae (4), Malvaceae (3), Euphorbiaceae (3)
	Families with least species		Anacardiaceae, Apocynaceae, Araceae, Arthyriaceae, Dennstaedtiaceae, Dioscoreaceae, Dracaenaceae, Musaceae, Nephrolepidaceae, Polypodiaceae, Rubiaceae, Solanaceae, Typhaceae, Ulmaceae, Verbenaceae, Vitaceae, had one (1) species each.
	Families with most individuals		Asteraceae (3890), Cyperaceae (1633), Malvaceae (1230), Convolvulaceae (844), Commelinaceae (846)
	Families with least individuals		Anacardiaceae (6), Apocynaceae (4), Solanaceae (10), Combretaceae (17), Polypodiaceae (19), Musaceae (20).

Source: GIEC/ Bell Fieldwork March (2020).

 *Musanga cecropioides* (Corkwood Tree)	 *Mitragyna stipulosa* (African Linden)
 *Cyperus difformis*	 *Anthocleistia vogelli* (Cabbage Tree)
 Conglomerate of Palm Trees	 Array of Raphia Palms (*Raphia hookeri*)

Alchornea laxiflora (Bead String) fruiting

Laguncularia racemosa (White Mangroove)

Alcornea cordifolia (Christmas Bush)

Chromolaena odorata (Siam Weed); Most important and most abundant in the Project Area

Plate 4.12: Some plant species encountered within the transect sites

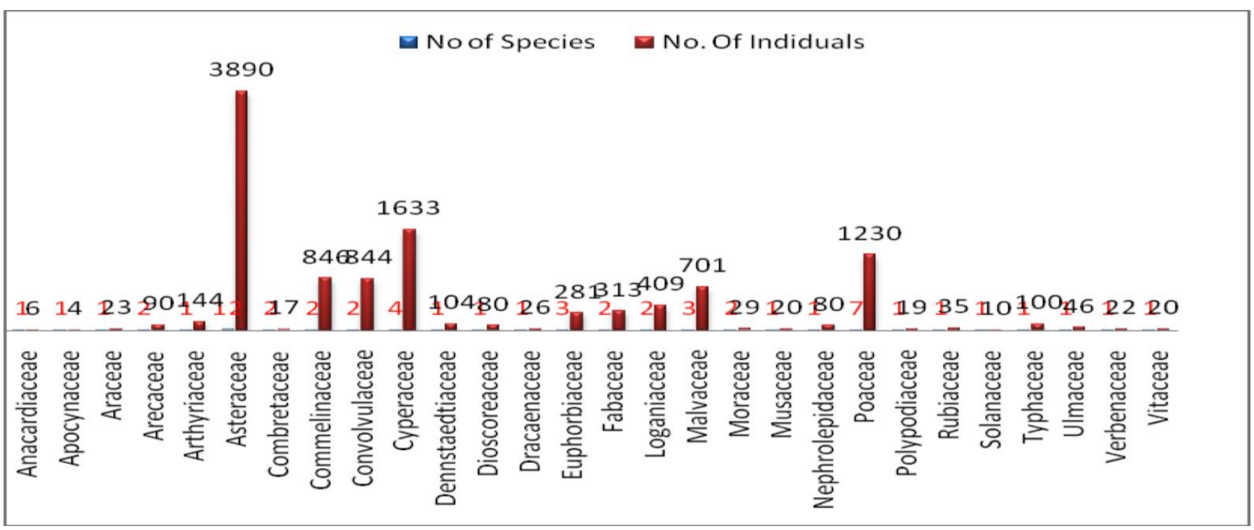


Figure 4.14: Family abundance of the plants encountered at LFZ and its environs

Source: GIEC/ Bell Fieldwork March (2020).

The result obtained in terms of species abundance, total density, relative cover, relative, density, relative frequency as well as the most important species (highest important values) in the study areas, their ranks as well as their International Union of Conservation of Nature (IUCN) status are presented in **Table 4.23**. *Chromonaela odorata* is the most important plant species with 12.59 important values while *Platycerium angolensis,* which has 1.21 important value, is the least. The IUCN status of all the plants encountered of the plant species encountered during the study showed that they can be categorised into three conservation status; most of the plants encountered are Data Deficient (DD), whereas only three (*Elaeis guineensis*, *Cyperus difformis* and *Trema orientalis*) of them are Least Concerned (LC). *Mitragyna stipulosa* is Vulnerable (V) and needs greater attention for its conservation. It is worthy of noting that those encountered are sampling sizes and are yet to be fully grown up.

Table 4.23: Floristic data and IUCN Status of Floral Community of Phase A and the Environs

Species Name	Family Name	IUCN Status	Abundance	Density	Frequency	Relative cover	Relative density	Relative frequency	Importance value	Rank
Chromolaena odorata	Asteraceae	DD	788	0.79	1.00	2.89	7.15	2.55	12.59	1
Cyperus ustulatus	Cyperaceae	DD	515	0.52	1.00	3.09	4.67	2.55	10.31	2
Raphia hookeri	Arecaceae	DD	57	0.06	0.60	7.48	0.52	1.53	9.53	3
Trema orientalis	Ulmaceae	LC	46	0.05	0.60	6.66	0.42	1.53	8.60	4
Musanga cecropioides	Moraceae	DD	22	0.02	0.60	6.56	0.20	1.53	8.29	5
Kyllinga erecta	Cyperaceae	DD	407	0.41	1.00	1.94	3.69	2.55	8.18	6
Ipomoea purpurea	Convolvulaceae	DD	486	0.49	0.80	1.72	4.41	2.04	8.17	7
Mariscus ligularis	Cyperaceae	DD	374	0.37	1.00	2.21	3.39	2.55	8.15	8
Commelina diffusa	Commelinaceae	DD	490	0.49	0.80	1.64	4.45	2.04	8.13	9
Aspilia africana	Asteraceae	DD	441	0.44	1.00	1.44	4.00	2.55	7.99	10
Mitragyna stipulosa	Rubiaceae	VU	35	0.04	0.60	5.99	0.32	1.53	7.83	11
Anthocleistia vogelli	Loganiaceae	DD	28	0.03	0.60	5.97	0.25	1.53	7.75	12
Cyperus difformis	Cyperaceae	LC	337	0.34	1.00	2.02	3.06	2.55	7.63	13
Elaeis guineensis	Arecaceae	LC	33	0.03	0.40	5.99	0.30	1.02	7.31	14
Setaria sphacelata	Poaceae	DD	364	0.36	1.00	1.17	3.30	2.55	7.02	15
Melanthera scandens	Asteraceae	DD	440	0.44	0.60	1.43	3.99	1.53	6.95	16
Sida acuta	Malvaceae	DD	396	0.40	0.60	1.79	3.59	1.53	6.92	17
Bidens pilosa	Asteraceae	DD	321	0.32	1.00	1.04	2.91	2.55	6.51	18
Spigelia anthelmia	Loganiaceae	DD	381	0.38	0.60	1.23	3.46	1.53	6.21	19
Ageratum conyzoides	Asteraceae	DD	362	0.36	0.60	1.33	3.28	1.53	6.15	20
Ipomoea aquatica	Convolvulaceae	DD	358	0.36	0.60	1.36	3.25	1.53	6.14	21
Sphagneticola trilobata	Asteraceae	DD	363	0.36	0.60	1.17	3.29	1.53	5.99	22
Tradescantia sp	Commelinacea	DD	356	0.36	0.60	1.16	3.23	1.53	5.92	23

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Laguncularia racemosa	Combretaceae	DD	11	0.01	0.60	4.22	0.10	1.53	5.85	24
Eleusine indica	Poaceae	DD	195	0.20	1.00	1.17	1.77	2.55	5.49	25
Sporobolus pyramidalis	Poaceae	DD	188	0.19	1.00	0.96	1.71	2.55	5.21	26
Centrosema pubescens	Fabaceae	DD	276	0.28	0.60	1.07	2.50	1.53	5.10	27
Panicum maximum	Poaceae	DD	193	0.19	0.80	1.17	1.75	2.04	4.97	28
Triumfetta cordifolia	Malvaceae	DD	218	0.22	0.80	0.90	1.98	2.04	4.91	29
Ficus platyphylla	Moraceae	DD	7	0.01	0.60	3.06	0.06	1.53	4.66	30
Erigeron floribundus	Asteraceae	DD	291	0.29	0.60	0.30	2.64	1.53	4.48	31
Spondias mombin	Anacardiaceae	DD	6	0.01	0.60	2.82	0.05	1.53	4.40	32
Typha latifolia	Typhaceae	DD	100	0.10	0.60	1.74	0.91	1.53	4.18	33
Terminalia superba	Combretaceae	DD	6	0.01	0.40	3.09	0.05	1.02	4.16	34
Tridax procumbens	Asteraceae	DD	256	0.26	0.40	0.77	2.32	1.02	4.12	35
Waltheria indica	Asteraceae	DD	109	0.11	1.00	0.57	0.99	2.55	4.11	36
Alchornea laxiflora	Euphorbiaceae	DD	115	0.12	0.60	1.44	1.04	1.53	4.01	37
Osteospermum sp	Asteraceae	DD	289	0.29	0.40	0.30	2.62	1.02	3.95	38
Imperata cylindrica	Poaceae	DD	122	0.12	0.80	0.77	1.11	2.04	3.92	39
Alchornea cordifolia	Euphorbiaceae	DD	100	0.10	0.60	1.40	0.91	1.53	3.84	40
Andropogon gayanus	Poaceae	DD	71	0.07	0.80	0.90	0.64	2.04	3.59	41
Tithonia diversifolia	Asteraceae	DD	188	0.19	0.60	0.30	1.71	1.53	3.53	42
Chloris sp	Poaceae	DD	97	0.10	0.80	0.58	0.88	2.04	3.50	43
Dioscorea sp	Dioscoreaceae	DD	86	0.09	0.80	0.66	0.78	2.04	3.48	44
Athyrium otophorum	Arthyriaceae	DD	144	0.14	0.60	0.53	1.31	1.53	3.37	45
Urena lobata	Malvaceae	DD	87	0.09	0.80	0.48	0.79	2.04	3.31	46
Pteridium aquilinum	Dennstaedtiaceae	DD	104	0.10	0.60	0.38	0.94	1.53	2.86	47
Nephrolepis undulata	Nephrolepidaceae	DD	80	0.08	0.40	0.64	0.73	1.02	2.39	48
Euphorbia heterophylla	Euphorbiaceae	DD	66	0.07	0.60	0.23	0.60	1.53	2.36	49
Xanthium strumaniunm	Asteraceae	DD	42	0.04	0.60	0.30	0.38	1.53	2.21	50
Anchomanes difformis	Araceae	DD	23	0.02	0.60	0.30	0.21	1.53	2.04	51
Alstonia boonei	Apocynaceae	DD	4	0.00	0.40	0.85	0.04	1.02	1.91	52
Stachytarpheta angustifolia	Verbenaceae	DD	22	0.02	0.60	0.04	0.20	1.53	1.77	53
Mucuna pruriens	Fabaceae	DD	37	0.04	0.40	0.14	0.34	1.02	1.50	54
Musa sapientum	Musaceae	DD	20	0.02	0.40	0.20	0.18	1.02	1.40	55
Dracaena sp	Dioscoreaceae	DD	20	0.02	0.40	0.17	0.18	1.02	1.37	56
Solanum erianthum	Solanaceae	DD	10	0.01	0.40	0.20	0.09	1.02	1.31	57
Cissus populnea	Vitaceae	DD	20	0.02	0.40	0.07	0.18	1.02	1.27	58
Platycerium angolensis	Polypodiaceae	DD	19	0.02	0.40	0.02	0.17	1.02	1.21	59
	TOTAL		11022	11.02	39.20	100.00	100.00	100.00	300.00	

Source: GIEC/ Bell Fieldwork March (2020).

Species Diversity Indices of the Project Areas

Shannon's diversity and evenness was calculated for all transect sites; number of individuals, number of species, evenness, Margalef index and Shannon's diversity index of the individual Sites are presented in Table 6. Diversity was observed to vary from 2.808 to 3.592; transect B has the highest diversity with H value = 3.592). The least diverse, being transect D, with 1197 individuals and 22 species. The most diverse transect i.e. Transect B, had the highest diversity value with 2845 individuals and 54 species. High value of H would be representative of more diverse community. Evenness or equitability values for all transects were also observed to show some variations; the least value (0.5887) was observed in transect E also and the highest value (0.7626) was observed in transect C which consists of 29 species and 2197 individuals. The results of the Margalef index is quite similar from those of Shannon's index but dissimilar from Evenness. The highest Margalef Index (6.664) was found in transect B while the lowest (2.963) was found in Transect D. Margalef index of species richness indicated that all the stations were ecologically diverse and stable, however, transects A and B are the closest in terms of ecological diversity, others are quite dissimilar from one another. It should be noted that any site with higher diversity index are more stable or expressing less stress than sites with lower values (**Table 4.24**).

Table 4.24: Biodiversity Indices of the project site

	A	B	C	D	E
Taxa_S	52	54	29	22	38
Individuals	2609	2845	2197	1197	2174
Dominance_D	0.03585	0.03325	0.05199	0.07463	0.05554
Simpson_1-D	0.9642	0.9668	0.948	0.9254	0.9445
Shannon_H	3.529	3.592	3.096	2.808	3.108
Evenness_e^H/S	0.6556	0.6724	0.7626	0.7538	0.5887
Margalef	6.483	6.664	3.639	2.963	4.815
Equitability_J	0.8932	0.9005	0.9195	0.9086	0.8543
Chao-1	52	54	29	22	38

Source: GIEC/ Bell Fieldwork March (2020).

Economic Importance of some Plant Species in LFZ

Some of the economic plant species encountered in the study area can be classified as either non-timber forest product or timber forest products. They were further sub-divided based on their uses for aesthetic values, beverages, charcoal, chewing sticks, fats/oils, fence, fruits/seeds, fuel wood, medicine, wrapping and vegetables.

Most of the economic crops have more than one use by the local people. For example, *Elaeis guineensis* (Palm oil) tree is used as source of oil, wine, building and medicinal purposes; *Raphia hookeri* (Raffia Palm) serves as source of palm wine ('Oguro'), fibre as well as for wrapping and roofing (**Table 4.25**). However, a few of the plants only served a single purpose for the community. Gamba grass,and *Panicum maximum*, for example, are used only as fodder. A total of 23% of the plants are used for medicinal purposes, 8% of the plants are used as roofing, 8% firewood and 3% in charcoal making. 14%% of the plants are used for food, 10% as edible fruits; 7% are used as beverage (**Table 4.26**). Cassava was what the farmers cultivate in their farms. Evidence of some of the utilizations of the plants/crops encountered in the study areas is shown in **Plate 4.13**.

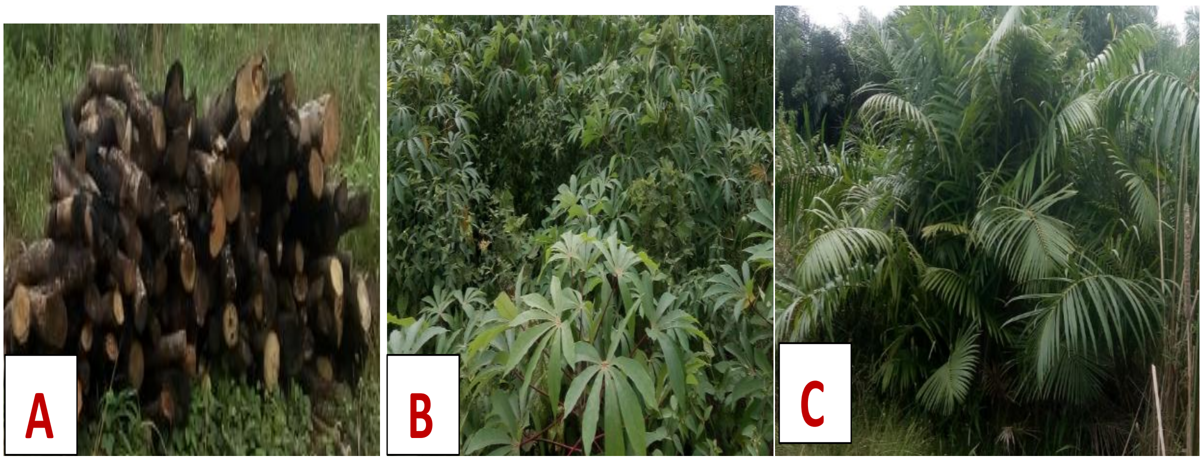


Plate 4.13: Evidence of forest utilization at LFZ community A: Bunch of Fire woods B: Cassava Farm C: *Raphia hookeri* for palm wine.

Table 4.25: Checklist of Common Economic Plants/Crops Encountered within LFZ Community

Crop Plants			
Scientific Names	**Common Names**	**Local Names (Yoruba)**	**Uses**
Alstonia boonei	Cheese Wood	Ahun	Medicinal, Firewood
Andropogon gayanus	Gamba grass	Eesun	Fodder
Chromolaena odorata	Siam Weed	Akintola	Medicinal
Dioscorea sp	Wild Yam	Isu Igbo	Medicinal
Elaies guineensis	Palm Oil Tree	Ope	Oil, roofing, broom and basket making
Hibiscus esculentus	Okra	Ila	Fruit and Medicinal purpose
Mangifera indica	Mango	Mangoro	Fruit and Medicinal purpose
Musa sapientum	Banana	OgedeWeewe	Food, Snacks, Medicinal Purpose, Wrapping and rope
Physalis angulata	Goose berry	Koropo	Medicine (Cures Impetigo in children)
Solanum aethiopicum	Eggplant	Igba	Snacks and Medicine

Raphia hookeria	Raffia Palm	Oguro	Palm wine, Roofing and Medicinal purpose
Panicum maximum	Elephant grass	Koriko Erin	Fodder
Spondias mombin	Yellow Mombin	Iyeye	Snacks and Medicinal
Trema orientalis	Charcoal wood	Afefe	Medicinal, Firewood
Zea mays	Maize	Agbado	Food, Beverage drink and Fodder

Source: GIEC/ Bell Fieldwork March (2020).

Table 4.26: Percentage of Indigenous Uses of the Plant Resources

S/No.	Economic Uses	Number of Plants	% Economic Importance
1	Medicine	17	23.3
2	Food	10	13.7
3	Firewood	6	8.2
4	Ornamental	2	2.7
5	Edible Fruit	7	9.6
6	Fodder	9	12.3
7	Beverage	5	6.8
8	Oil	1	1.4
9	Soup	1	1.4
10	Fencing	4	5.5
11	Body Lotion	1	1.4
12	Chewing Stick	4	5.5
13	Roof Covering	6	8.2

Source: GIEC/ Bell Fieldwork March (2020).

4.3.6 Wildlife and Endangered Species

Information on wildlife of the area is presented in two parts: Literature based information; and visual observations in the course of field visits

4.3.6.1 Literature Based

Mammals known to be present or reported to have existed in the area are presented **Table 4.27** below:

Table 4.27: The Mammals in the vicinity of the proposed Project Area

COMMON NAME	LOCAL (YORUBA) NAME	SPECIES
Primates		
Bosman's Potto	*Egbere*	*Perodicticus potto*
Demidov's Galago		*Galago demidovii*
Mona Monkey	*Obo*	*Cercopethicus mona*
Pholidota (Pangolins)		
Tree Pangolin	*Akika*	*Manis tricuspis*
Long-tailed Pangolin	*Akika*	*Manis tetradactyla*

COMMON NAME	LOCAL (YORUBA) NAME	SPECIES
Lagomorpha (Hares and Rabbits)		
Crawshay's Hare	*Ehoro*	*Lepus crawshayi*
Rodentia (Rodents)		
Giant Forest Squirrel	*Okere*	*Protoxerus stangeri*
Red-legged Sun-squirrel	*Okere*	*Heliosciurus rufobrachium*
Fraser's Flying Squirrel	*Okere*	*Anomalurus derbianus*
Giant Rat ("Rabbit")	*Okete*	*Cricetomys gambianus*
Cane Rat or Grasscutter	*Oya*	*Thryonomys swinderianus*
Brush-tailed Porcupine	*Oore*	*Atherurus africanus*
Carnivora (Carnivores)		
African Civet	*Eta*	*Viverra civetta*
Two-spotted Palm Civet	*Eta*	*Nandinia binotata*
Large-spotted Forest Genet	*Amotekun*	*Genetta poensis*
Cusimanse Mongoose	*Kolokolo*	*Crossarchus obscurus*
Gambian Mongoose	*Kolokolo*	*Mungos gambianus*
Marsh Mongoose ('Fox')	*Kolokolo*	*Atilax paludinosus*
Hyracoidea (Hyraxes)		
Tree Hyrax ("Bush dog")		*Dendrohyrax dorsalis*
Artiodactyla		
Bushpig	*Imado*	*Potamochoerus porcus*
Maxwell's Duiker	*Etu*	*Cephalophus maxwelli*
Bushbuck	*Igala*	*Tragelaphus scriptus*
Sitatunga ("Water Deer")	*Egbin*	*Tragelaphus spekei*

Source: GIEC/ Bell Fieldwork March (2020).

Birds

As will be seen from **Table 4.28**, the study area contains quite a few birds of the waterside and an abundance of species commonly associated with gardens, farmlands, fallows with scattered trees, and dense secondary growth. These include the Grey Heron, *Ardea cinerea,* Village Weaver, *Ploceus cuculatus,* Cattle Egret, *Bulbulcus ibis*, Black-shouldered Kite, *Elanus caeruleus*, Black Kite, *Milvus migrans*, Grey Kestrel, *Falco ardosiaceus*, Senegal Thick-knee, *Burhinus senegalensis*, African Green Pigeon, *Treron calva*, Red-billed Wood Dove, *Turtur afer*, Senegal Coucal, *Centropus senegalensis*, Pied Kingfisher, *Ceryl rudis,* and the African Pied Hornbill, *Tockus fasciatus.*

Reptiles

The reptilian fauna is made up of crocodiles, tortoises, snakes and lizards (**Table 4.29**). The Monitor Lizard, *Varanus niloticus*, the Nile Crocodile, *Crocodylus niloticus,* and the Dwarf Crocodile ("Alligator"), *Osteolaemus tetraspis* are hunted for food. Several species of snakes are said to occur in the area including the Black Cobra, *Naja melanoleuca*, Spitting Cobra, *Naja nigicollis*, Night Adder, *Causus maculatus*, African Beauty Snake *Psammorphis sibilans*, Royal Python, *Python regius*, and the Rock Python, *Python sebae*. Marine turtle are also known to come periodically to the isolated sandy beaches of the area to breed annually. Two families (Chelonidae and Dermochelidae), five genera and six species have been found in Nigerian marine waters (Dublin-Green and Tobor, 1992).

Table 4.28: Birds of the proposed Project Area

COMMON NAME	SPECIES
Ardeidae (Herons and Egrets)	
Cattle Egret	*Bubulcus ibis*
Grey Heron	*Ardea cinerea*
Accipitridae (Vultures, Hawks, Kites, Eagles, etc.)	
Black-shouldered Kite	*Elanus caeruleus*
Shikra	*Accipiter badius*
Lizard Buzzard	*Kaupifalco monogrammicus*
Black Kite	*Milvus migrans*
Falconidae (Kestrels, falcons)	
Common Kestrel	*Falco tinnunculus*
Grey Kestrel	*Falco ardosiaceus*
Phasianidae (Francolins & Guinea Fowls**)**	
Double-spurred Francolin	*Francolinus bicalcaratus*
Burhinidae (Thick-knees or Stone Curlews)	
Senegal Thick-knee	*Burhinus senegalensis*
Columbidae (Pigeons and Doves)	
Red-eyed Dove	*Streptopelia semitorquata*
Laughing Dove	*Streptopelia senegalensis*
Vinaceous Dove	*Streptopelia vinacea*
Red-billed Wood Dove	*Turtur afer*
Tambourine Dove	*Turtur tympanistria*
African Green Pigeon	*Treron calva*
Cuculidae (Cuckoos and Coucals)	
Senegal Coucal	*Centropus senegalensis*
Alcedinidae (Kingfishers)	
Woodland Kingfisher	*Halcyon senegalensis*
Grey-headed Kingfisher	*Halcyon leucocephala*
Shining-blue Kingfisher	*Alcedo quadribrachys*
Malachite Kingfisher	*Corythornis cristata*
Pied Kingfisher	*Ceryl rudis*
Meropidae (Bee-eaters)	
White-throated Bee-eater	*Merops albicollis*
Little Bee-eater	*Merops pusillus*
Bucerotidae (Hornbills)	
African Pied Hornbill	*Tockus fasciatus*
Capitonidae (Barbets)	
Speckled Tinkerbird	*Pogoniulus scolopaceus*
Hirundinidae (Swallows)	
Ethiopian Swallow	*Hirundo aethiopicus*
Motacillidae (Wagtails, Pipits, Longclaws)	
African Pied Wagtail	*Motacilla aguimp*
Pycnonotidae (Bulbuls)	
Common Garden Bulbul	*Pycnonotus barbetus*
Sylviidae (Warblers)	
Grey-backed Camaroptera	*Camaroptera brevicaudata*
Nectariniidae (Sunbirds)	
Olive-bellied Sunbird	*Nectarinia chloropygia*
Collared Sunbird	*Anthreptis collaris*
Corvidae (Crows, Magpies, etc)	
Pied Crow	*Corvus alba*
Passeridae (Sparrows)	

COMMON NAME	SPECIES
Grey-headed Sparrow	*Passer griseus*
Ploceidae (Weavers)	
Village Weaver	*Ploceus cucullatus*
Estrildidae (Finches, Waxbills, Mannikins)	
Bronze Mannikin	*Lonchura cucullata*
Red-billed Fire-Finch	*Lagonosticta senegala*
Viduidae (Whydahs, Indigo Birds)	
Pin-tailed Whydah	*Vidua macroura*

Source: GIEC/ Bell Fieldwork March (2020).

Table 4.29: Reptiles reported to occur in the vicinity of the proposed project area

COMMON NAME	SPECIES
Crocodylidae (Crocodiles)	
Nile Crocodile	*Crocodylus niloticus*
Short-snouted Crocodile (“Alligator”)	*Osteolaemus tetraspis*
Pelomedusidae (Swamp terrapins)	
Testudinidae (Tortoises)	
Serrate Hinge-backed Tortoise	*Kininxys erosa*
Home’s Hinge-backed Tortoise	*Kinixys homeana*
Bell’s Hinged Tortoise	*Kinixys belliana*
Varanidae (Monitor Lizards)	
Nile Monitor Lizard	*Varanus niloticus*
Boidae (Pythons)	
Royal Python	*Python regius*
African Python	*Python sebae*
Elapidae (Cobras and Mambas)	
Spitting Cobra	*Naja nigricollis*
Black Cobra	*Naja melanoleuca*
Viperidae (Vipers)	
Night Adder	*Causus maculatus*

Source: GIEC/ Bell Fieldwork March (2020).

Amphibians

Species recorded in the area include: *Bufo regularis* (common toad)*, P. taenioscelis, Aubria subsigilata,* and *Phrynobatrachs albolabris;* treefrogs: *Afrixalus dorsalis, and Hyperolius fusciventris;* and a Clawed toad, *Xenopus tropicalis*, (**Table 4.30**).

Table 4.30: Amphibians recorded in the vicinity of the proposed Project Area

COMMON NAME	SPECIES
Hyperolidae (Treefrogs)	
	Afrixalus dorsalis
	Hyperolius fusciventris
Ranidae (Frogs)	
	Ptychadena taenioscelis
	Aubria subsigilata
	Phrynobactrachus albolabris
Bufonidae (Toads)	
Common Toad	*Bufo regularis*
Forest Toad	*Bufo maculatus*

Pipidae (Clawed Toads)	
	Xenopus tropicalis

Source: GIEC/ Bell Fieldwork March (2020).

Economic Significance of Wildlife

Animals are hunted both for the pot and for the market. Apart from consumption as food, certain parts of wild animals are also used in folk medicine. For instance, discussions with some hunters revealed that the heart of some cats are used to make charms for bravery and wrestling skills, while the feathers of some birds such as the peacock are used to make beauty potions.

Site Observations Of Wildlife

Actual sighting of wildlife species on the site were limited to avian species in flight and along pools of water in the area. In addition, one or two reptilian species, especially a small Nile Monitor Lizard were seen. Pictorial representation of the site observations are presented below:

Plate 4.14: A Black Kite (Milvus migrans) seen overhead at the site (Photographed March 2020)

Plate 4.15: A Marabou Stork (Leptoptilos crumenifer) seen wading around a pond adjacent to the project site (Photographed March 2020)

Plate 4.16:White faced whistling ducks (Dendrocygna viduata) seen in the area(Photographed March 2020)

Plate 4.17: The Rainbow lizard and monitor lizard observed around the area (Photographed March 2020)

4.3.7 Groundwater Studies

Groundwater Studies - Physical parameters

The summary of the results of the physical characteristics of the groundwater samples from the area is presented **Table 4.31**. Water temperature ranged from 26.3 to 27.2 ^{0}C with average value of 26.7±0.2 ^{0}C in the dry season and ranged from 27.1 to 27.5 ^{0}C with average value of 27.3±0.2 ^{0}C during the wet season. Temperatures were generally higher in the wet season than in the dry season. This contrasting temperature variation across the seasons could be as a result of the time of sampling during these predominant seasonal periods in Nigeria. It could also, be due to the influence of the cold and dry north-east trade winds locally regarded as harmattan, prevailing during the time of dry season sampling (i.e. January) in Nigeria. The groundwater samples were less turbid with values ranged from 3.7 to 5.6 NTU and average value of 4.4±0.4 NTU as well as ranged from 3.0 to 5.0 NTU and average of 4.0±1.0 NTU during the dry and wet seasons respectively. On the average, the water samples were generally less turbid in the wet season than the dry season. Also the average turbidity values from the water samples in both seasons complied with NIS (2015) drinking water standards as presented in **Table 4.31.**

General chemical parameters

The water samples ranged from freshwater to saline during the dry season and completely freshwater during the wet season with conductivity and TDS values (range = 217 – 35700 μScm^{-1}; 108 – 18200 mgL^{-1} and mean = 9487.25±8744.32 μScm^{-1}; 4820.25±4462.84 mgL^{-1}) for dry season and (range = 98 – 201 μScm^{-1}; 53 – 110 mgL^{-1} and mean = 149.5±28.5 μScm^{-1}; 81.5±51.5 mgL^{-1}) respectively. Salinity (range = 0.1 – 0.1 ‰ and mean = 0.1±0.0 ‰) for wet season. Conductivity and TDS values were generally high in the dry season not complying with the NIS (2015) drinking water standards compared to their corresponding low values obtained during the wet season. This trend could be as a result of the infiltration of the groundwater sources in the area with freshwater and percolation of rainfall into the groundwater aquifer during the wet season as well as the contrasting evaporation of water that may result into a considerable increase in the dissolved solids of the water samples in the area during the dry season. The pH values showed that the water samples ranged from moderately alkaline (pH = 8.4) to strongly alkaline (pH = 8.7) and strongly alkaline (pH = 8.55±0.15) on the average during the dry season. The water samples also, ranged from moderately acidic (pH = 6.02) to neutral (pH = 7.30) and neutral (pH = 6.93±0.30) on the average in the wet season. On the average, the pH values did not comply with the NIS (2015) drinking water standards during the dry season but within the prescribed range during the wet season (**Table 4.31**). Alkalinity values (range = 42.2 - 86.0 $mgCaCO_3L^{-1}$; mean = 70.28±9.67 $mgCaCO_3L^{-1}$) shows the water samples were well buffered during the dry season. The water samples also, ranged from hard water sources (total hardness = 128.4 $mgCaCO_3L^{-1}$) to very hard (total hardness = 349.1 $mgCaCO_3L^{-1}$) and very hard on the average (total hardness = 198.45±50.98 $mgCaCO_3L^{-1}$) during the dry season.

Cations and anions

The summary of the values of the cations and anions from the groundwater sources from the area as presented in **Table 4.32** is:

Cations and anions			Dry season Range	Mean±S.E	Wet season Range	Mean±S.E.
Ca^{2+}	(mgL^{-1})	=	30.46 - 70.2	45.61±8.71	3.61 - 20.38	12.00±8.39
Mg^{2+}	(mgL^{-1})	=	3.89 - 41.67	20.32±7.86	0.95 - 5.38	3.17±2.22
Na^{+}	(mgL^{-1})	=	ND	ND	4.85 - 43.58	24.22±19.37
K^{+}	(mgL^{-1})	=	ND	ND	1.42 - 3.36	2.39±0.97
Cl^{-}	(mgL^{-1})	=	17.49 - 191.69	118.17±36.49	ND	ND
SO_4^{2-}	(mgL^{-1})	=	131.7 - 457.6	229.30±76.73	4.0 – 6.0	5.0±1.0.

The ionic hierarchy of dominance of the cations and anions from the groundwater sources in the area based on mean meq./L values of the ions in the water samples can be categorised as follows:

Dry season
Cations = $Ca^{2+} > Mg^{2+}$
Anions = $SO_4^{2-} > Cl^-$

Wet season
Cations = $Na^+ > Ca^{2+} > Mg^{2+} > K^+$
Anions = SO_4^{2-}.

The cations and anions values were generally higher in the dry season than in the wet season. This is due to the fact that they are generally salinity dependent and are also, indication of the dissolved solids in the water that have earlier been indicated to be generally higher in the dry season than the corresponding wet season. Except for the sulphate concentrations during the dry season, all the cations and anions concentrations on the average complied with the prescribed NIS (2015) standards for drinking water.

Oxygen parameters and nutrient compounds

The oxygen parameters DO, BOD_5 and COD values (range = 2.1 – 2.8 mgL^{-1}; 2.83 - 6.72 mgL^{-1}; 35.28 - 52.69 mgL^{-1} and mean = 2.5±0.15 mgL^{-1}; 4.46±0.82 mgL^{-1}; 42.71±3.75 mgL^{-1}) respectively in the dry season (range = 1.2 – 2.2 mgL^{-1}; 0.2 – 0.3 mgL^{-1}; 112.0 -152.0 mgL^{-1} and mean = 1.7±0.5 mgL^{-1}; 0.25±0.05 mgL^{-1}; 132±20.0 mgL^{-1}) respectively in the wet season. From the classification of waters by Hynes (1971), using the BOD_5 values, the water samples from the area can be classified based on their mean BOD_5 values as of doubtful quality (mean BOD_5 = 4.46±0.82 mgL^{-1}) in the dry season and very clean (mean BOD_5 = 0.25±0.05 mgL^{-1}) during the wet season. The values of the oxygen parameters were generally higher in the dry season than in the wet season as presented in **Table 4.31**.

The nutrient compounds NO_3^- and PO_4^{3-} ranged from 28.06 to 37.82 mgL^{-1} and from 0.5 to 1.32 mgL^{-1} with mean values of 31.51±2.23 mgL^{-1} and 0.83±0.17 mgL^{-1} respectively in the dry season. During the wet season, the PO_4^{3-} values ranged from 0.008 to 0.012 mgL^{-1} with mean value of 0.010±0.002 mgL^{-1}. The PO_4^{3-} values were generally higher in the dry season than in the wet season. This could be due to increase in its bulk concentration due loss of water from evaporation/evapotranspiration during the dry season as against the dilution that may occur to its bulk concentration in the water due to water refreshments/recharge during the wet season. In addition, the NO_3^- values complied with the prescribed NIS (2015) standards for drinking water.

Heavy metals/trace elements

The heavy metals/trace elements concentrations from the water samples in the area occurred over a wide range of < 0.001 mgL^{-1} (Cd and Hg) to 2.68 mgL^{-1} (Cu) in the dry season and ranged from 0.008 mgL^{-1} (Cu) to 82.684 mgL^{-1} (Fe) during the wet season (**Table 4.31**). Their concentrations (i.e. mean concentrations) occurred over the intervals:

Concentration (mgL^{-1})		Dry season	Wet season
• < 0.001	=	Cd = Hg	-
• 0.001 – 1.000	=	Cr > Fe > Mn > Pb > Zn > Ni > V	Mn > Pb > Cu
• > 1.000	=	Cu	-
• ≥ 61.00	=	-	Fe.

The concentrations of the heavy metals/trace elements (Fe and Pb) during the dry and wet seasons as well as (Cr, Mn and Ni) in dry season did not comply with the prescribed NIS (2015) standards for drinking water. Others were within the prescribed limits of the NIS (2015) standards for drinking water.

Organic compounds

The Total Hydrocarbon (THC), Oil and Grease (O&G) and Poly Aromatic Hydrocarbons (PAHs) (range = 1.94 - 3.45 mgL^{-1}; 3.48 - 7.99 mgL^{-1}; 0.082 - 3.074 mgL^{-1} and mean = 2.475±0.335 mgL^{-1}; 5.265±0.966 mgL^{-1}; 1.856±0.729 mgL^{-1}) respectively in the dry season. The PAHs values in dry season did not comply with the prescribed NIS (2015) standards for drinking water. Oil and grease and hydrocarbons are complex mixture of hydrocarbons that could be introduced into the aquatic ecosystems by an extensive range of mechanisms such as crude oil exploration and exploration activities, marine vessel operations or marine terminal operations as well as the use of finished petroleum products and are notable organic contaminants found in the organic wastes. In some cases Oil and grease could result from other sources of oils other than petroleum oils and in some cases a combination of both. Excess amount of oil and grease present pollution threat especially the petroleum related types and interfere with aerobic and anaerobic biological processes in the water. For instance, high level of PAHs in drinking water as observed in the underground water samples from the area could be possibly carcinogenic as suggested by NIS (2015).

Microbiology

The summary of the microbial taxa composition of the groundwater samples in the dry season from the area as presented in **Table 4.31** is:

Taxon	Unit	Range	Mean±S.E.
• THB	(cfu/mL) x 10^4	0.78 - 2.64	1.54±0.39
• HUB	(cfu/mL) x 10^4	0.13 - 2.02	1.02±0.40
• Coliform	(MPN/100mL) x 10^4	0.42 - 1.09	0.76±0.34
• *E. coli*	(MPN/100mL) x 10^4	0.12 - 1.08	0.60±0.48
• THF	(spore/mL) x 10^2	0.09 - 0.14	0.115±0.025
• HUF	(spore/mL) x 10^2	0.08 - 0.14	0.11±0.03

The presence of *E. coli* from the groundwater samples in the dry season from the area did not comply with the NIS (2015) standards for drinking water quality. However, the values of the total coliform count were within the prescribed maximum permitted levels of the NIS (2015) standards for drinking water (**Table 4.31**). It is noteworthy, that the presence of *E. coli* from the groundwater samples in the area during the dry seasons is an indication of faecal/sewage contamination of the groundwater sources in the area.

Table 4.31: Water quality characteristics of the groundwater samples from the area

S/N	Parameter	Unit	Dry Season		* Wet Season From Yulong EIA 2017		DWS
			Range	Mean±S.E.	Range	Mean±S.E.	NIS, 201
	Physical parameters						
1	Temperature	(^{0}C)	26.3 - 27.2	26.7±0.2	27.1 - 27.5	27.3±0.2	Ambient
2	Turbidity	(NTU)	3.7 - 5.6	4.4±0.4	3.0 – 5.0	4.0±1.0	5.0
	General chemical parameters						
3	Conductivity	(μScm^{-1})	217 - 35700	9487.25±8744.32	98 - 201	149.5±28.5	1000
4	TDS	(mgL^{-1})	108 - 18200	4820.25±4462.84	53 - 110	81.5±51.5	500
5	Salinity	(‰)	ND	ND	0.1 – 0.1	0.1±0.0	NS
6	pH		8.4 - 8.7	8.55±0.15	6.02 - 7.30	6.93±0.30	6.5 - 8.5
7	Total Alkalinity	($mgCaCO_3L^{-1}$)	42.2 – 86.0	70.28±9.67	ND	ND	NS
8	Total Hardness	($mgCaCO_3L^{-1}$)	128.4 - 349.1	198.45±50.98	ND	ND	150
	Cations and anions						
9	Ca^{2+}	(mgL^{-1})	30.46 - 70.2	45.61±8.71	3.61 - 20.38	12.00±8.39	NS
10	Mg^{2+}	(mgL^{-1})	3.89 - 41.67	20.32±7.86	0.95 - 5.38	3.17±2.22	20
11	Na^+	(mgL^{-1})	ND	ND	4.85 - 43.58	24.22±19.37	200
12	K^+	(mgL^{-1})	ND	ND	1.42 - 3.36	2.39±0.97	NS
13	Cl^-	(mgL^{-1})	17.49 - 191.69	118.17±36.49	ND	ND	250
14	SO_4^{2-}	(mgL^{-1})	131.7 - 457.6	229.30±76.73	4.0 – 6.0	5.0±1.0	100
	Oxygen parameters and nutrient compounds						
15	DO	(mgL^{-1})	2.1 – 2.8	2.5±0.15	1.2 – 2.2	1.7±0.5	NS
16	BOD_5	(mgL^{-1})	2.83 - 6.72	4.46±0.82	0.2 – 0.3	0.25±0.05	NS
17	COD	(mgL^{-1})	35.28 - 52.69	42.71±3.75	112.0 -152.0	132±20.0	NS
18	NO_3^-	(mgL^{-1})	28.06 - 37.82	31.51±2.23	ND	ND	50
19	PO_4^{3-}	(mgL^{-1})	0.5 - 1.32	0.83±0.17	0.008 - 0.012	0.010±0.002	NS
	Heavy metals/trace elements						
20	Cd	(mgL^{-1})	<0.001 - <0.001	<0.001±0.000	ND	ND	0.003
21	Cr	(mgL^{-1})	0.38 - 1.64	0.80±0.29	ND	ND	0.05
22	Cu	(mgL^{-1})	1.24 - 2.68	1.69±0.33	0.008 - 0.094	0.051±0.043	1.0
23	Fe	(mgL^{-1})	0.51 - 0.84	0.62±0.076	39.344 - 82.684	61.014±21.670	0.3
24	Hg	(mgL^{-1})	<0.001 - <0.001	<0.001±0.000	ND	ND	0.001
25	Mn	(mgL^{-1})	0.35 - 0.55	0.44±0.045	0.119 - 0.164	0.1415±0.0225	0.2
26	Ni	(mgL^{-1})	0.020 - 0.042	0.03±0.005	ND	ND	0.02
27	Pb	(mgL^{-1})	0.025 - 0.058	0.041±0.008	0.07 - 0.35	0.21±0.14	0.01
28	V	(mgL^{-1})	0.002 - 0.004	0.0025±0.0005	ND	ND	NS
29	Zn	(mgL^{-1})	0.146 - 0.367	0.242±0.04	ND	ND	3.0

	Organic compounds						
30	THC	(mgL^{-1})	1.94 - 3.45	2.475±0.335	ND	ND	NS
31	Oil & Grease	(mgL^{-1})	3.48 - 7.99	5.265±0.966	ND	ND	NS
32	PAHs	(mgL^{-1})	0.082 - 3.074	1.856±0.729	ND	ND	0.007
	Microbiology						
33	THB	(cfu/mL) x 10^4	0.78 - 2.64	1.54±0.39	ND	ND	NS
34	HUB	(cfu/mL) x 10^4	0.13 - 2.02	1.02±0.40	ND	ND	NS
35	Coliform	(MPN/100mL) x 10^4	0.42 - 1.09	0.76±0.34	ND	ND	10
36	*E. coli*	(MPN/100mlL x 10^4	0.12 - 1.08	0.60±0.48	ND	ND	0
37	THF	(spore/mL) x 10^2	0.09 - 0.14	0.115±0.025	ND	ND	NS
38	HUF	(spore/mL) x 10^2	0.08 - 0.14	0.11±0.03	ND	ND	NS

DWS = Drinking Water Standard; NIS = Nigerian Industrial Standards; ND = No data; NS = None stated

Source: GIEC/ Bell Fieldwork March (2020) and * Yulong EIA Study 2017

4.3.8 Landuse/Landcover

Landsat satellite image was used in the mapping of the various landuse/landcover patterns in the study area. The choice of the satellite image was based on its availability coupled with the fact that it provides a good coverage of the proposed project site. The Landsat image was classified into different landuse/landcover classes after the image was ground truthed. In ground truthing the image, various distinct categories of signature were verified in real life to determine what they represent. Once what each signature represents is clear, it becomes very easy to generalise the observed pattern on land for signatures on the image. This was achieved through image classification (supervised classification) and based on this; distinct landuse/landcover categories were identified (**See Fig 4.16**).

Project Area Land use

As part of the baseline environmental study, the landuse/landcover study for the proposed project location was carried out at 1Km distance on every direction from the project mid-point. In other words, existing landuse/landcover, 1km distance from the proposed site center to the north, south, east and west to captured. Result of the Landuse/Landcover as at March 2020 is shown in **Table 4.32** while its graphical presentation is shown in **Figure 4.16.** Identified uses of land within the study area extent are developed/built-up land, swampy/wetland vegetation, Road layout, Sand filled lands, and undeveloped/brown areas.

Developed/Built-Up Area

The developed/built-up areas are physical development within industrial zone. It is understood that the entire area of the proposed project site has been earmark for industrial activities known as free trade zone (FTZ) but physical development of lands are various stages. Therefore, developed area (built-up) within study area extent is about 72.30Ha representing 17.75%, although there are pockets of land parcels within these developed lands yet to be built but are within perimeter fences. As shown in **Figure 4.15** a developed/built-up land at the northern section bound the proposed project site.

Wetland/Swampy Vegetation

This cover type is the predominant landuse of the entire zone beforehand. It is presently given way to industrial development at a great rate. However, it is still the dominant landcover type within the study area extent. It is important to know that the present area covered by the swampy/wetland may have been earmark for future development. In other words, this landcover type may give way to physical development at any time. Coverage of wetland/swampy land within the study area extent is 258.01Ha (63.36%). As shown in **Figure 4.16**, this landcover type dominates the entire southern and western parts of the proposed project area.

Sand Filled Land

This includes the proposed project site area (15,146msq) as shown in figure. Sand filling (reclamation) is a common second stage of development after bush clearing in wetland environment. Several lands have been recently reclaimed in the immediate project neighborhood. Total area covered by this class of landuse is 2.96Ha (5.64%). This shows that the proposed project physical development may be taken place simultaneously along other projects or attracts further development.

Undeveloped/Brown field

These are lands that have been reclaimed for a while and now regenerating due to no physical development taken place on them. They are yet to built-up lands. Total land covers by the reclaimed but undeveloped lands is 34.69Ha and it represents 8.54% of the study area extent.

Road Layout

The roads (access route) range from dual to single carriageway. The roads are important landuse type because they cover an enormous area of land particularly in a well laid out industrial area such as the LFZ. Total land area occupy by roads within scope of study is about 4.71%.

Table 4.32: Landuse/Landcover around the Proposed Project Site

Sn	Landuse	Area(Sqm)	Area(Ha)	%Cover
1	Road Layout	191772.31	19.177	4.71
2	Wetland/Wampy Vegetation	2580081.14	258.01	63.36
3	Sand Filled Area	229636.11	22.96	5.64
4	Developed/Built-Up	723041.41	72.3	17.75
5	Undeveloped/Brown field	347940.95	34.79	8.54
	Total	4072371.92	407.237	100

Source: GIEC/ Bell Fieldwork March (2020)

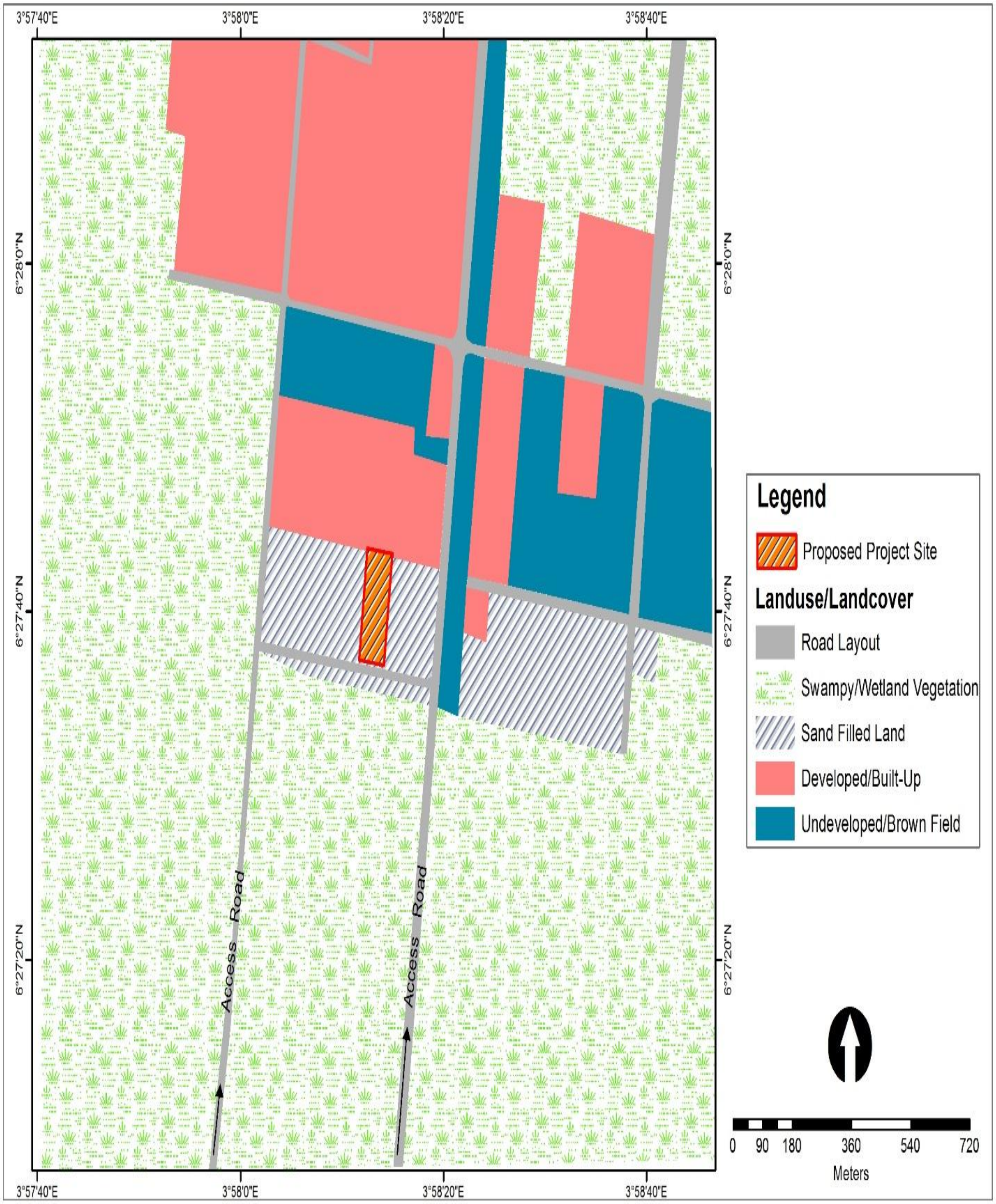


Figure 4.15: Static Landuse/Landcover Map of the Proposed Project Site

4.3.9 Socio-economic Studies

4.3.9.1 Introduction

It is indispensable to examine socio-economic conditions in the proposed project area with a view to grasp information on the current living conditions of households. In addition, it provides the basis for examining the anticipated negative impacts on the affected area and households, as well as considering mitigation measures against negative. The objective was achieved by collecting primary data using questionnaire, key informant interview, and stakeholder's consultation in the host communities of the Lekki Free Zone (LFZ) where the proposed project will be undertaken. The questionnaire used composed of two parts namely the perception survey and a general socio-economic survey. In total, 49 respondents were randomly interviewed in each of the two host communities (Tiye, and Imobido) of the LFZ. The information collected during the sample socio economic survey was analysed and a base line is prepared to describe about the general socio-economic condition of project area. In addition, informal Interviews were conducted to compliment the information obtained from the questionnaire survey and those obtained from existing records. Such interviews were usually with individual person or opinion leaders in the neighbourhood.

In the present study, socio-economic information regarding the host communities of the LFZ is outlined to evaluate the current socioeconomic status and to further assess impacts of the manufacturing companies on the community's social and economic well-being. Such an assessment requires qualitative and quantitative measures with regards to the community's demographic, employment, personal income, and provision of public services. The presented information has been sourced using questionnaire and key informant interviews and coupled with other ancillary secondary data from published sources.

4.3.9.2 Consultation and Community Engagement Approach

Early in the project development LFZ recognised that engagement with the local communities was critical to the successful implementation of the Project. The stakeholders were identified based on their roles, relevance, and potential to be impacted or to impact the project. Most of the stakeholders likely to be impacted by the project were pre-determined based on the previous knowledge of the project area of influence, while different stakeholders including the client identified others. Some of the stakeholders unfolded as consultations went along. Informal public meetings were held to provide information to potentially affected persons, and to collect their comments and questions. In addition, meeting with selected representatives of the host communities was held on 10th March 2020 was used to provide information on the status of the project, to collect relevant existing information, and to identify issues of concern. Global Impact Environmental Consulting (GIEC) undertook stakeholder consultation with the three communities in the vicinity of the proposed project site. This stakeholder engagement provided a matrix of key indicators as to the wishes and concerns of the leaders of the three communities and representatives of the local authorities. Meeting were held in the Lekki Free Zone office with the project proponent and representatives of the three communities. Register of the consultation undertaken and feedback from the participants, forms part of the GIEC consultation report (**See Annex**). The views and feedback received were incorporated into this report.

Initially, the community engagement focused on increasing public awareness and allaying the fear of negative changes that the proposed project activity might engender while amplifying the positive impacts. This was accomplished through the provision of project information on the various development activities and phases of the project to the various representatives of the host communities, in a non-technical manner, in their local dialect and to the extent possible. It was emphasised during the consultation that accessibility to information and receipt of prompt feedback would produce positive engagement results whereby community involvement in the Project development would be maximised, effective participation gained and mutual trust obtained. Consultation with local stakeholders indicated that they generally view the proposed project as a positive venture that might stimulate new economic and social activities and enhance development in the area. Most of stakeholders were aware of the project's activities, as similar activities have been previously conducted in the area. During the meetings held, the public expressed the wish that future projects be carried out in the same way, with transparent information dissemination with respect to the project to be developed. The stakeholders also showed special interest since they could verify that their concerns and recommendations were considered and were reflected on the identification of the potential impacts and on the management plans. The consultation process has already started, and it will continue in future at relevant stages.

Stakeholder engagement is a two-way process. It is therefore important to ensure that there is a feedback mechanism to ensure stakeholders affected by or interested in the proposed Project can present their input (e.g. opinions, requests, suggestions and grievances) for consideration and, if required, seek redress. It should be noted that, even where not all feedback or grievances are deemed 'valid' or applicable to the context of the proposed Project, the feedback mechanism needs to function in a non-judgmental manner and record all feedback received. Towards this end, a Grievance Redress Mechanism (GRM) would be developed to ensure that grievances are recorded and considered fairly and appropriately. The project proponent will work to continually improve this process. Affected parties would be notified of the available GRM procedure. Grievances are to be received in writing or verbally, directly from the complainant, consultants and/or contractors.

Pictures showing sections of the meeting/ consultation exercise held with the host communities are shown in **Plates 4.18**

Plate 4.18: The Elders of the host communities (Tiye, and Imobido) during the consultation exercise (Photographed March 2020)

Key Issues Raised by Stakeholders

- Employment of the local indigenes not just as casual labour (temporary) but into key management and technical positions
- Consultations with community heads before employment in the company is made to ensure that indigenes of the communities are employed
- The need to place indigenes of the community on the same salary scale as their non-indigene counterparts. They frown at what they termed discriminatory salary structure used by some of the companies in the LFZ
- They particularly want the company to identify relevant local raw materials that can be effective substitutes for the imported raw materials. This according to the stakeholders would spur local economy and provide opportunity for them to supply such raw materials to the company.
- They community leaders will appreciate if the company can support them financially during major festivals.

Addressing the Stakeholders' Concerns

The consultations provided a variety of views and opinions on what are considered to be the main concerns and issues of different stakeholders. Based on the raised issues/concerns, an analysis was carried out and recommendations were given for those issues that required attention in the study.

Disclosure

GIEC will provide public access to the produced EIA report as well as other relevant project documents. The full documentation will be made available in hard copy at the LFZ office and in selected government offices particularly in the Ibeju-Lekki Local Government Headquarter. Electronic copies of the finalized report may be available on the client's website.

4.3.9.3 Socio-economic and Health Conditions

Socio-economic Studies -Approach to Consultations

Preliminary Activities

Initial activities involved engagements with the FMEnv, the regulatory body for national environmental issues in Nigeria. This engagement was focused on developing the appropriate/acceptable terms of reference, scope of work and work execution plan for the EIA studies. In developing the scope of work, cognizance was taken/references made to existing/recent studies carried out around the project area. Consultations were held with members of the host communities as part of the social impact and health assessment.

To achieve the social impact and health assessment objectives, socioeconomic data was obtained using multiple methods, namely:

i. review of available literature,
ii. field visit for interactions with all seven stakeholder communities and,
iii. application of professional data collection techniques, including conventional methods of social science surveys and participatory rural appraisal methods.

From the reconnaissance survey carried out, two (2) communities were identified as the project affected communities (PAC). The communities are:

1. Tiye - Ibeju Lekki Local Government.
2. Imobido - Ibeju Lekki Local Government.

The communities and population as project-affected communities and population (PACs/PAPs) were all chosen as the primary sampling units (PSU) for the socioeconomic data collection exercise.

Consultation Exercise

Effective socio-economic baseline data collection involves the deployment of several techniques and methods, including community interactions, Focused Group Discussions (FGDs), Semi-Structured Interviews (SSIs), and Key Informant Interviews (KIIs), all participatory rural appraisal techniques were used for the socioeconomic data collection. Participatory methodology that employs a mix of the above techniques (SSI, FGD and KII) has yielded better results when appropriately utilized.

Detailed socioeconomic study commenced from 6th March 2020. The survey exercise was undertaken across the identified project affected communities. Prior to entry into the community, advanced notification was undertaken through the officials of Lekki Free Zone and thus great awareness for socioeconomic and biophysical data collection was created prior to the arrival of the Consultants.

A community-wide interactive meeting involving the leadership of the surveyed communities (i.e. community head, spokesman for elders, his deputy, chief priest, and women leaders, CDC chairman, youth chairman, women leaders and several members of the community. Information on settlement/community's history, structure, population and demography, culture, political economy, traditional and modern authority structures, landownership, farming and fishing rights, availability and status of infrastructures, issues of potential conflicts and resolution, the concerns, and expectations of the population as well as perceptions of impacts of the proposed steel pipe threading and valve assembly facilities project activities were solicited from those interacted with.

The administration of structured questionnaires is a conventional method of data collection in the social sciences. As a survey instrument and primary data collection method, the questionnaire is structured to incorporate socioeconomic and environmental issues and included binary, optional and open-ended questions that solicited relevant information from the householder **(See Annex**). The simple random technique was used in selecting respondents from the surveyed communities both at the community gathering (meetings) and across a cross section of respondents on the streets/compounds with the adult population as the target. Copies of the questionnaire were administered face-to-face to respondents with the assistance of field/technical assistants who were knowledgeable about survey techniques. Community members that were found literate were also allowed to self-administer/respond to the questionnaire after clarifications on how to do so by the SIA Consultant. In all, fifty (50) copies of the structured questionnaire were administered randomly to different class or/ groups namely the elders, women, youth and community development groups across the surveyed communities. The response rate amounted to approximately 76%, (**Table 4.33**).

Table 4.33: Number of questionnaires administered and retrieved

S/N	Project-affected community	No. Of questionnaires administered	No./ % retrieved
1.	Tiye	25	22 (88%)
2.	Imobido	25	23 (92%)
	Total	50	49(98%)

To complement and augment any gap in data, secondary sources of data was extensively utilized, involving published statistics on population and other studies that have been carried out in the area (Dale & Davis, 1995, SIEP, 1996, 2001). Data gathering and analysis were also based on advocated philosophy of “triangulation” (use of a variety of data sources, multiple perspectives and multiple methods (Denzin, 1970, Grady, et al., 1987, as reported by Glasson, 1995). Transect walking (triangulation) and ground-truthing method was also used to complement the data collection exercise.

Necessary photographs of the human environment, particularly on available infrastructures were also taken to aid discussions. For educational statistics, primary and secondary schools found in session during the fieldwork were visited and the headmasters and principals interviewed for the necessary data.

Socio-cultural Structure and Resources

Project Location, Area of Influence and Affected Communities/Population

The proposed Steel Pipe threading and Valve assembly facility is located on the Lagos Free Zone, off the Lagos-Epe road. Initiated with the President's approval in 2002, the Lagos Free Zone is the first private owned free trade zone in Nigeria. Designed to serve as an integrated hub with active road, rail and sea links, the Lagos Free Zone is set to open up the investment, business and tourism potential of Nigeria to the world. Spread over 805 hectares of land, the zone has several industrial zones and offer access to an enormous consumer market across West Africa. Administratively, the proposed project site is located in Ibeju-Lekki Local Government Area (LGA) of Lagos State. The project site is located in the eastern part of the LGA close to the Atlantic Ocean. The three identified host communities are Ilege, Imobido and Tiye, however only two of the communities are directly linked to the project site namely Imobido and Tiye communities (**Figure 4.16**), Epe local Government Area is to the north of the project site, while the Atlantic Ocean is the southern boundary of the LGA.

Figure 4.16: Satellite image of the project affected Communities

Community history/ ethnography, structure and Settlement pattern

The Yoruba are the second largest ethnic group in Nigeria, comprising approximately 21 percent of the nation's population (CIA World Factbook, 2002) and traditionally residing in the western region. The proposed project is located in Lagos State, one of the six constituent southwestern states, where the Yorubas are the major ethnic group. Sub-ethnic groups however, also exist. The indigenous people of Lagos state are the Yoruba sub groups of the Aworis in Ikeja, the Eguns in Badagry, the ijebus in Ikorodu and Epe, while Lagos Island consists of an admixture of Benin and Eko Aworis as well as repatriated Yorubas and other immigrants (www.onlineNigeria.com posted May 2, 2003). The people within the proposed project area are mainly Ijebu speaking who have settled in this local government area in 40 autonomous communities. Nineteen of these are prominent and theses are: Aba Onigangan, Abijo, Adebu, Akodo, Apakin and Agbowa ijebu. Others are Awoyaya, Bogije, Debojo, Dongo, Eputu, Eti Afa and Folu. The remaining are: Iberikodo, Ibeju agbe, Idie, Igbolomi, Igbekodo and Igando-orudu. In all, there are one hundred and fifty-five towns and villages here.

Although a higher proportion of the population in the project area is indigenes, other people from different parts of the country were found cohabiting with the indigenous population. The local government has an attractive ambience courtesy of its natural beaches and availability of land for development.

The settlement system in Lagos state is obviously dominated by metropolitan Lagos which incorporates not less than 16 of the 20 Local government areas (LGAs): Agege, Ajeromi – Ifelodun, Amuwo-Odofin, Alimosho, Apapa, Eti –osa, Ifako-ijaiye, Ikeja, Kosofe, Lagos Island, Lagos Mainland, Mushin, Oshodi- Isolo, Somolu, Surulere and part of Ojo.

Ibeju – Lekki local Government, the host of the Lekki Free Zone (LFZ) and industrial establishments such as the proposed Longrich production project has as its main town, Tiye, Ilege, Akodo, Idaso Imobido and others. The headquarters of the local government is Igando Oloja. Apart from Ibeju, Lekki and Akodo with some semblance of urban settings, most of the village communities are evidently rural both in terms of their physical layout and housing patterns. Houses are established along old and now new emerging transportation and communication routes but owing to some land environmental constraints (rainy season flooding), the settlements also possess some nucleated pattern.

The identified project-affected communities and population belong to the Ijebu sub-group. The language of the majority of the people in the project-affected communities (PACs) is Yoruba but some non-Yoruba ethnic groups are also present, although very much in the minority. Not only are most of the households Yoruba, the Yoruba language (Ijebu dialect) is the most widely spoken language in the surveyed communities, even among some minority ethnic groups.

Table 4.34: Communities within the Proposed Project Area

S/N	Communities	Settlement pattern and status	LGA
1	Tiye	Rural, permanent	Ibeju-Lekki
2	Imobido	Rural, permanent	-do-

Source: GIEC/ Bell Fieldwork March (2020).

All the communities consulted in the proposed project area have a common ancestry. Their oral history shows that their common ancestor migrated from the popular Ijebu land, between the 13th and 14th century AD, and settled in Ibeju – Lekki. Interactions with the Baales of Tiye, and Imobido communities revealed that, the communities were founded by their fore fathers; the land was therefore inherited from their fore fathers who had migrated from Ile-Ife / Ijebu-ode and settled there. They were into fishing, farming and hunting.

In terms of settlement pattern, they all conform to two basic settlement patterns: linear and nucleated. Formerly rural villages, settlements were linearly situated along the many roads and transportation routes that traverse the area, establishing housing on the basis of lineage and kinship.

Plate 4.19: Un-tarred Road Leading to Tiye community and its structures (Photographed March 2020)

Plate 4.20: Earth road leading to Imobido Community (Photographed March 2020).

Community Power Structure and Traditional Governance

Although the traditional political and social systems vary in different parts of the Yoruba regions, each town usually has a leader (Oba), who achieves his position in one of the three following ways: inheritance, participation in title associations, or personal selection by an Oba already in power. A council of chiefs usually assists the Oba in his decisions. Title associations, such as the *Ogboni*, also play an important role in assigning and balancing power within the cities (University of Iowa, Department of History, March 1999). Supplementing the traditional governance structures are other civil society institutions that participate in some forms of governance. These systems also help identify the critical stakeholders, with whom consultations are normally held for development projects, including those such as the proposed project area that involve land acquisition and compensation issues.

With particular reference to the proposed project environment, the PACs are organised formally under the Ibeju- Lekki Local Government Authority local jurisdictions with headquarters at Igando Oloja. Two levels of political organisation are recognised in the project area community; the formal governmental and the local/traditional administration respectively. At the formal governmental level, the Lekki Free trade Zone project area and proximate communities are under the local jurisdiction of the Ibeju-Lekki Local Government Council (LGAC), with its headquarters at Igando Oloja. The Tinubu led administration created what became known as Local Council Development Authority (LCDA'S), with the aim of bringing governance and development closet to the people, these were not recognised by the Federal Government. In this sprit, Lekki was excised from Ibeju – Lekki as an LCDA with administrative headquarters at Lekki.

Traditionally, all the project-affected communities have similar systems of traditional governance, organized as it were into hierarchies of administration: the *Oba* (or King) at the apex, his council of chiefs, the *Baales* for each individual community/village, also with elders and a Council of Chiefs, Family heads, the community development associations (CDA), Youth group, and the women's group respectively (**Figure 4.17**). The *Oba (or kabiyesi)* which is the highest traditional stool controls a group of communities under her domain, and at the individual village/community level, the *Baale* oversees the daily affairs of the community on behalf of the Oba. The traditional administrative system deals more on issues relating to the peoples' culture and values. They are therefore the custodians of the peoples' cultures and values and are important and revered institutions in the settlement of land dispute, inter and intra community disagreements.

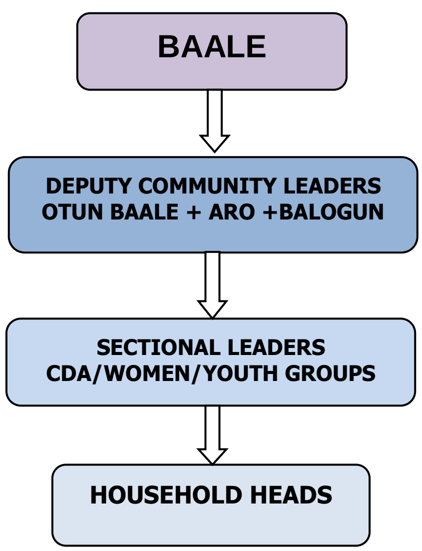


Figure 4.17: Traditional Leadership Structures in Ibeju-Lekki

The Oni Lekki of Lekki **Oba Liafeez Muyiwa Ogunbekun** is the paramount ruler of the of the project environment, supported by council of chiefs (Baale) who oversees other villages under its jurisdiction. Each of the villages also has a council of elders who are at the helm of affairs for each village. The council deliberates on vital issues that are brought before a ''general meeting'' constituted of all male and female members of the villages for final approval before implementation. There is a women group in charge of feminine affairs in the villages. Women do not exert much political power but they play important role in ceremonies. Cooperative and socio-cultural organization provide financial assistance to the members.

At the Tiye, and Imobido communities, the governing structures are the same; there is a *Baale* as village head (born and brought up in the villages and thus long residence time and a member of the ruling houses), a deputy *Baale,* and then member 'Council of Elders', with women leaders as members. The council meets regularly to deliberate on community issues and also make decisions. Final approval is sought when a "general community meeting or assembly'' is summoned with a 'gong' at the compound of the *Baale*. The youth and women groups complement the efforts of the ''Elders Council' and hence smooth governance in the communities.

Conflict Resolution and Community cohesion

As vividly illustrated in the preceding narratives, conflicts and contentious issues are resolved in the area by collaboration among the various organs. In the event that a community member runs foul of the law, the issue is handled from the lowest rungs, including family heads/chiefs, youth or women group, and the resolution terminates at the feet of the community head (Baale), depending upon the nature and gravity of the offence. The deviant is punished according to the gravity of the offence; smaller crimes could lead to monetary fines, while serious could involve meting out serious punishment, including being given up to the police.

Conflict is common in the local government area as a whole and in the project area as well. Types of conflict include:

- Conflict between communities and companies
- Conflict between communities
- Conflict within the communities and
- Conflict between communities and government

Causes of conflict between communities and companies include:

- Land disputes
- Agitation for employment

- Non-payment of compensation
- Non-compliance with court rulings and orders
- Perceived intimidation of the communities
- Perceived “divide and rule tactics”
- Ineffective communication channels

The conflict resolution strategies of communities in the study area are through dialogue in special meetings summoned by the elders-in-council, council of chiefs, elders and chiefs assembly, religious leaders, juju priests, youth council and women groups. Issues could either be discussed at the lower levels of family, age grade and women or taken directly to the community leadership.

In addition, appeals and summons are common processes utilized at community level. Issues are referred to the police and courts, when they are criminal offences that are mandatory to be reported and when the resolution of the conflict overwhelms community leadership.

4.3.9.4 Demographic Characteristics

The population distribution of the host communities of the LFZ is not available, from the National Population Commission’s (NPC) office because the result of the 2005 household surveyed released by the Commission did not include a breakdown of population by communities. However, estimates of the population of the Ibeju Lekki LGA where the LFZ is located shows that the population of the LGA increased from 24,937 in 1991 to 117,793 in 2006, to 130,230 in 2009, 143,223 by 2012 and to 162,200 in 2016. Ibeju-Lekki is a local government area in Epe Division of Lagos State, Nigeria. The headquarter of the LGA was formally located at Akodo and was later shifted to Igando Oloja due to the creation of Lekki Council Development Area.

Age and Gender

The ages of respondents in the communities ranged from 20 to 85 years; the youngest (21 years) being a female from Tie and the oldest, a 68-year-old male from Imobido community. The majority of respondents (39 percent) were males. Reported household sizes ranged from 1 to 9 persons. The higher end of the spectrum comprised households with extended families. These types of households were more prevalent in all the communities. The largest household was an extended family in Tiye. The average size of all the households surveyed was 3.5 persons. Male accounts for roughly 60 per cent of the total household population. The working age group (15 to 64 years) was the largest proportion of the population (69 percent). The predominance of this economically active age group could be explained in terms of the closeness of the community to not only the LFZ but also Victoria Island, which is a major job-pull centre. The need to get jobs and the desire of a number of people to live close to their work place has fueled a large-scale migration of people into the neighbourhood. The communities may still witness massive in-migration when the ongoing Dangote Refinery in the vicinity of the LFZ is completed. Dependents (residents younger than 15 or older than 64 years) accounted for about 31 per cent of the household population with persons 65 years and over representing 13 per cent.

Marital Status and Household Size

The marital status among respondents is such that 55.3% are married, 40.4% are single while the remaining 4.3% are either widower or divorced (**Figure 4.18**). A strong correlation was observed between age of respondents and marital status. This is because more than 65% of respondents between the ages of 26 and 50 years are all married. About 10% of the respondents that are not married indicated that their inability to get marry on time is due to their insufficient take-home pay. More than 30% of the respondents also indicated that they got married after they moved to into the community. However, the average number of children per family among the respondents ranges from 4 to 8. Based on the data obtained during the survey, many of the respondents showed preference for between three and five children. Government would need to increase the awareness campaign for smaller family size in this community because 82% of the respondents indicated that their household size is more than 4 persons. This figure is still relatively large considering the various family planning programme of government.

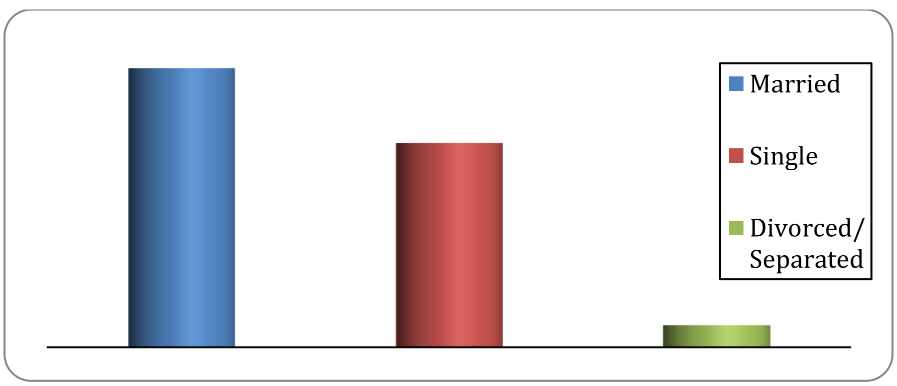


Figure 4.18: Marital Status among the Respondents.

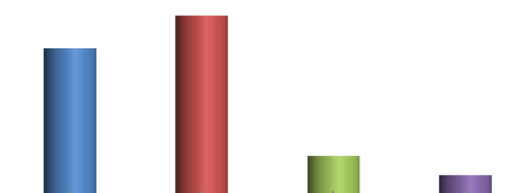
Religion and Ethnic Composition

Religious attachment is an expression of the believe system of individuals and this can affect their interaction with other components of human and social environment. There are more Christians (52.0%) than Moslems (47.0%), while other religious groups accounted for the remaining 1%. These two religions are the two dominant religions in most part of the country and they jointly account for 99.0% of the sampled population. Apart from Muslims and Christians, other religious groups identified from the administered questionnaire include traditional worshippers etc. There are also a number of churches and mosques in this neighbourhood. With respect to the traditional worshippers, some of the gods and traditional festivals include Ota, Obaluaye, Esu, Oro and Obatala. The people claimed that the yearly sacrifice to these gods is all carried out within a single month in a year. In addition, the discussion with the heads of the community shows that it is ceremony that is not violent. Although, some of the respondents declined to disclose their ethnic grouping, nevertheless people in the LFZ host communities are mostly Lagosian. These people and their tenants are therefore mostly Yoruba speaking people from the southwestern Nigeria (Lagos, Ogun, Ondo, Oyo, Ekiti, and Kwara). Despite this seemingly homogenous ethic distribution, there are still pockets of other ethnic groups found in the community. These ethnic groups include Ibo (south-east and south-south geopolitical region) and the Hausa/Fulani from the northern part of the country. These other ethnic groups account for less than 5% of the community population.

Employment, Livelihoods, and Income

Approximately 31.0% of the total working household population are unemployed. A large proportion (60%) reported being self-employed, primarily as farmers and fishermen. The main type of farming practiced is crop production, especially root crops (maize and cassava) followed by green vegetables, okra and pepper. Quite a sizable amount of agricultural production takes place in these communities on small scale as farms are characterized by small yields per size and no access to agricultural credit. Farming is seasonal and limited by generally poor soil conditions and insufficient rains. Traditional small hand hoe is the major implement used by farmers. The main food crops are maize, cassava and yam. A few households in the community are also undertaking subsistence rearing of domestic animals such as chicken, sheep and goat. Fishing is a traditional activity and the main source of livelihood of the majority of people living within the project area especially since they are sea bordering communities. Fishermen found in the community are characterized as artisan fishermen, and net fishing fishermen. The majority of fishers about 70% are using traditional dugout canoes, outrigger canoes and small boats propelled by sails and few propelled by engines. A large proportion of the traditional fishers in the area fish mainly for subsistence and the majority own neither fishing crafts nor fishing gears. Fishing gears includes; beach seine, hand line, and hooks. Much of the population of the host communities of the LFZ engaged in either agricultural or fishing, or related activities such as processing or trading and similar to most of the coastal zone in Nigeria. Small-scale trade and handicraft activities are undertakings to supplement household's incomes. This includes women selling produce such as coconuts, vegetables, fried fish and palm wine and producing crafts such as mats, pottery and some weaving. Coastal forests are an important source of raw materials for carpentry, carving, and weaving. Men are involved in small-scale trades such as tailoring and carpentry. The transportation of people, goods, food, processed fish; handcraft products include raw materials are also conducted by men. A few respondents of Imobido also reported being government retirees. Almost, all respondent who indicated that they are civil servants work full times. Among the three communities, Imobido had the widest range of livelihoods comprising hotel work, construction, small business/shop owner, and Government work. Generally, respondents were of the view that the coming of the company might help to alleviate the unemployment condition in the communities provided the company employs residents of the community.

Respondents were generally unwilling to provide information on their income. From the data obtained, the observed pattern of income distribution is in close consonance with the occupational structure in the project area as 37.6% of the respondents earn less than N20, 000 monthly, 45.9% claimed they earn between N21, 000 and N40, 000 monthly, 10.6% earn between N41, 000 and N60, 000, while the remaining 5.9% claimed that they earned more than N60, 000 monthly (**Figure 4.19**). During the socio-economic survey, it was gathered that the average income for most of the unskilled labour ranges between 5,000 and 15,000 naira monthly. The implication of this is that many of the of the unskilled workers are actually living below poverty line, with transportation expenses accounting for more than 45% of their expenditure. This situation might get worse in the face of the persistent rise in the cost commuting.



	0--20,000	21,000-40,000	41,000-60,000	More than 60,000
Percenatge	37.6	45.9	10.6	5.9

Figure 4.19: Income Distribution in the Proposed Project Area

Social Amenities and Facilities in the Community

With population size of over 162,200 according to 2016 data, only sixteen Junior Secondary Schools (JSS) and nine Senior Secondary School (SSS) with 37 private schools exist in the Local government. This is clear evidence that the available education facilities cannot adequately served the people in this Local Government Area effectively. There are few public and private primary and secondary schools including private schools in the communities. In terms of educational qualification, it was observed that 58.3% of the respondents indicated that they completed primary schools, while 26.8% indicated that they completed secondary schools while 4.1% indicated that they have post-secondary school education in either polytechnics or Colleges of Education. The remaining 10.8% indicated that they do not have any formal education (**Figure 4.20**). Most people in this category are Okada riders and few artisans and some individuals older than 70 years old.

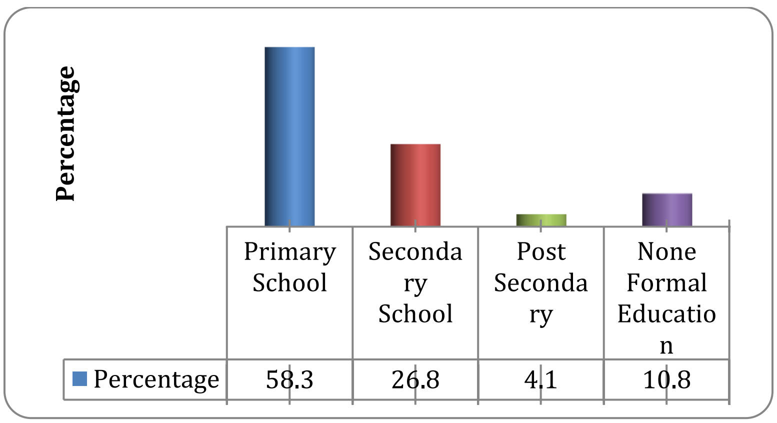


Figure 4.20: Educational Status Among Respondents in the Study Area

Health Care Facilities

There were about nine (9) Primary Health Care Centre and 58 private health care facilities in the LGA as at 2006. Out of these numbers, 32 were private health care facilities, 4 were dental hospitals, 10 were optical hospitals 9 were Medial Laboratories and 3 were traditional healing homes. The government owned facilities are not evenly distributed within the LGA, while private health care centre, though many, tend to concentrate in view places where the rich and affluent lives. Currently the greatest health threats in the communities are malaria, diarrhea, vomiting and rashes, which have been attributed to unhygienic environment in which the people live as well as their closeness to the sea. These are diseases associated with contaminated drinking water. Malaria is rife in this area, with a high incidence noted among children and women populations.

Household Energy Sources

Greater percentage of the houses in the three communities is detached/ individual structures mostly built of concrete/block-wall or a combination of these and mud or wood. Of the total surveyed households, 73.02% structures are cemented, followed by 21.84% brick made, 4.31% mud made, 0.42% others, 0.28% made of mud and cement and 0.145 of wooden houses (**Table 4.35**). There is electricity in all the three host communities. However, residents claimed that it is highly irregular and epileptic. More than 34.6% indicated that they depend of generators for energy supply. Absence of electricity could be responsible for low level of the development observed in the communities. In all the communities, electricity is their main source of lighting but it is hardly used as fuel for cooking. As far as the electrification is concerned, the survey revealed that most (89.64%) of the households have electricity while the remaining 10.22% reported not having any electricity connection. The majority of households used firewood, charcoal or kerosene or a combination of these as fuel for cooking. No industrial establishment was observed in the neighbourhood during the survey except those located within the LFZ. Regular electricity supply to these neighbourhood would replace or reduce the consumption of woody biomass and petroleum products used for cooking and lighting, respectively. This is because most of the respondents indicated that they used fuel wood for cooking and coal to iron their dresses.

Table 4.35: Type of Housing Construction Materials Used

Type of Construction	**Per cent**
Mud Made	4.31
Brick Made	21.84
Cemented	73.02
Wooden	0.14
Combination of Mud and Cement	0.28
Others	0.42
Total	100.00

Sources of Water

The survey indicated that the majority of households in all the communities use mainly borehole and shallow well water as their primary source of water for domestic purposes. Overall, the quality of the borehole and shallow well was rated as good and generally reliable. Some households also used Rainwater harvesting tanks/containers. A few households also reported using a combination of different water sources. Some households were of the opinion that borehole water was a better and a more hygienic source compared to water from shallow well. Some of the respondents also noted that shallow wells are indispensable because when there is no electricity to pump water from borehole, shallow well provide the needed water for household needs. Therefore, water supply to the communities is also affected by inadequate electricity supply as some of the respondents claimed that they need electricity to pump water from their shallow and deep well. However, because of the inadequate electricity supply, people could not use the borehole as effectively as they should. Generally, improvement in electricity supply would results in an increase in commercial activities while boosting the production of small and medium industries including laundry service and tailoring etc. In brief, it would facilitate all rounded economic growth in these communities and create employment opportunities for the people, including women, thereby increasing income levels and reducing poverty.

Accessibility

Accessibility to and out of the proposed project site is through the Lekki-Ajah-Epe Express road. The Lekki-Ajah-Epe Express road is a dual carriage road, although, the road is not wide enough to support the traffic generated due to the increasing number of people moving to this area. It is common to experience minimal traffic jam in the morning and evening when people are going to work or returning from work. To avoid this traffic bottleneck, many of the residents claimed that they leave their house early before the traffic build-up and they do not return until about 9.00pm at night. It can therefore be concluded that the relative difficulty often experiences in getting to the area is because of its position along this busy expressway. The presence of many buses plying this route is largely responsible for the transportation congestion that often characterized the area particularly in the morning and evenings. Apart from the Taxi cab and busses that ply this route, motor cycle popularly refers to as “Okada” also provides door-to-door services particularly for those residents that are not mobile. Many people prefer this mode of transportation because of its size as it does not require a large space to move. This particularly makes it easy to penetrate locations where there is traffic congestion. However, one major problem associated with this mode is the low level of safety. This has been attributed to the reckless manner in which the cyclists ride motor bicycle.

Community Expectations on the proposed project Development

Community members in the project environment area have high expectations regarding the proposed project activities with particular reference to the associated positive effects; overall social issues, including increased and more permanent employment opportunities to indigenes at the skilled, semi-skilled and unskilled levels as company’s operations enlarges and as opportunities emerge, economic empowerment of youth and women group through skills training/acquisition and micro-credit programs; vendor services/minor supplies (contractor), compensation for resource losses, scholarships and provision of infrastructures, e.g., electricity, water, roads, among others are expectations of the community. The individual community expectations and needs are as set out in summary **Table 4.36.**

Table 4.36: Expectations and Priority Needs of LFZ's Project Affected Communities

Communities	Needs/Demands and Expectations
Tiye	✓ Provision of infrastructures, including, roads and drainages, potable water supplies of easy reach to population, building of a cottage hospital/health center and provision of educational infrastructures (buildings for primary school and a new post primary school). ✓ Provision of public toilet facilities ✓ Provision of employment opportunities for the teeming youths shall be greatly appreciated.
Imobido	✓ More employment opportunities for the youths of the community. ✓ Provision of health care facilities for the community ✓ Royalty for the community. ✓ Any benefit meant for the community should be discussed with the community members.

In general, the community engagement revealed that the community needs includes the following**:**

- Provision of job opportunities for the teaming youth population was a major need in all the communities. This was obvious during the consultation held at the Lekki Office. The community heads unanimously indicated that they would want the company to employ workers (not just casual/ temporary workers) from the host communities.
- The respondents want the Lagos State government to improve water supply in the communities. It is believed that this will help to improve their health condition. Furthermore, provision of additional health and education facilities in the communities was also identified. According to the respondents, the average distance travel to utilize both health and educational facilities is more than 1.0 km and in view of this, some of the would-beneficiaries of such facilities are marginalized. They therefore want the government to assist them in the provision of these essential facilities.
- Improvement in road condition is the third most important request of the inhabitants. The inhabitants want the present government to help them with regards to the maintenance of their community roads so that accessibility to and from the neighbourhood can be much better.

CHAPTER FIVE

ASSOCIATED AND POTENTIAL IMPACTS

5.1 INTRODUCTION

This chapter discusses the potential and associated impacts of the proposed project on the environmental, health and socio-economic characteristics of the project area. It equally presents an overview of the impact assessment methodology as well as results of impact screening and detailed qualitative and quantitative impact assessment.

The assessment covers all aspects of the project from preconstruction, through construction and operations as well as decommissioning of the project.

A key to successful Environmental Impact Assessment (EIA) is the use of appropriate impact identification and prediction methods. Generally, a number of impacts assessment methods have been developed over the years and new approaches continue to emerge. All good methods have certain elements in common, which are widely accepted as essential to EIAs. Any good and widely acceptable impact assessment method (or technique) should address, at least, the following:

Comprehensiveness

The premise of a sound impact assessment is to ensure that all impact(s), no matter how remote their chances of occurring, are comprehensively assessed and discussed. Thus, a sound impact assessment method must, as a minimum, be capable of detecting the full range of important elements and combinations of elements. It must be innovative in considering possibilities, focusing not only on established possibilities typically associated with planned activities, but also directing attention to novel or unsuspected effects or impacts.

Selectiveness

In spite of the need for comprehensiveness, impact assessment documents can become unnecessarily bulky if undue attention is paid to and undeserved effort dissipated on trivialities. Thus, while not completely discountenancing negligible and/or insignificant issues, a good impact assessment method must be able to focus attention on major factors. In this regard, such a method must be designed to be able to eliminate, as early as possible, un-important impacts, by providing a basis for determining the potential significance of an impact, even at the early stages of assessment.

Exclusiveness

It is very easy to double-count, or duplicate impacts. For instance, loss of vegetation would necessarily imply loss of wildlife habitat. Thus, while this may not necessarily mean destruction of wildlife (since they can migrate), double counting could occur, if loss of vegetation is regarded as a separate impact from destruction of wildlife habitat. To this end therefore, a sound assessment method must make concerted efforts to avoid such occurrences, even though experience has shown that this is difficult because of the many interrelationships that exist in a natural environment.

Confidence

The level of confidence about the possibility of an impact occurring or not occurring is important in the overall rating of the significance of an impact. Therefore, in assessment, a sound method must have provision for indicating confidence levels for each impact predicted. Therefore, adequate information must be provided on assumptions made, so that they are open to critical examination, and if necessary, alterations to suit realities on ground.

Objectiveness

A sound assessment method must exclude bias, as much as possible. For instance, a Muslim would regard the removal of wild pig species from an environment as a positive impact, based on religious consideration. However, this may not necessarily be true from an ecological viewpoint. Therefore, provisions must be made in any method, to remove subjectivity, by including objectiveness. Several Agencies, including the Lagos State Ministry of Environment and the Federal Ministry of Environment (FMEnv) have emphasized this. Objectivity minimizes the possibility that the predictions automatically support the preconceived notions of the promoter and/or assessor. These prejudgments are usually caused by a lack of knowledge of local conditions or insensitivity to public opinion. A second reason for objectivity is to ensure comparability of EIA predictions amongst similar types of actions.

Several methods are generally used for impact prediction and analyses. Some of the more popular and internationally accepted options include the following:

- Checklists
- Matrices
- Flowcharts and Networks
- Mathematical/Statistical models
- Overlays using maps and GIS

It is obvious that no single method can have all the attributes described above, thus, in order to optimize on impact assessment, different groups have over the years evolved methods that have the positive aspects of some or all of the options listed above. For this proposed project, a method was evolved that incorporated all the foregoing. The methodology is summarized in **Figure 5.1**, while a description of the process and the results obtained from applying the method is described in the following sub-sections.

Figure 5.1: Methodological Process for Impact Assessment

Step 1

Identification and description of project phases associated activities and their possible interaction with environmental, social and health components

Step 2

Preliminary identification of potential impacts on biophysical, social and health components of the environment.

Step 3

Screening for impact importance; elimination of activity/environment interactions producing no effects. Selection of focus impacts for further assessment.

Step 4

Detailed assessment of selected focus impacts under the following bases:

Nature: Positive or Negative; direct or indirect

Magnitude: Qualitative and Quantitative

Extent: Qualitative and Quantitative

Frequency

Step 5

Final assessment and assignment of overall impact significance levels based on level 4 results and application of objective impact severity criteria and likelihood. Identification of impacts that requires mitigation

5.2 PRELIMINARY IDENTIFICATION AND SCREENING OF ENVIRONMENTAL IMPACTS

In line with widely recommended impact assessment approaches (FMEnv, 1995; UNEP, 1996; Canter, 1996; DPR 2002, Lohani *et al*., 1997) the first level of impact assessment involves the preliminary identification and screening of potential environmental impacts from anticipated activity-environment interactions based on an understanding of the activities and the nature of interaction with environmental components. A modified Leopold matrix (Leopold, 1971) is then used for the identification and screening. The matrix arrays project activities against environmental (biophysical, socio-economic and health) components, and supports a methodical, comprehensive, and objective identification of the impacts each project activity may have on each biophysical, socioeconomic and health component.

Impact identification is based on Wathern (1988), who defines an impact as “having both spatial and temporal components and can be described as the change in an environmental parameter over a specified period within a defined area, resulting from a particular activity compared with the situation which would have occurred had the activity not been initiated”.

To further guide the identification and screening of impacts using the matrix, established environmental impact indicators or indices are developed, for each of the environmental interaction categories. Impact indicators are the observable or measurable parameters of each environmental component that can be directly or indirectly linked to changes in environmental conditions. **Table 5.1** gives the project phases and the summary of related activities. **Table 5.2** gives the specific environmental components and sub- elements to be used as indicators while **Table 5.3** presents a description of the indicators.

Table 5.1 Project Phases and Associated Activities

PHASES	ACTIVITIES
Pre-Construction	Mobilization of equipment and men to site
	Bush Clearing activities
	Setting up of camp site
	Site preparation
Construction Phase	Movement of the construction equipment and men for construction activities;
	Actual construction of the building and ancillary building
	Installation of machineries and equipment
	Wastes and Emission generation and handling
Operational Phase	Transportation of Raw material Pipe threading and Valve assembly, repair, painting and testing Storage and Stacking of finished products Delivery of finished products Waste storage, logging, and collection for disposal by contractors Maintenance operation works;

Table 5.2: Activity-Environment Interaction Categories and Environmental Components

Environment	Environmental and Health Components
Biophysical	Soil Quality
	Surface Water
	Groundwater Quality
	Air Quality and noise levels
	Vegetation and wildlife
Socio-economic/Human	Population Characteristics
	Livelihoods
	Socio-cultural institutions
	Community Infrastructure/health and Safety Issues
	Conflicts

Table 5.3: Environmental Components and their Impact Indicators

Environmental Components	Impact Indicators
Biophysical	
Climate	Temperature, Rainfall, Relative Humidity, Wind speed and direction.
Vegetation	Changes in vegetation abundance and species composition as well as biomass productivity
Groundwater Quality	Changes to basic water quality indices such as pH, conductivity, heavy metals and total hydrocarbons
Air Quality and noise levels	Changes in background values of basic air quality indices such as TSP, hydrocarbons, NOx, SOx, Co, etc. Increase in background ambient noise levels
Wildlife	Changes to species composition and abundance
Socio Economics	
Population Characteristics	Changes in population indices – Total population, gender ratio, age distribution
Livelihoods	Improvement or pressure on existing urban/rural infrastructure including waste handling facilities
Transport Infrastructure/Health and Safety	Impact on traffic congestion road structure and health problems among neighboring communities/residences.
Conflicts	Communal strife between project workers and neighboring communities

The modified Leopold impact matrix consists of a horizontal list of biophysical, socioeconomic and health environmental components that could be affected by the proposed project activities versus a vertical list of project activities, which represent environmental aspects, or “sources of impact,” associated with each project phase. Environmental aspects are elements of an activity that can or will interact with the biophysical, socio economic and health conditions within the area of influence.

Entries in the matrix cells represent the nature and *preliminary* ranking of the severity of the impact. Ranking of the severity is based on the following scale and symbols:

Major - (2)
Minor - (1)
Negligible and/or no effect– (- (i.e., a dash)
Positive (+)

For this preliminary impact assessment stage, the impacts are defined as:

A **Major impact** is one that would affect a large (higher than 40%) amount of a resource and or have a relatively large footprint and persist for a long time or is irreversible.

A **Minor impact** is one that could either affect a large (as defined above) or moderate (less than 40%) amount of an affected resource, has a mid to long-term effect but is most likely reversible.

A **Negligible impact** is one that may occur but based on experience, available scientific information and expert knowledge will have no measurable effect on the environmental component.

A **Positive** impact is one that adds a measurable benefit to the environment. All number entries denote negative impacts. Cells with Positive sign (+) and numbers) indicate a positive and negative impact for the specific activity- environment interaction.

All potential impacts, whether likely or unlikely, are also considered at this stage. The likelihood of an impact is further assessed in the *detailed* impact evaluation.
Identification and screening of impacts relied on the following:

Documented impacts of similar projects in similar environments
Consultation with experts
Professional judgment.
Results of earlier environmental studies carried out in the area

Spatial boundaries of interaction were decided based on specialist knowledge and documented experience of the specific activity-environment interaction.

5.3 DETAILED ASSESSMENT OF IMPACTS (STEP 4)

The preliminary identification and screening of environmental impacts resulted in a group of focus impacts (those with impact rankings of 1 and 2), which were further assessed in terms of severity and significance. Impact severity and significance criteria used at the next stage relied on a number of resources and tools including the following:

- Federal Ministry of Environment, (FMEnv) EIA Guidelines

- Overlaying project components on maps of existing conditions to identify potential impact areas and issues
- Environmental Baseline Studies conducted specifically for this project
- Consultation with Nigerian experts and residents
- Results of earlier studies carried out on the project.
- Experience from similar projects in Nigeria and worldwide
- Published and unpublished documents (such as *The World Bank Environmental Assessment Sourcebook* and other authoritative texts on performing environmental impact assessments) providing guidance on performing impact analysis for industrial development activities
- UNEP ESIA Training Resources Manual (1996).
- European Commission Guidance on EIA EIS Review (*European Commission, 2001*)

The approach applied to this proposed Pipe threading and Valve Assembly facilities project EIA also incorporates the following key elements:

IMPACT SEVERITY EVALUATION

A number of criteria are used to assess the severity of the environmental (biophysical, socio economic and health) impacts that were not screened out in the earlier steps.

The severity criteria set forth in this section are widely applicable to all types of impacts identified, including impacts that can be expected from the project and impacts resulting from emergencies. Several types of potential consequences (or impacts) were considered for all project stages where applicable:

- Natural (physical, chemical and biological) environment
- Socio-economic environment
- Health and Safety of the public or workers

The detailed assessment of impacts also involved evaluating the potential effects of project activities on the same impact indicators earlier defined but at a greater detail. Impacts were assessed as to whether they are positive (beneficial) or negative (detrimental).

Five impact severity evaluation criteria were applied to this study: **Magnitude, Duration, Frequency, Areal Extent,** and **Sensitivity of the Receptor.** Within these five criteria, impacts were also evaluated with respect to whether they will result in cumulative effects, incremental changes, or indirect (secondary) effects. The overall impact evaluation considers not only the potential severity of the impact but also the likelihood of its occurrence.

Magnitude is defined as the quantitative intensity of the impacts and can be measured as the percentage of a resource or a population within the area of influence that may be affected by an impact. The definitions of “high,” “medium” and “low” with respect to Magnitude may vary depending upon the specific receptor. The Magnitude of an impact may be characterized as follows:

- High – large amount of the resource or population is affected; an easily observable and measurable effect
- Medium – moderate amount of the resource or population is affected; generally measurable and observable effect
- Low – small amount of the resource or population is affected; a low magnitude impact may be within the range of normal variation of background conditions
- Negligible – the amount of resource or population affected is unnoticeable or immeasurably small

Magnitude may also be defined with respect to quantitative or semi-quantitative criteria, if available and applicable, (e.g., level of noise impact in units of decibels). The Magnitude of an impact may be characterized as follows:

High – greater than the quantitative or semi-quantitative criteria
Medium – at the quantitative or semi-quantitative criteria
Low – less than the quantitative or semi-quantitative criteria
Negligible – impact not detected or at background conditions

Duration is defined as the time that is estimated for a population or resource to return to conditions present prior to the impact. The duration is calculated from the time the impact begins or which may coincide with the start of the activity that causes the impact. The Duration of an impact may be characterized as follows:

High –long-term impact (recovery would not occur within ten years)
Medium –moderate-term impact (recovery time between one year and ten years)
Low –short-term impact (recovery time within less than one year)
Negligible – impact or recovery is very short term or immediate

Characterization of the Duration of an impact as low, medium, or high includes consideration of the Degree of Reversibility of the impact. Impacts for which the Duration is classified as high, as defined above, would be irreversible impacts.

Frequency is defined as the number of times an impact is expected to occur over the life of the project. The Frequency of an impact may be characterized as follows:

- High – continuous impact: Impact will occur continuously throughout the life of the project (e.g., continuous process wastewater discharge)

- Medium – intermittent impact: Impact will occur intermittently over the life of the project (e.g., dredging for sand, selling the dredged sand, etc.).
- Low – rarely occurring impact: Impact will occur a very limited number of times (e.g., construction impacts).

There is no "negligible" category for frequency because impacts with no frequency would not occur and were screened out.

Areal Extent refers to the potential areal extent of an impact and may be quantified in units of area affected (e.g., square kilometres). The Areal Extent of an impact may be characterized as follows:

High – impact to the national, regional, or global environment (e.g., greenhouse gas emissions)
Medium – impact to the general vicinity of the project site or study area
Low – impact limited to the immediate vicinity of the activity or occurrence that results in the impact
Negligible – impact limited to a very small part of the activity area

Sensitivity of the Receptor refers to economic, social, and/or environmental/ecological importance of the receptor, including the receptors' intrinsic sensitivity, reliance on the receptor by people for sustenance, livelihood, or economic activity, and to the importance of direct impacts to persons associated with the resource. Impacts that directly affect people or vital natural resources are deemed to be more important than impacts that indirectly affect people or vital resources.

The Sensitivity of the receptor criterion also refers to potential impacts to Environmentally Sensitive Areas (ESAs) and impacts to species, including loss of endangered species, effects of introduction of invasive species, and similar environmental/ecological impacts. The intrinsic sensitivities of a receptor species and actions that alter the function of the receptor are also considered. Sensitivity of the Receptor may be characterized as follows:

High – receptor is of high economic, social, and/or environmental importance and or has an intrinsic sensitivity (including vulnerability and exposure) to the specific impact (e.g., fresh water resources and mangroves).
Medium – receptor is of moderate economic, social, and/or environmental importance and is not particularly vulnerable and/or exposed to the impact.
Low – receptor is of low economic, social, and/or environmental importance and is not vulnerable and/or exposed to the specific impact.
Negligible – receptor is not of economic, social, and/or environmental importance or is not sensitive to impact.

These significance criteria are applied to each of the potential impacts initially identified during the screening process to determine whether they would likely be **negligible**, **minor**, **moderate**, or **major**. The impact assessment at this stage takes into consideration design mitigation measures. Those issues determined to be inconsequential or not applicable after consideration of the design mitigation measures are eliminated from or "screened out" from further consideration.

To reach an overall impact severity rating for each impact assessed, the five impacts severity criteria mentioned above are further aggregated using impact severity matrices. Aggregation is at three levels. First, Impact Magnitude and Areal Extent are combined to arrive at a rating for the Impact Quantum (Impact Quantum is a function of the magnitude and areal extent as earlier defined), while Duration and Frequency are aggregated to give the overall Temporal Effects. Impact Quantum and Temporal Effects are then combined and their resulting aggregate assessed in terms of sensitivity to arrive at the overall impact severity. **Figures 5-2** to **5-5** show the aggregation process.

A qualitative and where possible, quantitative discussion of the potential for cumulative effects is then used to further qualify the impact based on knowledge of other attendant or anticipated stress factors.

IMPACT QUANTUM				
Magnitude	**Areal Extent**			
	Negligible	**Low**	**Medium**	**High**
High	Low	Medium	Medium	High
Medium	Low	Low	Medium	High
Low	Negligible	Low	Medium	Medium
Negligible	Negligible	Negligible	Negligible	Low

Figure 5.2: Impact Severity Matrix for Impact Quantum

TEMPORAL EFFECTS				
Frequency	**Duration**			
	Negligible	**Low**	**Medium**	**High**
High	Low	Medium	High	High
Medium	Negligible	Low	Medium	High
Low	Negligible	Low	Low	Medium

Figure 5.3: Impact Severity Matrix for Temporal Effects

IMPACT QUANTUM AND TEMPORAL EFFECTS				
TEMPORAL EFFECTS	**IMPACT QUANTUM**			
	Negligible	**Low**	**Medium**	**High**
High	Low	Medium	High	High
Medium	Low	Low	Medium	Medium
Low	Negligible	Negligible	Low	Low
Negligible	Negligible	Negligible	Negligible	Low

Figure 5.4: Impact Severity Matrix for Quantum and Temporal Effects

IMPACT QUANTUM AND TEMPORAL EFFECTS				
SENSITIVITY	**IMPACT QUANTUM AND TEMPORAL EFFECTS**			
	Negligible	Low	Medium	High
High	Minor	Moderate	Major	Major
Medium	Minor	Minor	Moderate	Major
Low	Negligible	Negligible	Minor	Moderate
Negligible	Negligible	Negligible	Negligible	Minor

Figure 5.5:Overall Impact Severity Rating Matrix

IMPACT LIKELIHOOD EVALUATION (STEP 5)

To further assess the significance of the severity associated with each potential negative impact identified in the previous section, likelihood criteria are applied to each negative impact (**Table 5.4**). The likelihood criteria are used to determine whether negative impacts can be prevented, mitigated, or is unavoidable.

It should be noted that the likelihood criteria is applied to the likelihood of the impact occurring and *not* the activity occurring, for example, the sinking of the dredge vessel. Thus the overall severity rating (significance) of a negative environmental impact is a function of its severity as earlier defined and the likelihood of occurrence as defined in **Table 5-4.** For example, a moderate impact that has a high likelihood of occurrence would be more severe than a major impact with a very low likelihood of occurrence. Assigning a significance ranking and a likelihood ranking to each impact allows for semi-quantitative evaluation of the severity of the impact.

Table 5.4: Impact Likelihood Criteria

Likelihood Level	Definition
Very Low	Impact has approximately less than 1 or 2 per cent likelihood of occurring; impact unknown to have previously resulted in similar circumstances in the industry.
Low	Impact highly unlikely, given the controls in place (e.g., between approximately 2 to 20 per cent likelihood of occurring, impact has been known to result, but only very rarely, in similar circumstances).
Medium	Impact could occur infrequently during normal operations, but given a breakdown of the safeguards and controls (i.e. lack of maintenance for a protecting device) it could occur more readily (e.g., between approximately 20 to 70 per cent likelihood of occurring, impact has been known to result in many similar circumstances, but does not result routinely).
High	Given the controls in place, the impact is likely to occur during normal operations (e.g., over 70 per cent likelihood of occurring, impact has been known to result routinely, though not necessarily in all similar circumstances).

Table 5.5: Summary of Impact Severity

	Magnitude	Duration	Frequency	Areal Extent	Sensitivity of Receptor
High	Large amount of resource or population affected; easily measurable OR> than the quantitative or semi-quantitative criteria	Long-term impact (recovery would not occur within ten years**)**	Continuous impact: impact will occur continuously throughout the life of the project (e.g., continuous process emissions from power generating sets and vehicles)	Impact to the national, regional, or global environment (e.g., greenhouse gas emissions)	Receptor is of high economic, social, and/or environmental importance. Has very high intrinsic sensitivity, e.g., sensitivity of juveniles to spills.
Moderate	Moderate amount of resource or population affected; generally measurable, observable OR At the quantitative or semi-quantitative criteria	Moderate-term impact (recovery time between one year and ten years)	Intermittent impact: impact will occur intermittently over the life of the project (e.g., noise emissions from vehicles).	Impact to the general vicinity of the project site or study area	Receptor is of moderate economic, social, and/or environmental importance; has moderate intrinsic sensitivity.
Minor	Small amount of resource or population affected; low magnitude impact may be within range of normal OR Less than the quantitative or semi-quantitative criteria	Short-term impact (recovery time within one year)	Rarely occurring impact: impact will occur a very limited number of times (e.g., construction impacts)	Impact limited to the immediate vicinity of the activity or occurrence that results in the impact	Receptor is of low economic, social, and/or environmental importance; has low intrinsic sensitivity.
Negligible	Amount of resource or population affected is unnoticeable or immeasurably small OR Impact not detected or at background conditions	Impact or recovery is very short term or immediate	Never occurring impact: occurrence of impact is almost impossible	Impact limited to a very small part of the activity area	Receptor is not of economic, social, and/or environmental importance or is not sensitive to impact

The colour coded impact severity matrix presented in **Figure 5.6** illustrates the application of the impact severity and likelihood. The likelihood ranking is placed in the y-axis and the impact significance ranking in the x-axis. The colour codes are also used in the text discussing each impact assessed using this method.

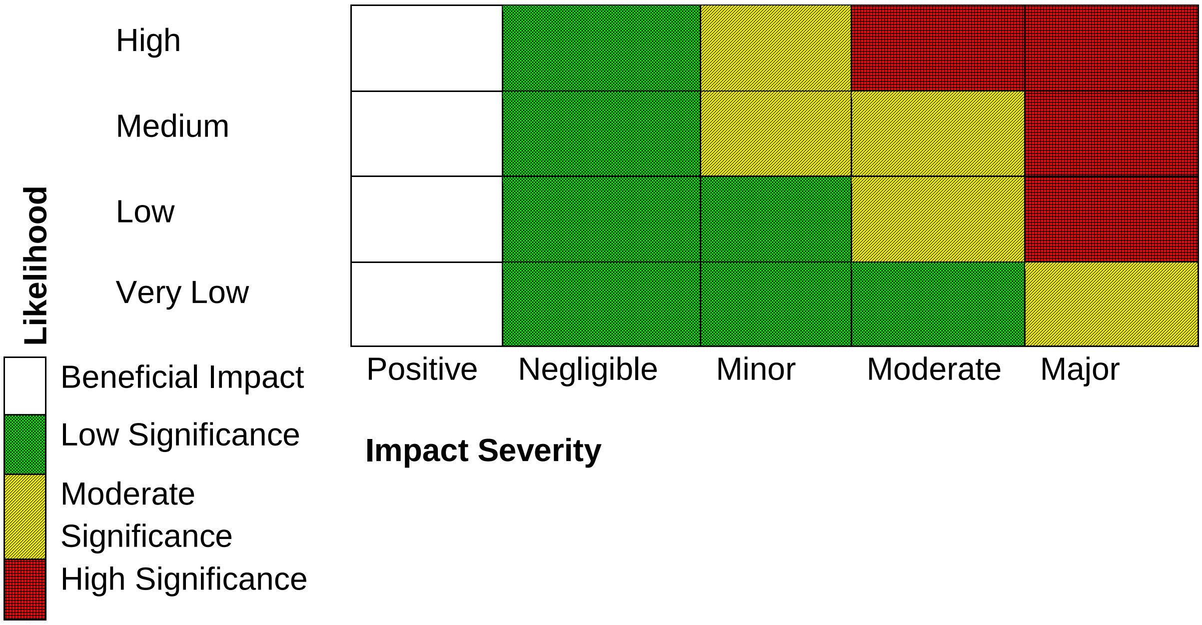


Figure 5.6: Impact Significance Matrix

The overall impact significance level is indicated by the position on the impact significance matrix. For example, impacts placed within the red boxes have a high likelihood of occurrence and serious consequence; thus they have a *high* significance rating. These high-significance impacts become high priority issues for further evaluation or management action. Similarly, impacts in the yellow category are *moderate* impacts, with a medium priority. Impacts in the green boxes are *low* and are given lowest priority. Impacts identified by the white boxes indicate positive or *beneficial* impacts. The criteria and severity matrix set forth in this section is widely applicable to all the types of events and impacts identified.

Table 5.6: Potential Impact Identification, Qualification and Rating

Project Phase	Project Activity	Description of impact	Impact Qualification						Overall Rating High/Moderate/Low
			Beneficial	Negative	Short term	Long time	Reversible	Irreversible	
Mobilization of personnel and equipment	Movement of goods, workers, Equipment etc.	**Biophysical**							
		Increase in noise nuisance		x	x		x		L
		Reduction in ambient air quality		x	x		x		L
		Increase in Traffic gridlocks and loss of man hour		x	x		x		L
		Socio-Economic							
		More pressure on existing infrastructures e.g. roads		x	x		x		L
		Employment Opportunities	x		x		x		M
		Health and Safety							
		Increase in risk of accident/injury due to increase in road traffic		x	X		x		L
		Increase in respiratory disease		x	X		x		L
		Movement of heavy equipment to worksite which may pose danger to public		x	X		x		L
Site preparation/ Construction	- Land Clearance and removal of vegetation - Waste generation - Fuelling for Transportation	**Biophysical**							
		Reduction in biodiversity/Loss of Flora and fauna		x		x		x	H
		Alteration of natural soil profile		x		x		x	L
		Soil Degradation and Soil/Groundwater contamination		x		x		x	M
		Surface water contamination as a result of surface runoff		x	X		x		M
		Increase in noise nuisance due to the usage of earth moving machineries		x	X		x		L
		Reduction in air quality		x	X		x		M
		Solid waste generation		x	x		x		L

		Socio Economics							
		Pressure on existing infrastructure as a result of influx of people		x	x		X		L
		Stress on existing security structure		x	x		x		L
		Cultural shock due to influx of construction workers		x	x		x		L
		Job creation/Business opportunity/economic growth	x			x	x		H
		Improvement of existing infrastructure	x			x		x	M
		Increase in social vices		x		x	x		L
		Health & Safety							
		Injury/fatalities in workforce/communities		x	x		x		L
		Increase in communicable disease (Including STIs)		x	x		x		L
		Increase in respiratory diseases		x	x		x		**L**
		Increase in road traffic volume and risk of accidents/injury		x	x		x		**M**
Construction Phase	Civil Works and construction activities/fuel consumption, transportation and waste generation	**Biophysical**							
		Increase in noise nuisance		x	x		x		**L**
		Reduction in air quality		x	x		x		**M**
		Soil Degradation and soil/ground water contamination		x		x	x		**M**
		Surface water contamination as a result of surface runoff		x	x		x		**M**
		Solid waste generation impact on existing waste disposal facility		x	x		x		**L**
		Socio-Economics							
		Creation of employment for skilled and unskilled Labour	x		x		x		H
		Skills acquisition	x			x		x	H
		Gradual increase in cost of living in nearby communities		x	x		x		M
		Improvement in the welfare of neighbouring communities	x			X	X		M
		Business opportunities/economic	x			X	X		M

		enhancement.							
		Death/ Injury of personnel during construction and loss of equipment due to accidents		**x**		**x**		**x**	M
		Temporary obstruction of human and vehicle movement during transportation of equipment and construction materials		**x**	**x**		**x**		M
		Risk to personnel and equipment security on site and transit to site		**x**	**x**		**x**		L
Operation Phase	Operation of Proposed Pipe threading and Valve Assembly Facilities Facility	**Biophysical**							
		Increase in noise nuisance		**x**		x	x		M
		Reduction in air quality		**x**		x	x		M
		Soil Degradation and soil/ground water contamination		**x**		x		x	L
		Surface water contamination as a result of effluent discharge		**x**		x		x	M
		Solid waste generation impact on existing waste disposal facility		**x**		**X**	**x**		**L**
		Socio-Economics							
		Creation of employment for skilled and unskilled Labour	**x**			**X**	**x**		H
		Gradual increase in cost of living in nearby communities		**x**		**X**		**x**	M
		Increase in population due to migration		**x**		**x**		**x**	M
		Increase in traffic volume and accidents as a result of off-taker influx		**x**		**x**	**x**		M
		Increase in social vices including prostitutions		**x**		**x**	**x**		M
		Improvement in the welfare of neighboring communities	**x**			**x**		**x**	M
		Business opportunities/economic enhancement.	**x**			**x**	**x**		M

		Health and Safety							
		Increase in risk of accident/injury due to transportation of raw materials and finished threaded pipes and valves		x		x		x	M
		Accidental spillage from anti-corrosive paint storages		x		x		x	M
		Increase in respiratory diseases as a result of inhalation of chemicals		x		x	x		M
		Fire outbreak as a result of gas supply to the facility		x	x			x	M
		Death/ Injury of personnel due to work hazards		x		x		x	L

NB: L = Low, M= Moderate, H= High

Table 5.7: Summary of Quantitative Impact for the Proposed Pipe threading and Valve Assembly Facility

Project Phase	Project Activity	Description of impact	Impact Severity	Impact Significance
Pre-construction Phase-Mobilization	Movement of workers, Machineries and equipment	* Increase in noise level within the project from movement of equipment	Negative	Minor
		• Impact on Ambient Air Quality from vehicular emissions conveying the workers and equipment	Negative	Minor
		• Increase in road traffic volume and risk of accidents/injury during the preconstruction phase	Negative	Minor
		• Impact on the existing infrastructure	Negative	Minor
		• Increase employment opportunities	Positive	Medium
		• Increase in respiratory disease	Negative	Minor
		• Movement of heavy equipment to worksite may pose danger to public	Negative	Minor
	Site Preparation	• Impact on the biodiversity • Loss of vegetation and fauna during clearing activities	Negative	Major
		• Alteration of natural soil profile	Negative	Minor
		• Soil Degradation and Soil/Groundwater contamination	Negative	Moderate
		• Surface water contamination as a result of surface runoff	Negative	Moderate
		• Use of earth moving machineries and equipment for the clearing and	Negative	

		other site preparations may lead to increase in the existing noise level		Minor
		• Reduction of ambient air quality due to the dust and particulate generated during site clearing and excavation activities	Negative	Moderate
		• Solid waste Generation-impact on existing disposal facility	Negative	Minor
		• Pressure on existing infrastructure due to influx of workers for the site preparation activities	Negative	Minor
		• Stress on existing security structure	Negative	Minor
		• Cultural shock due to influx of construction workers	Negative	Minor
		• Increase social vices	Negative	Minor
		• Job creation/Business opportunity/economic growth	Positive	Major
		• Improvement of existing infrastructure	Positive	Medium
		• Health & safety-Injury/fatalities in workforce/communities • Increase in respiratory diseases & Communicable disease	Negative	Minor
		• Increase in road traffic volume and risk of accidents/injury	Negative	Moderate
Construction Phase-	- Excavation - Fabrication -Soil compaction -Foundation works	Increased noise level and nuisance due to use of heavy-duty equipment and machineries for construction activities.	Negative	Minor
		Reduction in ambient air quality through dust/ and particulate emissions from excavation and other constriction activities	Negative	Moderate
		Soil Degradation and Groundwater contamination	Negative	Moderate
		Solid/ Liquid waste Generation impact during construction activities on existing disposal facility	Negative	Minor
		Surface water contamination as a result of surface runoff	Negative	Moderate
		Creation of employment for skilled and unskilled Labour	Positive	Major
		Skills acquisition	Positive	Major
		Improvement in the welfare of neighbouring communities	Positive	Medium
		Business opportunities/economic enhancement.	Positive	Medium
		Increase in the cost of living due to influx of construction workers and their activities	Negative	Moderate
		Death/ Injury of personnel during construction and loss of equipment due to accidents	Negative	Moderate
		Temporary obstruction of human and vehicle movement during transportation of equipment and construction materials	Negative	Moderate
		Risk to personnel and equipment security on site and transit to site	Negative	Minor

Operation Phase	Operation of the BOG Pipe threading and Valve Assembly Facilities	• Impact on Ambient Air Quality from emissions from the facility operations	Negative	**Moderate**
		▪ Increase noise level from the operation of equipment and machineries	Negative	**Moderate**
		• Solid waste generation-impact on existing waste disposal facility	Negative	**Minor**
		• Surface Water and Groundwater Contamination as a result of discharge of untreated Wastewater and Sewage	Negative	**Moderate**
		• Creation of employment for skilled and unskilled Labour	Positive	**Major**
		• Gradual increase in cost of living in nearby communities	Negative	**Moderate**
		• Increase in population due to migration	Negative	**Moderate**
		• Transportation disturbance from the project operations on the existing traffic along Lekki free zone coastal road	Negative	**Moderate**
		• Increase in social vices including prostitutions	Negative	**Moderate**
		• Improvement in the welfare of neighboring communities	Positive	**Medium**
		• Business opportunities/economic enhancement.	Positive	**Medium**
		• Increase in risk of accident/injury due to transportation of raw materials and finished threaded pipes and valves	Negative	**Moderate**
		• Accidental spillage from anti-corrosive paint storages	Negative	**Moderate**
		• Increase in respiratory diseases as a result of inhalation of chemicals	Negative	**Moderate**
		• Fire outbreak as a result of gas supply to the facility	Negative	**Moderate**
		• Death/ Injury of personnel due to work hazards	Negative	**Minor**
Decommissioning/Abandonment Phase	Demolition and closure of the BOG Pipe threading and Valve Assembly Facilities	• Impact on Ambient Air Quality from dust and emissions from demolition operations	Negative	**Moderate**
		• Noise level and Dust generation	Negative	**Minor**
		• Solid Waste generation	Negative	**Minor**
		• Loss of job/change in economic conditions/emotional disturbance	Negative	**Major**
		• Injury/fatalities in workforce/communities	Negative	**Minor**

5.4 IMPACT ANALYSIS

This section of the report analyses the associated and potential impacts of activities of the various phases of the project.

5.4.1 Potential Positive Impacts of the Proposed Project

Like any other developmental project, the proposed project will have some positive impacts. Most of these impacts revolve around the benefits accruable from the world-class service by Bell Oil and Gas in the Nigeria Oil and Gas Industry, attraction of foreign investment into the country, creation of large and small market and income generation and employment opportunities. The basic and most critical positive impacts include the following:

Impact on Socio-economic and Employment Generation

The proposed project will create employment opportunities for both skilled and unskilled labor. Hundreds of temporary and permanent direct employment opportunities will be created during the construction and operational phases of the project. Indirect employment opportunities will be created through of contractors and suppliers of materials.

The employment generation will enhance training of qualified Nigerian to operate and manage the facility. This will no doubt add to available local capacity in this sector. The operation of the facility will also lead to skill acquisition by the local staff ad enhance the local content drive of the project.

Impact on Economic Growth

The injection of over seventy percent of the project cost into the local economy will help in stimulating the economy. Also, the project upon completion will require Wholesalers and Dealers thus resulting in the creation of some Small and Medium Scale Businesses and revival of some existing ones thus bring about economic growth.

Reduction in Foreign Exchange Expenditures on Importation

The proposed project when operational will reduce foreign exchanges expended on importation of similar products from Europe or Asia. This would indirectly reduce the demand for foreign exchange and by extension the pressure on Naira.

Impact on Local Capacity Development

Improvement in the welfare of neighboring communities

The project will contribute to the wellbeing of the neighboring communities through provision of temporary and permanent jobs for some skilled and unskilled members of the communities. Also, the project will directly impact on the wellbeing of the project host communities through implementation of Corporate Social Responsibility (CSR) initiatives.

5.4.2 Potential Negative Impacts

5.4.2.1 Pre-construction Phase - Mobilization Phase Impacts

This is the planning phase of the project where movement of goods, personnel (workers) and equipment machineries to the project site. Personnel and Materials will be mobilized to the project site and as such, a number of impacts are expected to result from this activity. Some of these impacts will include:

Noise Impact

The movement of equipment, machineries and workers by vehicular traffic could result in increase noise level within the project area as a result of noise generated from vehicles and machineries. The magnitude of this impact is considered be **low** given the fact that the mobilization of equipment and workers will happen within limited period and will be restricted to the route to the project area. The areal extent of the impact is **low** when compared to the entire size of the free zone. In terms of frequency, the impact will occur intermittently during the construction phase. Impact duration is therefore **low** as it will be short lived each time it occurs. The sensitivity of the resources to noise impacts is considered **low** and the impact is reversible. The likelihood of the impact occurring is **moderate** since the movement of equipment, machineries and workers are certain to occur. The overall severity rating of the impact is **low**. The impact significance is therefore of overall **low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Cumulative impacts are expected although they will be minimal.

Impact on Ambient Air quality

The increase in vehicular traffic due to the movement of equipment, machineries and workers to site will lead to increase in vehicular emission thereby impacting on the ambient air quality. The magnitude of this impact is considered **low** given the fact that the movement will be restricted to the vicinity of the project area. The areal extent of the impact is **low** when compared to the entire size of the free zone. In terms of frequency, the impact will occur intermittently during the preconstruction activities. Impact duration is therefore **low** as it will be short lived each time it occurs. The sensitivity of the resources to impact is considered **medium** and the impact is **reversible.**

The likelihood of the impact occurring is **moderate** since the movement of equipment, machineries and workers are certain to occur. The overall severity rating of the impact is **low**. The impact significance is therefore of overall **low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Cumulative impacts are expected although they will be minimal

Impact on Traffic

The mobilization of materials, machineries and workers to site would be done by road and this could result in increase in vehicular traffic along the coastal road in Lekki Free Zone corridor. The magnitude of the impact will be **low** given the fact that the movement shall be planned for off-peak periods to reduce the possibility of causing traffic jams. The areal extent of the impact is **medium** considering the fact the movement activities extend outside the project environment. This impact would be short term and with the implementation of an efficient Traffic and Journey Management Plan, the duration of impact will be **low,** as the mobilization to site would only occur for few days. The frequency of the impact will be **low,** as the impact will occur intermittently throughout the preconstruction period. The sensitivity of the resources to impact is considered **medium** as the movement activities can affect other road users in the area but the impact is reversible.

The likelihood of the impact occurring is **moderate** since the movement of equipment, machineries and workers are certain to occur. The overall severity rating of the impact is **low,** as the mobilization will be planned for off-peak period. The impact significance is therefore of overall **low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Cumulative impacts are expected since the project related transportation would be add-on to existing transport situation in the area although they will be minimal.

Impact on Existing Infrastructure

The movement of materials and personnel to the project site by road will no doubt put additional pressure on the existing road infrastructure. The magnitude of the impact will be **low** given the fact that the movement shall be planned for off-peak periods to reduce the possibility of causing stress on other road users. The areal extent of the impact is **medium** considering the fact the movement activities extend outside the project environment. This impact would be short term and with the implementation of an efficient Traffic and Journey Management Plan, the duration of impact will be **low,** as the mobilization to site would only occur for few days. The frequency of the impact will be **low,** as the impact will occur intermittently throughout the preconstruction period. The sensitivity of the resources to impact is considered **medium** as the movement activities would cause additional pressure on the road and other road users in the area but the impact is reversible.

The likelihood of the impact occurring is **moderate** since the movement of equipment, machineries and workers are certain to occur. The overall severity rating of the impact is

low since the mobilization will be planned for off-peak period and would be short-term. The impact significance is therefore of overall **low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Cumulative impacts are expected since the project related transportation would be add-on to existing transport situation in the area although they will be minimal.

I**Impact on Public Health and Safety**

The movement of heavy trucks and equipment/ machineries could increase the risk of accidents/injuries due to increase in road traffic. This exposure to vehicular emission and noise increases could affect the public health such as increase in respiratory disease. The possibility of occurrence is **low**, as all project drivers would be made to pass through safe driving training before commencement of project.

The magnitude of the impact will be **low** given the fact that movement of heavy trucks and equipment will be planned for off-peak period and the equipment will be properly maintained/or service to reduce the likely noise to be generated since noise levels will be attenuated by distance and diffusion into background noise levels. The duration of the impact will be **low** since the movement of heavy truck will happen within few days. The frequency of the impact will be **low** given the fact that movement of personnel, materials and men to the site will be a one-off activity, and subsequent materials movement will be intermittent and in bits, the associated impacts of this activity. The areal extent of the impact will be **medium** with regards to health impacts of noise and risk of accident since the movement activities extend outside the corridor of the project development. The sensitivity of the resources to impact is considered **medium** as the movement activities could be life threatened to the people in the area but the impact is reversible.

The likelihood of the impact occurring is **moderate** since the movement of equipment, machineries and workers are certain to occur. The overall severity rating of the impact is **low** since the mobilization will be planned for off-peak period and would be short-term. The impact significance is therefore of overall **low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Cumulative impacts are expected since the project related transportation would be add-on to existing impact from other transport related activities in the area although they will be minimal.

5.4.2.2 Construction Phase - Site Preparation Activities

During this phase of the project, vegetation within the designated acreage will be cleared properly. Cleared vegetal matter will be moved offsite for handling. The various machinery and equipment will generate emissions and noise. Human presence within and around the site will increase significantly, and there will be a number of critical negative impacts on the environment. Some of these impacts are summarized below:

Impact on Biodiversity

Site preparation activities would involve clearing of the project site, excavation and removal of vegetation. This would result in the loss of biodiversity. Some flora and fauna that are native to the project area would be displaced and or destroyed.

The magnitude of the impact will be **high** given the fact that site preparation activities such as site clearing could lead to destruction of vegetation that may be of social and economic importance, temporary disturbance or displacement of soil fauna. The duration of the impact will be **high** since the site preparation activities are expected to continue for long term since the cleared area will be utilize for the planned project. The frequency of the impact will be **low** given the fact that the site preparation will be a one-off activity, and subsequent materials movement will be intermittent and in bits, the associated impacts of this activity. The areal extent of the impact will be **medium** with regards to the consequence of the activities on biodiversity and destruction of vegetation even though the loss of vegetation and fauna will only take place within the immediate vicinity of the project area. The sensitivity of the resources to impact is considered to be **high** since the site preparation activities will lead to permanent destruction of vegetation and biodiversity in the project area and the impact is irreversible.

The likelihood of the impact occurring is **moderate** since the site preparation activities such as site clearing are certain to occur. The overall severity rating of the impact is **high** since the impact of the activity is long-term and will lead to permanent destruction of vegetation and soil fauna. However, efforts shall be made to ensure that site clearance is limited to only the required space while sensitive natural settings that can be accommodated in the project design shall be preserved. The impact significance is therefore of overall **high** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
High	Moderate	High

Impact on Geology

Site clearance may involve some form of excavation and removal of topsoil. It is however not expected to have any significant impact on the geology of the area.

Impact on Surface Water

Oil spills from Oil Storage facility on site as well as machineries used for site preparation could be washed by the site run-off and contaminate the stormwater drains or any surface water in close proximity to the project area. This can subsequently constitute health hazard to the aquatic animals.

The magnitude of the impact will be **low** given the fact that the machineries for the site preparation activities will be well maintained and service to avert any possibility of oil spill. In addition, the proponent intends to have a comprehensive Construction Environmental Management Plan (CEMP) that will detail the approaches to be adopted to avoid surface water contamination. The areal extent and duration of the impact is **medium** as the surface water contamination could penetrate into the aquatic animals and long-term as the impact does not disappear easily. The frequency of the impact will be **low,** as the impact would occur occasionally throughout the construction period. The sensitivity of the resources to impact is considered **medium** as the impact of surface water contamination is health risk but the impact is reversible.

The likelihood of the impact occurring is **low** with an effective CEMP in place throughout the construction phase. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Low	Moderate

Noise Impact

Site clearance activities will involve the use of earth moving machineries that are expected to add to the existing noise level in the project area. The magnitude of this impact is considered- be **low** given the fact that the impact from the use of earth moving equipment will be short-term and reversible and also confined within the immediate project environment (15,146.0sq. meter).

The areal extent of the impact is **low** when compared to the entire size of the free zone. In terms of frequency, the impact will occur intermittently during the site preparation activities. Impact duration is therefore **low** as it will be short lived each time it occurs. The sensitivity of the resources to noise impacts is considered **low**.

The likelihood of the impact occurring is **moderate** since the site clearance activities are certain to occur. The overall severity rating of the impact is **low**. The overall significance is therefore **low**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Cumulative impacts are expected although they will be minimal

Impact on Ambient Air Quality

There is no doubt that site preparation activities would contribute to the reduction in the ambient air quality of the project area. Dusts/Particulate Matters from site clearing and excavation works as well as emissions from machineries would contribute to the impairment of the ambient air quality. The magnitude of this impact is considered to be **low** given the fact that the movement will be restricted to the vicinity of the project area, therefore the impact on ambient air quality will be limited to the immediate environment. Duration of the impact will be short term since the site preparation activities will not be more than 3 - 6months. The areal extent of the impact is **low** when compared to the entire size of the free zone. In terms of frequency, the impact will occur intermittently during the preconstruction activities. Impact duration is therefore **low** as it will be short lived each time it occurs due to the effect of air dispersion. The sensitivity of the resources to impact is considered **medium** and the impact is reversible.

The likelihood of the impact occurring is **moderate** since the site clearing activities will certainly occur. All machineries to be used on site would be properly maintained/services. This will reduce emissions of gases. The overall severity rating of the impact is **medium**. The overall significance is therefore **moderate**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Moderate	Moderate

Waste Management Impact

Site clearing would result in the production of solid waste such as cleared vegetation, debris and plant trunks. Also, workers on site are expected to generate sanitary and domestic wastes and if not properly manage. These wastes would not only constitute environmental nuisance but also health hazards.

The magnitude of the impact will be **low** given the fact that wastes will be contained within the clearly fenced and demarcated project site. The duration of the impact will be **low**. Vegetal waste and debris will only be generated once during the site clearing activities of the project. The frequency of the impact will be **low,** as the impact will occur only a few times during the project site clearance. The areal extent of the impact will be **low**. All wastes will be contained within the project site and will not be allowed to leave project site unless it is in the custody of experienced, certified and duly authorized persons. Given the relatively small volume of wastes that will be generated and the fact that the host communities will be allowed to scavenge the wood for other uses that will benefit the host communities economically, the sensitivity of the project environment is adjudged **minor**. The likelihood of the impact occurring is **moderate** since the site clearing activities will certainly occur and vegetal waste will be generated. The overall severity rating of the impact is **medium**. The overall significance is therefore **Low**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Impact on Existing Infrastructure

Influx of workers into the project area is expected to put additional pressure on the existing infrastructures in the area such as Power, Water, Health facilities etc. This impact though reversible would be throughout the construction phase of the project.

Impact on Existing Security and cultural Structure

With the influx of hundreds of workers that would be involved in the project's construction phase and those prospecting for employment opportunities comes the challenge of security and respect for the local culture. This will stretch the existing security structure and if not adequately managed may result in increase in social vices and crimes in the project area. Also, the influx of the construction worker could lead to cultural challenges as the construction workers are expected to come from different tribes in the country and understanding the local culture might be a challenge.

The site preparation activities will no doubt put additional pressure on the existing road infrastructure and could create cultural and security challenges due to the influx of construction workers. The magnitude of the impact will be **low** given the fact that the site preparation activities will be restricted to the vicinity of the project area as well as the construction workers would be given pre-employment training on the local culture. However, the areal extent of the impact is **medium** considering the fact these specific site preparation activities extend outside the project environment. This impact would be short term and the duration of impact is **low,** as the site preparation activities would only occur for few weeks. The frequency of the impact will be **medium,** as the impact will occur throughout the site preparation activities. The sensitivity of the resources to impact is considered **medium** as the effect of the impact could cause additional pressure on the other infrastructure users and the local culture but the impact is reversible.

The likelihood of the impact occurring is **moderate** since the site preparation activities are certain to occur. The overall severity rating of the impact is **low** since the site preparation will be restricted to the vicinity of the project area while appropriate planning and monitoring mechanism will also be put in place for the external effects of the activities such as the security challenges. The overall significance is therefore **low**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Impact on Health and Safety

Site preparation activities could result in injuries to workers as well as fatalities if appropriate health and safety control measures are not put in place. Also, the operation of the vehicles and machineries will lead to emissions that could increase the respiratory disease. The influx of workers and other persons seeking to do brisk businesses as a result of the project in the area could result in increase in communicable diseases such Sexually transmitted diseases (STDs), Tuberculosis, and in deed sexually transmitted Infections (STIs).

The magnitude of the site preparation activities will be **low** given the fact that the project is restricted to project site. The duration of the impact will be **low** and **short-term** since the site preparation activities will take less than 6 month. The frequency of the impact will be

low as the impact will occur is not certain through the project life cycle. The areal extent of the impact and sensitivity will be **medium** given that the impact could affect the host community outside the free zone.

The likelihood of the impact occurring is **low** since the possibility of injuries and increase in communicable diseases are not certain to occur with appropriate planning and pre-employment health checks. The overall severity rating of the impact is **low** since the site preparation will be restricted to the vicinity of the project area while appropriate planning and monitoring mechanism will also be put in place for the external effects of the activities such as the security challenges. The overall significance is therefore **low**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Low	Low

Construction Phase Impacts –Construction Activities

The construction activities for the Proposed Pipe threading and Valve Assembly facility will include construction of temporary camp offices, warehouses, Composite Pipe workshop and other ancillary facilities. The various machinery and equipment that will be used for the construction activities will generate emissions, vibrations and noise. Human presence within and around the site will increase significantly, and there will be a number of critical negative impacts on the environment. Some of these impacts are summarized below:

Impact on Noise Level

Construction activities particularly the civil works would involve excavation, foundation works such as pilling and the use of heavy-duty equipment/machineries. These activities will generate high level of noise that would increase the noise nuisance in the project area. Pilling works can also result in vibration that may affect other facilities within close proximity.

The magnitude of the impact moderate and will be restricted to the project area. The areal extent of the impact will be **low**. Noise and air emissions will only take place within the immediate vicinity of the project area. The project area is located within a designated industrial zone in the free zone and consists of mainly commercial/industrial land uses, therefore noise levels are not expected to significantly exceed the existing background level and the sensitivity of the project area is adjudged **low**.

The likelihood of the impact occurring is **moderate** since the construction activities are certain to occur. The overall severity rating of the impact is **low**. The overall significance is therefore **low**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Impact on Ambient Air Quality

Excavation, pilling works, fabrications etc., are activities that would generate dust and produce emissions. There will also be emission of noxious gases from vehicles and machineries on site that will contribute to the reduction in ambient air quality.

The magnitude of the impact will be **medium** given the fact that quite a number of machineries that could generate dust and emissions would be utilize for the construction activities. The duration of the impact will be **medium**. As construction activities are expected to continue for not less than 6 months. The areal extent and sensitivity of the impact will be **medium**. Considering the size of the project area, the impact of air emissions will not only affect the project area but also the immediate environment due to dispersion effect.

The likelihood of the impact occurring is **moderate** since the construction activities are certain to occur. The overall severity rating of the impact is **medium**. The overall significance is therefore **Moderate**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Moderate	Moderate

Impact on Soil and Ground Water

Oil spills from Oil Storage facility on site as well as machineries could lead to soil contamination and indeed ground water contamination through percolation into the ground water aquifer. This can constitute serious health hazard because of the carcinogenic nature of Poly-Aromatic Hydrocarbons (PAHs)

The magnitude of the impact will be **low** given the fact that the machineries for the construction activities will be well maintained and service to avert any possibility of oil spill. In addition, the proponent intends to have a comprehensive Construction Environmental Management Plan (CEMP) that will detail the approaches to be adopted to avoid soil and groundwater contamination. The areal extent and duration of the impact is **medium** as the soil or aquifer contamination could penetrate into the groundwater aquifer and long-term as the impact does not disappear easily. The frequency of the impact will be **low,** as the impact would occur occasionally throughout the construction period. The sensitivity of the resources to impact is considered **medium** as the impact of soil and groundwater contamination is health risk but the impact is reversible.

The likelihood of the impact occurring is **low** with an effective CEMP in place throughout the construction phase. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Low	Moderate

Waste Management Impact

Construction activities are expected to produce solid wastes such as construction debris, metal and iron cuttings from fabrication works, packing materials, nylons and pet bottles etc. these wastes could constitute environmental and health hazards if not properly managed. It is also expected that workers on site would generate liquid waste resulting from taking care of their personnel hygiene and answering the call of nature. This waste if not properly managed would constitute serious health hazard.

The magnitude of the impact will be **low** given the fact that wastes will be contained within the clearly fenced and demarcated project site. The duration of the impact will be **low**. Construction wastes will only be generated once during the construction phase of the project. The frequency of the impact will be **low,** as the impact will occur only a few times during the project construction phase. The areal extent of the impact will be **low**. All wastes will be contained within the project site and will not be allowed to leave project site unless it is in the custody of experienced, certified and duly authorized persons. Given the relatively volume of wastes that will be generated and the sensitivity of the project environment is adjudged **medium**.

The likelihood of the impact occurring is **low** with an effective CEMP in place throughout the construction phase. The overall severity rating of the impact is **low** therefore the impact significance is **low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Low	Low

Impact on Surface Water

Oil spills from Oil Storage facility on site as well as machineries used for construction activities could be washed and oil spill contaminate the site run-off into the stormwater drains or any surface water in close proximity to the project area. This can subsequently constitute health hazard to the aquatic animals.

The magnitude of the impact will be **low** given the fact that the machineries for the construction activities will be well maintained and service to avert any possibility of oil spill. In addition, the proponent intends to have a comprehensive Construction Environmental Management Plan (CEMP) that will detail the approaches to be adopted to avoid surface water contamination. The areal extent and duration of the impact is **medium** as the surface water contamination could penetrate into the aquatic animals and long-term as the impact does not disappear easily. The frequency of the impact will be **low,** as the impact would occur occasionally throughout the construction period. The sensitivity of the resources to impact is considered **medium** as the impact of surface water contamination is health risk but the impact is reversible.

The likelihood of the impact occurring is **low** with an effective CEMP in place throughout the construction phase. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Low	Moderate

Cumulative impacts are expected since free zone is undergoing development with different construction activities. Hence, the impact on surface water would be add-on to other construction activities within the free zone although they will be minimal.

Impact on Socio – Economics

As a result of the project activities, there could be gradual increase in the cost of living of the nearby communities. In addition, there could be temporary obstruction of human and vehicle movement during transportation of equipment and construction materials

The magnitude of the impact will be **medium** given the fact that the project construction activities will engage large number of unskilled labour that would patronize nearby communities that could create increase in the cost of living within the communities. In addition, the temporary obstruction of human and vehicle construction will affect the local communities who are still struggling with the poor road network within the communities. The duration of the impact will be **medium**. Construction activities are expected to continue for not less than 12 months. The frequency of the impact will be **medium,** as the impact will occur throughout the construction period. The areal extent of the impact will be **medium** as the construction workers are likely to relate with the neighboring communities and the temporary obstruction will extend outside the immediate project environment. Given the sensitivity of the neighboring communities to increases in living expenses and obstructions due to the construction activities, the sensitivity of the project is adjudged **medium**.

The likelihood of the impact occurring is **moderate** since construction workers will be engaged for the project construction phase. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Moderate	Moderate

Impact on Health and Safety

Construction activities could result in injuries to workers as well as fatalities if appropriate health and safety control measures are not put in place. In addition, the influx of workers and other persons seeking to do risk businesses as a result of the project into the project area could result in increase in communicable diseases such Sexually transmitted diseases (STDs), Tuberculosis, and in deed sexually transmitted Infections (STIs).

The magnitude of the site preparation activities will be **low** given the fact that the project is restricted to project site. The duration of the impact will be **low** and **short-term** since the construction activities will take less than 6 month. The frequency of the impact will be **low** as the impact will occur is not certain through the project life cycle. The areal extent of the impact and sensitivity will be **medium** given that the impact could affect the host community outside the free zone.

The likelihood of the impact occurring is **low** since the possibility of injuries and increase in communicable diseases are not certain to occur with appropriate planning and pre-employment health checks. The overall severity rating of the impact is **low** since the site preparation will be restricted to the vicinity of the project area while appropriate planning and monitoring mechanism will also be put in place for the external effects of the activities such as the security challenges. The overall significance is therefore **low**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Low	Low

5.4.2.3 Operational Phase Impacts

During the operation of the proposed facility, a number of activities will take place on a continuous basis. This will include waste generation and handling, maintenance of plants/machineries, power generation and distribution, water supply and domestic sewage/effluent treatment and disposal, etc. All of these activities could generate negative environmental effects. This sub-section of the report presents an overview of some of the impacts that could result from this phase of the project.

Impact on Noise

The pipe threading and valve assembly operations within the facility would involve the use of high technology equipment and machineries with resultant increase in noise level. Though appropriate measures will be put in place to mitigate noise pollution, the impact would be a long-term impact and the possibility of occurrence is high.

The magnitude of the impact will be **low** given the fact that the noise sources from the facility will be from only a few pieces of equipment and noise from these equipment will also have cumulative effect thus, the noise level will be minimal and cumulative, compared to the overall noise that occurs in the area. The duration of the impact will be **high**. The proposed facility is expected to operate for long term and during the period noise generation will be taking place continuously. The frequency of the impact will be **high,** as the impact will occur continuously throughout the operational life of the project. Areal extent of the impact will be **low**. The impacts of noise levels will be most acute within the immediate vicinity of the project site and would be significantly attenuated at distances beyond 100m from the project area.

The likelihood of the impact occurring is **high** since the operation of the equipment and machineries will be continuous over project life span and it's cumulative due to other noise sources in the project area. However, with adequate maintenance of machineries and the installation of mufflers, the noise level will be significantly reduced. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	High	Moderate

Impact on Ambient Air Quality

The pipe threading and valve assembly operations could bring about emission of some gases, all of which contributes to the impairment of ambient air quality.

The magnitude of the impact will be **low** given the fact that the sources of fugitive gases and particulate emission from the facility will be from only a few pieces of equipment but these will also have cumulative effect thus, the emissions will be minimal and cumulative, compared to the overall emissions that arise from other sources within the zone. The duration of the impact will be **high**. The proposed facility is expected to operate for long term and during the period fugitive gases and particulates will be take place continuously. The frequency of the impact will be **high,** as the impact will occur continuously throughout the operational life of the project. Areal extent of the impact will be **low**. The impacts of emissions will be most acute within the immediate vicinity of the project site and would be significantly diffuse due to wind effect at distances beyond 100m from the project area.

The likelihood of the impact occurring is **high** since the operation of the equipment and machineries will be continuously over project life and it's cumulative due to other emission sources in the project area. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	High	Moderate

Cumulative impacts are expected since emissions from the proposed project would be add-on to other emissions generated by other sources in the area although they will be minimal.

Impact on Traffic

The operation of the facility will impact on existing traffic situation along the coastal road as heavy trucks bringing in raw materials and conveying products from the facility would have to ply the road. This could add to the traffic situation of the project area resulting in gridlock and loos of man-hour. There is also possibility of the trailers and trucks parking along the road if there are no enough parking spaces. This situation if allowed to occur will contribute to traffic jams along the corridor.

The magnitude of the impact will be **high** given the fact that the heavy trucks will ply the road frequently to either discharge raw materials or convey the products due to the operation of the facility. The areal extent of the impact is **medium** considering the fact the transportation activities extend outside the project environment. This impact would be long-term and with the implementation of an efficient Traffic and Journey Management Plan, the duration of impact will be **high** since the activity will occur throughout the project life span. The frequency of the impact will be **medium,** as the impact will occur as required during operation of the facility. The sensitivity of the resources to impact is considered **medium** as the movement activities could lead to traffic jams within the project environment but the impact is reversible.

The likelihood of the impact occurring is **high** since the transportation of raw materials and products are certain to occur. However, adequate provision has been made within the proposed facility for parking and no truck from the facility is expected to park along the road. The overall severity rating of the impact is **medium,** as an efficient Traffic and Journey Management Plan will be put in place throughout the project life cycle. The impact significance is therefore of overall **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	High	Moderate

Cumulative impacts are expected since the project related transportation would be add-on to existing transport situation in the area although they will be minimal.

Waste Management Impact

The operation of the facility would result in the generation of liquid, solid and gaseous waste streams which if not properly managed could constitute serious environmental and health hazards.

The magnitude of the impact will be **low** given the fact that wastes will be contained within the project area. The frequency of the impact will be **moderate,** as the impact will occur throughout the operation period. The areal extent of the impact will be **low**. All wastes will be contained within the project site and will not be allowed to leave project site unless it is in the custody of experienced, certified and duly authorized persons or corporate entities. Given the relatively volume of wastes that will be generated and the sensitivity of the project environment is adjudged **medium**.

The likelihood of the impact occurring is **moderate** with an effective waste management plan in place throughout the operation phase. The overall severity rating of the impact is **Low** therefore the impact significance is **Low** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Low	Moderate	Low

Impact on Surface Water and Groundwater

Apart from the possibility of oil spills from Oil Storage facility on site being washed into the run-off to the stormwater drains that could contaminate the surface water or groundwater, the discharge of untreated wastewater and sewage can also contaminate the surface water or groundwater.

The magnitude of the impact will be **low** given the fact that the machineries for the operations will be well maintained and service to avert any possibility of oil spill. In addition, the proponent intends to have a comprehensive Standard Operating Procedure (SOP) that will detail the approaches to be adopted to avoid surface water and groundwater contamination. The areal extent and duration of the impact is **medium** as the groundwater or surface water contamination could penetrate into the aquifer or aquatic animals respectively. It is also long-term as the impact does not disappear easily. The frequency of the impact will be **low,** as the impact would occur occasionally throughout the operation phase. The sensitivity of the resources to impact is considered **medium** as the impact of surface water or groundwater contamination is health risk but the impact is reversible.

The likelihood of the impact occurring is **low** with an effective SOP in place throughout the operation phase. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Low	Moderate

Cumulative impacts are expected since other facilities exist in free zone. Hence, the impact on surface water or groundwater would be add-on to other operations of other facilities within the free zone although they will be minimal.

Impact on Socio – Economics

As a result of the project activities, there could be gradual increase in the cost of living of the nearby communities. In addition, there could be obstruction of human and vehicle movement along the coastal road during transportation of raw materials and finished products.

The magnitude of the impact will be **medium** given the fact that the project operation activities will engage few number of unskilled labour that would patronize nearby communities that could create increase in the cost of living within the communities. In addition, the obstruction of human and vehicle construction will affect the local communities, as the existing coastal road within the communities requires urgent attention. The duration of the impact will be **medium**. Operation activities are expected to continue for a long period. The frequency of the impact will be **medium,** as the impact will occur throughout the operation period. The areal extent of the impact will be **medium** as the operation workers are likely to relate with the neighboring communities and the obstruction will extend outside the immediate project environment. Given the sensitivity of the neighboring communities to increases in living expenses and obstructions due to the facility operations, the sensitivity of the project is adjudged **medium**.

The likelihood of the impact occurring is **moderate** since project workers will be engaged for the operation phase. The overall severity rating of the impact is **medium** therefore the impact significance is **moderate** significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Moderate	Moderate

Impact on Health and Safety

The operations of the proposed facilities could result in injuries to workers as well as fatalities if appropriate health and safety control measures are not put in place. Fire outbreak can also occur as a result of the facility operation due to gas supply. In addition, influx of workers and other persons seeking to do risk businesses as a result of the project could result in increase in communicable diseases such Sexually transmitted diseases (STDs), Tuberculosis, and in deed sexually transmitted Infections (STIs).

The magnitude of the facility operations will be **low** given the fact that the project is restricted to project site. The duration of the impact will be **medium** and **long-term** since the operation phase will take for long time. The frequency of the impact will be **low** as the impact will occur is not certain through the project life cycle. The areal extent of the impact and sensitivity will be **medium** given that the impact could affect the host community outside the free zone.

The likelihood of the impact occurring is **low** since the possibility of injuries and increase in communicable diseases are not certain to occur with appropriate planning and pre-employment health checks. The overall severity rating of the impact is **medium** since the operation phase could affect the local community while appropriate planning and monitoring mechanism will also be put in place for the external effects of the activities such as the security challenges. The overall significance is therefore **Moderate**.

Impact Severity	Impact Likelihood	Overall Impact Significance
Medium	Low	Moderate

5.4.3 Cumulative Impacts

These are impacts resulting from contributions from other facilities within and around the project area. The identified cumulative impacts include:

Impact on Traffic

Activities of the various facilities and companies within the Lekki Free Zone will involve the movement of Personal, Materials and Machineries by road and would impact on the traffic situation along the corridor.

Impact on Ambient Air Quality and Noise level

Operational activities of existing facilities and activities from the proposed project implementation will impact negatively on the quality of ambient air and noise level in the project area. This cumulative impact will require commitment from the various facilities to put in place pollution abatement facilities.

Impact on Groundwater

Due to the third party facilities such as Yulong Steel Pipe Production facility close to the proposed project location, the groundwater extraction from the facilities will affect the aquifer within the project area thereby impacting cumulatively on the groundwater level in the area.

CHAPTER SIX

MITIGATION MEASURES

6.1 Introduction

One of the cardinal purposes of an EIA is to be able to predict and identify the possible impacts of a proposed project on the Environment as well as socio-economic activities within the project environment. These Impacts could be positive or negative. It is therefore expected that adequate measure would be put in place by the project proponent to mitigate if not eliminate the negative impacts and enhance the positive ones. For this project, mitigation measures where appropriate have been developed to avoid and/or minimize potential adverse or negative Impacts from the project. Potential environmental and socioeconomic Impacts predicted in chapter 5 of this report form the basis for developing the required mitigation measures.

This section presents the project environmental mitigation plan for the affected resources and project hazards listed below:

- Land Resources;
- Air Quality and Noise;
- Water Resources (Ground and Surface water);
- Plant and Wildlife Habitat;
- Geology and Soils;
- Man Made Hazards;
- Socioeconomic impact;
- Infrastructure and utilities; and
- Cultural Resources

It should be cleared here that most of the likely impact due to this project have been considered in the design and selection of the project option and site. While additional measures may require outright purchase of abatement equipment, others will be requiring sound operational procedures and good maintenance.

The selection of the proposed project site at Lekki Free Zone has the potential to assist in avoiding or eliminating many possible impacts that might occur from a project of this nature, especially with reference to its proximity to like uses. **Table 6.1** outlines a summary of the potential environmental impacts associated with the project, together with corresponding mitigation measures.

6.2 Impacts and Mitigation Measures

This section of the report describes the Identified or predicted impacts and the corresponding mitigation measures based on the activities at the various phases of the project.

Pre-construction Phase

Mobilization Phase Impacts Mitigation Measures

This will involve the movement of goods, personnel (workers) and equipment/ machineries to the project site.

Impact on Noise

The movement of equipment, machineries and workers to site could increase the noise nuisance on the project area due to noise from vehicles and machineries.

Project vehicles shall be serviced and put in good condition and where necessary. Noise silencers/ mufflers will be installed on the vehicles to reduce if not eliminate noise.

Impact on Ambient Air quality

Emission from vehicle conveying workers and machineries being mobilized to site would contribute to the reduction in ambient air quality**.**

All Project vehicles shall be properly maintained and put in good working condition prior to the commencement of the project. All project vehicles shall be put off while in traffic jams to avoid continuous release of emission into the environment.

Impact on Traffic and Existing Infrastructure

The mobilization of materials, machineries and workers to site would be done by road and this could result in increase in vehicular traffic along the coastal road in the Lekki Free Zone corridor. It will also exert additional pressure on the existing road infrastructure.

Bell Oil and Gas FZE shall develop and implement an efficient Traffic and Journey management Plan. Meanwhile, the movement will be planned for off peak periods to reduce additional pressure on the road infrastructure/ or users and avert the possibility of any traffic jams. The relevant traffic management Authorities such as LASTMA, FRSC and the Police will be engaged for efficient traffic management around the corridor.

Impact on Public Health and Safety

The movement of heavy trucks and equipment/ machineries could increase the risk of accidents/injuries due to increase in road traffic and vehicular movement. This exposure to vehicular emission and noise increases could affect the public health such as increase in respiratory disease.

All Project drivers will be made to pass through safe driving training before commencement of project. **Also,** ***Bell Oil and Gas FZE shall ensure:***

- *Visible warning signs are placed on roads and vehicles associated with the project*
- *Defensive driving course are organized for project drivers*
- *Large and slow moving vehicles are scheduled during off-peak periods*
- *Community awareness of unusual activity within the project area will be raised.*
- *Compulsory medical fitness tests shall be carried out on project drivers.*

6.2.1 Construction Phase - Site Preparation

Impact on Biodiversity

Site preparation activities would involve clearing of the project site, excavation and removal of vegetation. This would result in the loss of biodiversity. Some flora and fauna that are native to the project area would be displaced and or destroyed.

Bell Oil and Gas FZE shall ensure that site clearance is limited to only the required space while sensitive natural settings that can be accommodated in the project design will be preserved. Bell Oil and Gas FZE shall ensure that:

- *Cleared area are limited to what is required*
- *Site clearing will commence from developed (e.g. roads) to underdeveloped areas to provide escape routes for wildlife.*

Impact on Groundwater and Surface water quality

Oil spills from Oil Storage facility on site as well as machineries used for site preparation could be washed by the site run-off and contaminate the stormwater drains or any surface water in close proximity to the project area. This can subsequently constitute health hazard to the aquatic animals.

Bell Oil and Gas FZE shall **ensure**

- *Excavated materials are properly stacked to reduce turbidity effect on surface runoffs;*

- *Surface runoffs are contained within the existing storm water drainage system on the site;*
- *Trenches are backfilled and compacted to minimize the mobilization of highly turbid surface runoffs from the site into the Lagoon.*

Impact on Noise

Site clearance activities will involve the use of earth moving machineries that are expected to add to the existing noise level on the project area. This impact is short-term and reversible and expected to be confined within the immediate project environment.

Bell Oil and Gas FZE shall ensure will ensure:

- *Noise attenuation measures such as installation of acoustic mufflers on large engines and equipment are put in place;*
- *Hearing protection will be provided for workers on site.*

Impact on Ambient Air Quality

The site preparation activities would contribute to the reduction in the ambient air quality of the project area. Dusts/Particulate Matters from site clearing and excavation works as well as emissions from machineries would contribute to the impairment of the air quality.

Bell Oil and Gas FZE shall ensure:

- *Movements of men and materials are properly coordinated to optimize vehicle use and reduction resultant of vehicular emissions.*
- *All mobile and stationary internal combustion engines are properly maintained.*
- *Low emission/high efficiency engines will be used.*
- *Site is watered regularly to douse emission of dust*

Impact on Waste Management

Site clearing would result in the production of solid waste such as cleared vegetation, debris and plant trunks. Also, workers on site are expected to generate sanitary and domestic wastes and if not properly manage, these wastes would not only constitute environmental nuisance but also health hazards.

Bell Oil and Gas FZE shall ensure:

- *An efficient Waste Management Plan is put in place*
- *Waste generated from the project activities will be properly containerized to avoid contamination of groundwater and nearby surface water.*
- *PSP refuse collector certified by LAWMA will be contracted to handle waste generated on site.*

- *Construction wastes such as debris, metal cuttings, iron cuttings etc. will be properly stacked for re-use where possible while those not re-useable will be sold to third parties who need them.*

Impact on Existing Infrastructure

Influx of workers into the project area is expected to put additional pressure on the existing infrastructures in the area such as Power, Water, Health facilities etc. This impact though reversible would be throughout the construction phase of the project.

Bell Oil and Gas FZE *shall assist the host community in the provision of some other essential amenities within the limits of its resources.*

Impact on Health and Safety

Site preparation activities could result in injuries to workers as well as fatalities if appropriate health and safety control measures are not put in place. Also, the operation of the vehicles and machineries will lead to emissions that could increase the respiratory disease. The influx of the workers for the site preparation activities could results in increase in communicable diseases.

Bell Oil and Gas FZE shall ensure:

- *Safety awareness trainings are put in place for workforce*
- *Emergency Response Procedures are put in place and enforced.*
- *The use of PPE is ensured.*
- *Personnel on site will wear nose masks during (dusty) operations*
- *Community based training on the prevention of common communicable diseases, water protection/purification techniques and basic sanitation will be organized periodically*

Construction Phase Impacts

Impact on Noise Level

Construction activities particularly the civil works would involve excavation, foundation works such as pilling and the use of heavy-duty equipment/machineries. These activities will generate high level of noise that would increase the noise nuisance in the project area.

Bell Oil and Gas FZE shall ensure:

- *Noise attenuation measures such as installation of acoustic mufflers on large engines and equipment are put in place;*
- *Hearing protection will be provided for workers on site.*

Impact on Ambient Air Quality

Excavation, pilling works, fabrications etc., are activities that would generate dust and produce emissions. There will also be emission of noxious gases from vehicles and machineries on site that will contribute to the reduction in ambient air quality.

Bell Oil and Gas FZE shall ensure

- *Movements of men and materials are properly coordinated to optimize vehicle use and reduction in resultant vehicular emissions.*
- *All mobile and stationary internal combustion engines are properly maintained.*
- *Low emission/high efficiency engines are used.*
- *Site is watered regularly to douse emission of dust*

Impact on Soil and Ground Water

Oil spills from Oil Storage facility on site as well as machineries could lead to soil contamination and indeed ground water contamination through percolation into the ground water aquifer. This can constitute serious health hazard because of the carcinogenic nature of Poly Aromatic Hydrocarbons.

***Bell Oil and Gas FZE shall ensure**:*

- *Excavated materials are properly stacked and protected to prevent being washed into site run-offs*
- *Oil Storage facility shall be protected with bundwall to prevent any oil spills being washed into the soil and subsequently the groundwater aquifer*
- *Surface runoffs are contained within the existing storm water drainage system on the site;*

Impact on Waste Management

Construction activities are expected to produce solid wastes such as construction debris, metal and iron cuttings from fabrication works, packing materials, nylons and pet bottles etc. These wastes could constitute environmental and health hazards if not properly managed. It is also expected that workers on site would generate liquid waste resulting from taking care of their personnel hygiene and answering the call of nature. This waste if not properly managed would constitute serious health hazard.

Bell Oil and Gas FZE shall ensure

- *An efficient Waste Management Plan is put in place and implemented*
- *Waste generated from the project construction activities will be properly containerized to avoid contamination of groundwater and nearby surface water.*

- *PSP refuse collector certified by LAWMA will be contracted to handle waste generated on site.*
- *Construction wastes such as debris, Metal Cuttings, Iron Cuttings etc. will be properly stacked for re-use where possible while those not re-useable will be sold to third parties who are in need of them.*
- *Provision of onsite toilet facilities at the site during the construction phase of the project.*

Impact on Surface Water

Oil spills from Oil Storage facility on site as well as machineries used for construction activities could be washed and oil spill contaminate the site run-off into the stormwater drains or any surface water in close proximity to the project area. This can subsequently constitute health hazard to the aquatic animals.

Bell Oil and Gas FZE shall ensure:

- *Oil Storage facility shall be protected with bundwall to prevent any oil spills being washed into the site run-off and subsequently the surface water*
- *Excavated materials are properly stacked to reduce turbidity effect on surface runoffs;*
- *Surface runoffs are contained within the existing storm water drainage system on the site;*
- *Trenches are backfilled and compacted to minimize the mobilization of highly turbid surface runoffs from the site into the Lagoon.*

Impact on Health and Safety

Construction activities could result in injuries to workers as well as fatalities if appropriate health and safety control measures are not put in place. In addition, the influx of workers and other persons seeking to do risk businesses as a result of the project into the project area could result in increase in communicable diseases such Sexually transmitted diseases (STDs), Tuberculosis, and in deed sexually transmitted Infections (STIs).

Bell Oil and Gas FZE shall ensure:

- *Safety awareness trainings are put in place for workforce*
- *Emergency Response Procedures are put in place and enforced.*
- *The use of PPE is ensured.*
- *Personnel on site will wear nose masks during (dusty) operations*

- *Community based training on the prevention of common communicable diseases, water protection/purification techniques and basic sanitation will be organized periodically*

Operational Phase Impacts

<u>Impact on Noise</u>

The operation of the pipe threading and valve assembly facility would involve the use of high technology equipment and machineries with resultant increase in noise level.

Bell Oil and Gas FZE *shall ensure the facility operations are planned such that regulatory limits are not to be exceeded. Appropriate measure will be put in place to mitigate noise pollution.*

<u>Impact on Ambient Air Quality</u>

The pipe threading and valve assembly operations could result in the release of particulate matters and fugitive gases of which contributes to the impairment of ambient air quality. Lekki Free Zone will supply the power requirement of the facility in addition to the national grid source therefore impacts on the project environment will be cumulative since other facilities will be connected to the power source.

Bell Oil and Gas FZE shall ensure:

- *All flanges and vents are properly tightened to minimize fugitive emissions*
- *All systems are regularly checked to ensure that there are no leakages and losses.*
- *All machinery, equipment and vehicles for the project have high efficiency burners to reduce emission of noxious gases.*

<u>Impact on Traffic</u>

The operation of the facility will impact on traffic situation in the area as heavy trucks bringing in raw materials and conveying products from the facility would have to ply the road. This could add to the traffic situation of the project area resulting in gridlock and loses of man-hour. There is also possibility of the trailers and trucks parking along the road if there are no enough parking spaces. This situation if allowed to occur will contribute to traffic jams along the corridor.

Bell Oil and Gas FZE shall ensure:

- *Put in place and implement an efficient Traffic Management Plan*
- *Provide enough parking spaces for trucks and cars within the facility.*

Impact on Waste Management

The operation of the facility would results in the generation of liquid, solid and gaseous waste streams which if not properly managed could constitute serious environmental and health hazards especially to the storm water drainage channel beside the site.

Bell Oil and Gas FZE shall:

- *Put in place waste reduction strategy*
- *Ensure wastes generated are properly containerized to avoid contamination of ground water.*
- *Ensure runoff from the stockpile of wastes will be prevented from flowing into the* storm water drainage channel
- *Engage LAWMA to handle wastes generated on site*
- *Ensure proper treatment of wastewater / sewage before discharge into the environment*
- *Effluents from treatment process will be tested to meet local regulatory standards before discharge*
- *Ensure all sludge resulting from treatment processes will be properly stacked at designated area and dried before disposal.*
- *Ensure all waste or spent oil will be properly containerized and disposed off through the services of LASEPA accredited operators.*

Impact on Surface Water and Groundwater

Apart from the possibility of oil spills from Oil Storage facility on site being washed into the run-off to the stormwater drains that could contaminate the surface water or groundwater, the discharge of untreated wastewater and sewage can also contaminate the surface water or groundwater.

***Bell Oil and Gas FZE shall ensure**:*

- *Oil Storage facility shall be protected with bundwall to prevent any oil spills being washed into the site run-off and subsequently the surface water*
- *Reuse strategy of wastewater are implemented on site*
- *Wastewater are treated on–site to regulatory requirement before they are discharge;*
- *Surface runoffs are contained within the existing storm water drainage system on the site;*

Impact on Health and Safety

The operations of the proposed facilities could result in injuries to workers as well as fatalities if appropriate health and safety control measures are not put in place. Fire outbreak can also occur as a result of the facility operation due to gas supply.

Bell Oil and Gas FZE shall ensure:

- *Safety awareness trainings are put in place for workforce*
- *Emergency Response Procedures are put in place and enforced.*
- *The use of PPE is ensured.*
- *Personnel on site will wear nose masks during (dusty) operations*
- *Personnel will be trained on Fire Prevention technique while fire fighting measure are put in place*

Decommissioning Phase Impacts

Impact on Noise

Decommissioning activities including the demolition of structures and removal of fittings would result in increase in noise level around the project area. Though short-term, the possibility of occurrence is high. Bell Oil and Gas FZE shall ensure mobile and stationary internal combustion engines are properly maintained.

Impact on Waste Management

Demolition of structure and fittings would result in generation of solid wastes such as demolition debris, disused unserviceable machineries and equipment. Also, iron rods, metal cuttings, roofing materials and other solid wastes would be generated. These wastes if not properly stacked and disposed would constitute serious environmental and health hazards.

Bell Oil and Gas FZE shall

- *Ensure the project's waste management plan are strictly followed*
- *Ensure all wastes arising from demolition and decommissioning of facilities will be properly stacked and disposed off through the services of LAWMA accredited PSP Operators*
- *Assists in skill acquisition for all workers that would be disengaged*
- *Ensure worker who will be disengaged are properly counseled*
- *Ensure enough notice on disengagement from employment is given.*

Impacts on Employment/Income

Decommissioning/Closure of the facility would lead to loss of both temporary and permanent jobs. It would also result in loss of direct jobs by workers within the facility and indirect jobs by those who had to do business with the facility. Food vendors and sellers of other sundry articles may also experience drastic reduction in income.

Bell Oil and Gas FZE shall

- *Assists in skill acquisition for all workers that would be disengaged*
- *Ensure worker who will be disengaged are properly counseled*
- *Ensure enough notice on disengagement from employment is given*

Impact on Health and Safety

Decommissioning activities if not properly coordinated will impact on health and safety of workforce and community members. Demolition activities may cause injuries and sometimes fatalities if appropriate safety controls are not put in place. There could be emotional disturbance and in some cases health challenges such as High Blood Pressure as a result of loss of jobs.

Bell Oil and Gas FZE shall ensure:

- *Safety awareness training are put in place for workforce*
- *Emergency response procedures are put in place and enforced*
- *Use of PPE is enforced.*

Table 6.1: Summary of Impact Classifications and Significance of the Proposed Mitigation Measures

Project Phase	Project Activity	Description of impact	Impact Significance	Mitigation Measures	Residual Impact Significance
Pre-construction Phase-Mobilization	Movement of workers, Machineries and equipment	Increase in noise level within the project from movement of equipment and machineries.	Minor	***Bell Oil and Gas FZE** shall ensure:* • *Project vehicles shall be serviced and put in good condition* • *Noise silencers/ mufflers will be installed on the vehicles to reduce if not eliminate noise where necessary.*	**Negligible**
		Impact on Ambient Air Quality from emissions from vehicle conveying the workers and equipment	Minor	***Bell Oil and Gas FZE** shall ensure:* ▪ *All vehicles for the movement of project worker and equipment shall have high efficiency burners to reduce emission of noxious gases.* ▪ *Movements of men and materials are properly coordinated to optimize vehicle use and reduction resultant vehicular emissions.*	**Negligible**
		Increase in road traffic volume and risk of accidents/injury during the preconstruction phase	Minor	***Bell Oil and Gas FZE** shall ensure:* ▪ *Develop and implement an efficient Traffic and Journey management Plan* ▪ *Visible warning signs are placed on roads and vehicles associated with the project* ▪ *Defensive driving course are organized foe project Drivers* ▪ *Large and slow moving vehicles are scheduled during off-peak periods* ▪ *Community awareness of unusual activity within the project area is raised.* ▪ *Compulsory medical fitness tests are carried out on project drivers*	**Negligible**
		Impact on the existing infrastructure	Minor	***Bell Oil and Gas FZE** shall ensure:* • *Large and slow moving vehicles are scheduled during off-peak periods*	**Negligible**
		Movement of heavy equipment to worksite may pose danger to public health and safety	Minor	***Bell Oil and Gas FZE** shall ensure:* • *Visible warning signs are placed on roads and vehicles associated with the project* • *Defensive driving course are organized foe project drivers*	**Negligible**

				• *Community awareness of unusual activity within the project area will be raised.*	
Construction Phase- Site Preparation	- Land Clearance - Fabrication Transportation -Fuel utilization -Waste generation	Reduction in biodiversity/Loss of flora and fauna	**Major**	***Bell Oil and Gas FZE** shall ensure:* ▪ *Cleared area shall are limited to what is required* ▪ *Site clearing will commence from developed (e.g. roads) to underdeveloped areas to provide escape routes for wildlife.*	**Moderate**
		Degradation of surface water quality	**Moderate**	***Bell Oil and Gas FZE** shall ensure* • *Excavated materials are properly stacked to reduce turbidity effect on surface runoffs;* ▪ *Surface runoffs are contained within the existing storm water drainage system on the site;* ▪ *Trenches are backfilled and compacted to minimize the mobilization of highly turbid surface runoffs from the site into the Lagoon.*	**Minor**
		Increased noise nuisance- noise emission generation through site preparation activities.	**Minor**	***Bell Oil and Gas FZE** shall ensure:* ▪ *Noise attenuation measures such as installation of acoustic mufflers on large engines and equipment are put in place;* ▪ *Hearing protection will be provided for workers on site.*	**Negligible**
		Reduction in air Quality- through dust emissions from excavation of and site clearing activities leading to high suspended particulates in the atmosphere	**Moderate**	***Bell Oil and Gas FZE** shall ensure* • *Movements of men and materials are properly coordinated to optimize vehicle use and reduction resultant vehicular emissions.* ▪ *All mobile and stationary internal combustion engines are properly maintained.* ▪ *Low emission/high efficiency engines are used.* ▪ *Site is watered regularly to douse emission of dust*	**Minor**
		Solid waste Generation-impact on existing disposal facility	**Minor**	***Bell Oil and Gas FZE** shall ensure:* • *An efficient Waste Management Plan is put in place* ▪ *Wastes generated as a result of the project activities are properly containerized to avoid*	**Negligible**

				▪ *contamination of groundwater and nearby surface water.* ▪ *PSP refuse collector certified by LAWMA will be contracted to handle waste generated on site.* ▪ *Construction wastes such as debris, Metal Cuttings, Iron Cuttings etc. will be properly stacked for re-use where possible while those not reusable will be sold to third parties who are in need of them.*	
		Pressure on existing infrastructure	**Minor**	***Bell Oil and Gas FZE*** *shall* ▪ *Assist the host community in the provision of some other essential amenities within the limits of its resources.*	**Negligible**
		Health & safety-Injury/fatalities in workforce/communities	**Minor**	***Bell Oil and Gas FZE*** *shall ensure:* ▪ *Visible warning signs are put on roads and vehicles associated with the project* ▪ *Transportation of equipment/materials will be planned to coincide with low traffic periods* ▪ *Safety awareness training will be put in place for workforce* ▪ *Emergency response procedures will be put in place and enforced.* ▪ *Use of PPE will be ensured.* ▪ *Personnel on site will wear nose masks during (dusty) operations*	**Negligible**
		Increase in respiratory diseases & Communicable disease	**Minor**	***Bell Oil and Gas FZE*** *shall* • *Assist in organizing community-based training on the prevention of common communicable diseases, water protection/purification techniques and basic sanitation*	**Negligible**
Construction Phase	Construction activities - Excavation -Soil Compaction - Foundation and civil works -Facility construction	Increased noise level and nuisance due to use of heavy-duty equipment and machineries for construction activities.	**Minor**	***Bell Oil and Gas FZE*** *shall ensure:* ▪ *Noise attenuation measures such as installation of acoustic mufflers on large engines and equipment are put in place;* ▪ *Hearing protection will be provided for workers on site.*	**Negligible**

		Reduction in ambient air quality through dust/ and particulate emissions from excavation and other construction activities	**Moderate**	***Bell Oil and Gas FZE*** *shall ensure* • *Construction vehicles and machineries are properly coordinated to optimize vehicle use and reduction in resultant vehicular emissions.* ▪ *All mobile and stationary internal combustion engines are properly maintained.* ▪ *Low emission/high efficiency engines are used.* ▪ *Site is watered regularly to douse emission of dust*	**Minor**
		Soil Degradation and Groundwater contamination	**Moderate**	***Bell Oil and Gas FZE*** *shall ensure:* • *Excavated materials are properly stacked and protected to prevent being washed into site run-offs* • *Oil Storage facility shall be protected with bundwall to prevent any oil spills being washed into the soil and subsequently the groundwater aquifer* ▪ *Surface runoffs are contained within the existing storm water drainage system on the site;*	**Minor**
		Solid/ Liquid waste Generation impact during construction activities on existing disposal facility	**Minor**	***Bell Oil and Gas FZE*** *shall:* • *Put in place waste reduction strategy* • *Wastes generated will be properly contained to avoid contamination of ground water.* • *Runoff from the stockpile of wastes will be prevented from flowing into the River* • *PSP waste handlers certified by LAWMA will be contracted to handle wastes generated on site*	**Negligible**
		Surface water contamination from site run-off	**Moderate**	***Bell Oil and Gas FZE*** *shall:* • *Oil Storage facility shall be protected with bundwall to prevent any oil spills being washed into the site run-off and subsequently the surface water* • *Excavated materials are properly stacked to reduce turbidity effect on surface runoffs;* ▪ *Surface runoffs are contained within the existing storm water drainage system on the site;*	**Minor**

				▪ *Trenches are backfilled and compacted to minimize the mobilization of highly turbid surface runoffs from the site into the Lagoon.*	
		Increase in the cost of living due to influx of construction workers and their activities	**Moderate**	***Bell Oil and Gas FZE** shall :* *Ensure that most of the construction workers will come from the neighbouring communities*	**Minor**
		Health & safety-Injury/fatalities in workforce/communities including possibilities of communicable diseases	**Minor**	***Bell Oil and Gas FZE shall ensure:*** ▪ *Safety awareness trainings are put in place for workforce* ▪ *Emergency Response Procedures are put in place and enforced.* ▪ *The use of PPE is ensured.* ▪ *Personnel on site will wear nose masks during (dusty) operations* ▪ *Community based training on the prevention of common communicable diseases, water protection/purification techniques and basic sanitation will be organized periodically*	**Negligible**
Operation Phase	Operation of the Pipe threading and valve assembly	Impact on Air Quality from emissions from Generating Set and Operational vehicles	**Moderate**	***Bell Oil and Gas FZE** shall ensure* ▪ *All flanges and vents are properly tightened to minimize fugitive emissions* ▪ *All systems are regularly checked to ensure that there are no leakages and losses.* ▪ *All machinery, equipment and vehicles for the project have high efficiency burners to reduce emission of noxious gases.*	**Minor**
		Increase noise nuisance	**Moderate**	***Bell Oil and Gas FZE** shall ensure* • *the facility Operations are planned such that regulatory limits are not to be exceeded.* • *Appropriate measure will be put in place to mitigate noise pollution.*	**Minor**
		Transportation-disturbance to traffic.	**Moderate**	***Bell Oil and Gas FZE** shall ensure* ▪ *Put in place and implement an efficient Traffic Management Plan* ▪ *Provide enough parking spaces for trucks and*	**Minor**

				cars within the facility.	
		Solid waste generation-impact on existing waste disposal facility might lead to environmental health hazards	**Minor**	***Bell Oil and Gas FZE** shall:* • *Put in place waste reduction strategy* ▪ *Ensure wastes generated are properly containerized to avoid contamination of ground water.* ▪ *Ensure runoff from the stockpile of wastes will be prevented from flowing into the* storm water drainage channel ▪ *Engage LAWMA to handle wastes generated on site* ▪ *Ensure proper treatment of wastewater / sewage before discharge into the environment* • *Effluents from treatment process will be tested to meet local regulatory standards before discharge* • *Ensure all sludge resulting from treatment processes will be properly stacked at designated area and dried before disposal.* • *Ensure all waste or spent oil will be properly containerized and disposed off through the services of LASEPA accredited operators.* •	**Negligible**
		Surface Water Contamination as a result of discharge of untreated Wastewater and Sewage	**Moderate**	***Bell Oil and Gas FZE** shall ensure* • *Proper treatment of wastewater / sewage before discharge into the Environment* • *Effluents from treatment process will be tested to meet local regulatory standards before discharge*	**Minor**
		Health & safety-Injury/fatalities in workforce including possibilities of fire outbreak	**Moderate**	***Bell Oil and Gas FZE** shall ensure* ▪ *Safety awareness trainings are put in place for workforce* ▪ *Emergency Response Procedures are put in place and enforced.* ▪ *The use of PPE is ensured.* ▪ *Personnel on site will wear nose masks during (dusty) operations*	**Minor**

				▪ *Personnel will be trained on Fire Prevention technique while firefighting measure are put in place*	
Decommissioning/Abandonment Phase	Demolition	Noise level and Dust generation	**Minor**	***Bell Oil and Gas FZE*** *shall ensure mobile and stationary internal combustion engines are properly maintained*	**Negligible**
		Solid Waste generation	**Minor**	***Bell Oil and Gas FZE*** *shall ensure* ▪ *The project's waste management plan will be strictly followed* ▪ *All wastes arising from demolition and decommissioning of facilities will be properly stacked and disposed off through the services of LAWMA accredited PSP Operators.*	**Negligible**
		Loss of job/change in economic conditions/emotional disturbance	**Major**	***Bell Oil and Gas FZE*** *shall ensure:* • *Assists in skill acquisition for all workers that would be disengaged* ▪ *Ensure worker who will be disengaged are properly counseled* ▪ *Ensure enough notice on disengagement from employment is given*	**Moderate**
		Injury/fatalities in workforce/communities	**Minor**	***Bell Oil and Gas FZE*** *shall ensure:* ▪ *Safety awareness training are put in place for workforce* ▪ *Emergency response procedures are put in place and enforced* ▪ *Use of PPE is enforced.*	**Negligible**

NB: **Negligible** **Minor** **Moderate** **HighHigh**

6.3 Residual Impacts

Residual Impacts are impacts of a project that still exists even after measures have been taken for mitigation. These are impacts that would exist as long as the project exist and would only change upon decommissioning of the project. Some residual impacts remain even after decommissioning of the facility. For this project, the residual Impacts include:

Land take or Land Availability

The land acquired for this project will not be available for other uses as long as this project exists. This is an impact that will only change when the facility is decommissioned, and the site is committed to other use(s). However, this project area is originally designated for a project of this nature, the significance of this impact is therefore rated **low.**

Change in Landform

Construction activities would to some extent result in change in the landform and natural aesthetics of the project environment with clearing of vegetation and some land improvement activities.

Loss of Biodiversity

The construction phase of the project will no doubt result in loss of biodiversity. Even when the facility is decommissioned, and the site restored, it is practically impossible to restore the lost biodiversity that is native to the project site.

6.4 Summary

In summary, the mitigation measures recommended in this section are deemed adequate to effectively ameliorate the negative impacts that may attend this project. From the assessment undertaken, when the measures are applied, all minor and moderate negative impacts will be reduced significantly and will leave, in all case, only negligible residual impacts.

In order to ensure sustainability and effectiveness of these measures, it is necessary to have in place a sound cost-effective and fit-for-purpose Environmental Management Plan (EMP). This is presented in the next section of this report.

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Introduction

One of the overarching rationales behind an Environmental Impact Assessment is the identification of potential and associated impacts of a proposed project on the biophysical and socioeconomic environment of the project area; proffer mitigation measures for the identified negative impacts (and enhance positive impacts) and develop a robust, fit-for-purpose Plan to ensure the mitigation measures and other monitoring requirements are strictly followed throughout the various phases of the project in line with global best practices and compliance with relevant regulatory requirements. This Environmental and Social Management Plan (ESMP) is therefore an integral part of the EIA report.

Bell Oil and Gas FZE has developed this site specific Environmental and Social Management Plan (ESMP) to manage all environmental and social issues that may arise from the project implementation. This ESMP expounds a series of measures and procedures that very easily spell out all requirements for environmental protection including mitigation measures and monitoring plan in an attempt to avoid, minimize, or ameliorate effects or impacts of project implementation and where possible, enhance beneficial effects in accordance with Nigerian and other applicable international standards and regulations.

This ESMP is to guarantee that the proposed Bell Oil and Gas FZE Oil Country Tubular Goods (OCTG) Steel Pipe threading and Valve Assembly project will be implemented in an environmentally friendly and sustainable manner through the management and monitoring of environmental, socioeconomic, health and safety impacts of the various phases of the project. Consequently, a bilateral environmental management framework is adopted. The framework consists of an Environmental Management System (EMS) and an Environmental and Social Monitoring Programme. It is essential to reemphasize that this ESMP focused only on the proposed Bell Oil and Gas (BOG) FZE Steel Pipe threading and valve assembly facilities for steel pipes used mainly in onshore and offshore oil and gas upstream operations.

7.2 Objectives of the ESMP

The Environmental and Social Management Plan is a tool for managing the predicted environmental and social impacts of a project. It provides the means whereby mitigation measures developed for reducing the identified impacts to ***as low as reasonably practicable*** (ALARP) are implemented and monitored throughout the project lifecycle. This ESMP is therefore a planned and integrated programme aimed at ensuring that both the identified and unidentified impacts that may arise during various phases of the project are brought to acceptable level

Bell Oil and Gas FZE objective is to avoid, where practicable, unacceptable adverse environment, social and/or economic impacts. In the circumstance, impacts cannot be avoided; Bell Oil and Gas FZE and Project Contractors are committed to the implementation of appropriate mitigation measures.

The objectives of this proposed project ESMP are to:

i. ensure compliance with relevant regulatory requirements/ legislations and Bell Oil and Gas FZE HSE policy
ii. achieve enhance and demonstrate sound environmental and social performance built around the principle of continuous improvement
iii. encourage and achieve the highest performance and response from individual employee and contractors
iv. identify the roles and responsibilities of the individuals responsible for the management of the environmental and social components of the project; and
v. communicate environmental and social expectations and requirements throughout the project team.
vi. identify key environmental issues envisaged to be encountered during construction and operation phases of the project
vii. provide guidelines for appropriate mitigation measure
viii. establish systems and procedures for implementing mitigation measures
ix. ensure the implementation of mitigation measures and monitor their effectiveness
x. take necessary prompt action when unforeseen impacts occur

To achieve the above, the ESMP considered each environmental, social and health impacts from the point of view of the valued ecosystem and social components (VEC/VSC) to be monitored as well as the parameters for their monitoring.

All contractors shall c be required to comply with the ESMP requirements as applicable to the tasks they are engaged to undertake. It is recognized that practical implementation of many of the measures may rest with contractors and consequently, Bell Oil and Gas FZE Project Management Unit (PMU) shall monitor contractors' compliance with the ESMP and will require the implementation of a robust review programme, as described in this ESMP, to measure and ensure that the contractors are committed to its implementation.

7.3 Implementation of Mitigation Measures

It is necessary to ensure implementation of all mitigation measures proffered for the identified/ predicted impacts as detailed in the previous chapter in order to achieve the objectives of the ESMP. An Impact Mitigation Plan ensures the allocation of responsibilities and spells out what stage of the project they are to be conducted. For this project, BOG FZE shall assign a Project Management Unit (PMU) with strong support of the management to ensure implementation of the mitigation measures. Where the mitigation measures are to be implemented by contractors, the PMU shall monitor to ensure the measures are effectively implemented. Major responsibilities of the PMU are to ensure the mitigation measures and monitoring programs are carried out as agreed, and reporting is completed in compliance with the appropriate regulatory requirements.

7.4 Environmental Management Programme/Resources

7.4.1 <u>Environmental Management System (EMS)</u>

An environmental management system (An Environmental Management System, or EMS, is a structured framework under which an entity can manage environmental impacts and is a formally documented procedure or guideline that supports the management and monitoring of impacts on the environment in the operation and future expansion of an entity. An EMS is a management tool that systematically ensures environmental compliance that works towards continuous environmental improvement, and it must start with an endorsed environmental policy

At the center of an EMS is a self-analysis of all operations, activities, and environmental aspects that can lead to an impact on the environment, and includes a monitoring and measurement requirement that quantifies selected metrics that can demonstrate environmental improvement. The ISO 14001 Environmental Management Systems standard is one of the world's most recognized best management practices in sustainability. The ISO 14001 EMS standard requires documentable evidence of agreement with the standard to achieve third-party certification.

An EMS is balanced around communication and awareness of environmental issues, with the intention of having participation from each member of a cross functional team, comprised of well-trained representatives from many parts of an organization, facility, or department. Environmental rating systems can be valuable verification tools to predict future improvements in design projects. In the end, an EMS is a management tool to help measure environmental performance, to ensure environmental compliance and authenticate continuous improvement. Government projects can benefit from an EMS, and by strengthening its commitment to the environment, it can prove that public funding is being spent with the consideration of the environment as a priority.

7.4.1.1 Purpose of Environmental Management System (EMS): It

- serve as a tool, or process, to improve environmental performance and information mainly "design, pollution control and waste minimization, training, reporting to top management and the setting of goals"
- provide a systematic way of managing an organization's environmental affairs
- Is the aspect of the organization's overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment,

- assists with planning, controlling and monitoring policies in an organization
- gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes
- creates environmental buy-in from management and employees and assigns accountability and responsibility.
- sets framework for training to achieve objectives and desired performance.
- Helps understand legislative requirements to better determine a product or service's impact, significance, priorities and objectives.
- focuses on continual improvement of the system and a way to implement policies and objectives to meet a desired result. This also helps with reviewing and auditing the EMS to find future opportunities.
- encourages contractors and suppliers to establish their own EMS.

The Environmental Management System (EMS) and HSE-MS manual is developed as an integral part of the detailed engineering design stage. The plan will ensure protection of the environment, employees and the public from impacts related to site preparation, construction and operational activities of the project.

Objectives of BOG FZE Environmental Management System

- To ensure that the components of the development are operated in accordance with the design.
- To provide early warning of environmental impact and be able to prevent or reduce deterioration.
- To ensure regular training of staffers on environmental management and safety with ever changing environmental systems and technologies.
- To ensure that all workers, subcontractors and others involved in the project meet legal and other requirements with regard to environmental management.

The major components of the EMS developed for this project include:

- Commitment by leadership at all levels to promote operational excellence by assuring alignment of vision, expectations, resources and accountabilities;
- Comprehensive identification of high-level issues, risks, opportunities, and gaps in system and operating practices that can impact current or future ability to achieve the required level of performance;
- Establish processes to ensure documents and records that are critical to operational excellence are current, controlled, and accessible.
- Establish clear yardsticks to measure statistically significant performance improvement toward goals and targets;
- Implement a process to ensure that contractors authorized to act on behalf of the company understand and comply with relevant company policies and procedure.
- Establish and maintain appropriate processes for management to regularly monitor company's HSE performance, conduct regular HSE audits and

evaluations to ensure that the system is implemented and maintained and remains effective

7.5 BOG FZE, Health Safety and Environment Policy

Within Bell Oil and Gas FZE, effectively managing Health, Safety and Environmental processes is a top priority. As such, HSE is fundamental to the company's corporate culture and a pre-requisite for achieving business objectives.

Such objectives are predicated on a "Responsible Growth" philosophy, which means protecting the health and safety of employees and customers, supporting communities where we do business and minimizing impact on the environment, while also maintaining the sustained growth and profitability of the company.

BOG FZE has adopted the principles laid out in the OHSAS 18001 standards and operates an HSE Management System that encourages continual improvement of our HSE performance. The governing principles of this system are:

- Setting HSE objectives and targets relevant to operations, working environment and customer's requirements.
- Monitoring HSE performances against objectives and targets and reviewing HSE strategy and approach accordingly.
- Communicating, training and educating employees on HSE matters at all level of the organization.
- Complying with statutory HSE requirements and adopting applicable Industry best practices.

The Managing Director/ CEO is responsible for the overall Corporate HSE performance and has delegated responsibilities and authorities to each Business and Service Unit Manager for implementing the HSE Management System within their area of control.

All Bell Oil and Gas FZE and subcontractor's employees are held accountable for their HSE performance and are encouraged to actively participate in shaping an incident free working environment.

7.6 ENVIRONMENTAL AND SOCIAL MANAGEMENT ORGANIZATION

Bell Oil and Gas FZE is committed to providing resources essential to the implementation and control of the EMP. These include appropriate human resources and specialized skills, training, programs and capacity building, communication procedures, documentation control and a procedure for the management.

Bell Oil and Gas FZE have an HSE unit that is responsible for the management of health, safety and environmental issues including community related issues .The organizational structure of the existing HSE unit is shown below in **Figure 7.1**.

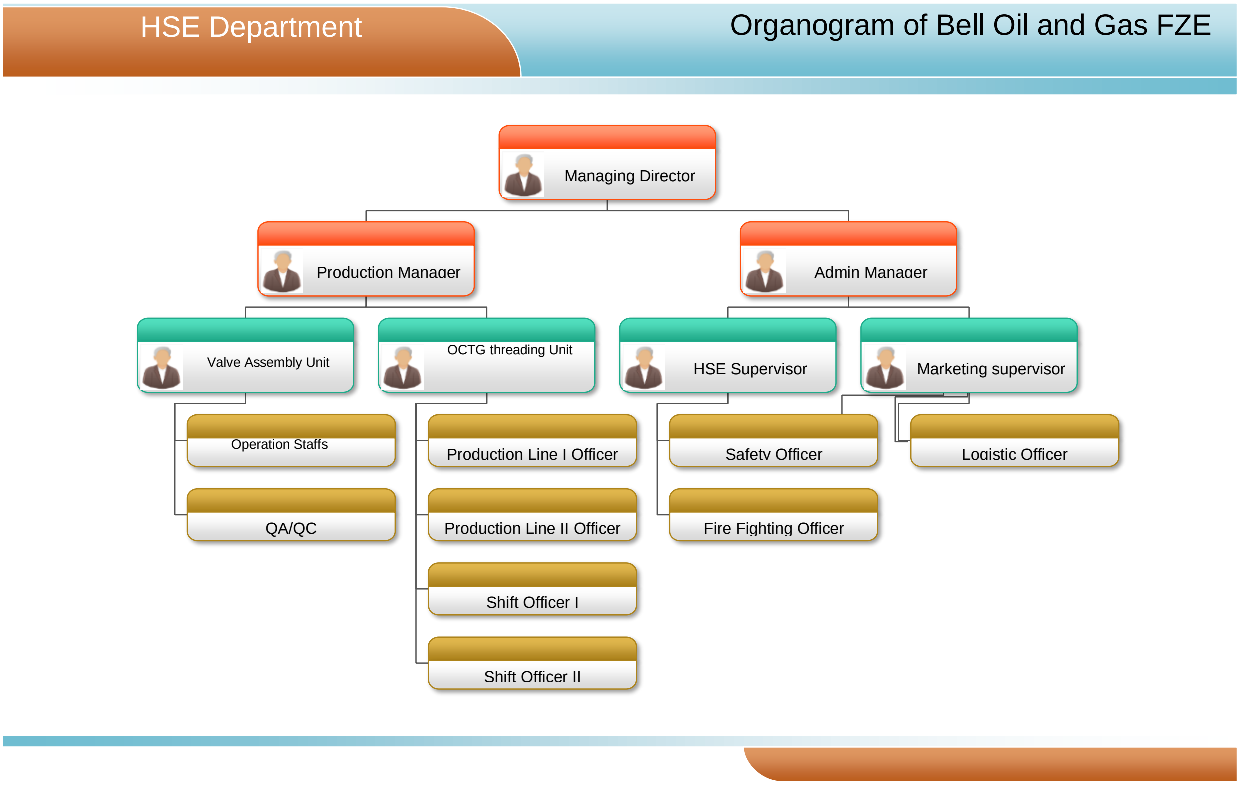


Fig 7.1: Organogram of Bell Oil and Gas FZE

The head of the HSE unit shall oversee the environmental and social (including health and safety) aspects of the Proposed Steel Pipe threading and Valve Assembly Facilities Project. The HSE Manager shall ensure that the Project and subcontractors operate in accordance with the applicable regulatory HSE requirements and plans and also monitor implementation of environmental and social protection measures.

7.7 BOG FZE Environmental Management System

The BOG FZE Environmental Management System is designed to:

- minimize environmental liabilities;
- maximize the efficient use of resources;
- reduce waste;
- demonstrate a good corporate image;
- build awareness of environmental concern among employees;
- gain a better understanding of the environmental impacts of business activities; and
- Increase profit, improving environmental performance, through more efficient operations.

This EMS is a powerful tool for BOG FZE to both improve her environmental performance, and enhance her business efficiency. Construction has outstanding impacts on the natural environment. Construction activities are generally characterized as environmental disturbing business. They produce environmental nuisance in the form of muddy runoffs, noise, dust, bad odours, vibration, and chemical emissions of particles, toxic gases, solid waste and water pollution. Facing the growing pressure of environmental protection, BOG FZE has undertaken measures to reduce their damage to the environment.

Implementation of ISO 14001 EMS provides the basic systems, which lead to effective environmental management. These systems are combined with the other management requirements. The primary objective of ISO 14001 EMS is to aid BOG FZE minimize their contribution to environmental problems through a systematic control system.

7.8 Training and Capacity Building

Training is essential for ensuring that the ESMP provisions are implemented efficiently and effectively. Training needs shall be identified based on the available and existing capacity of site and project personnel (including the Contractors) to undertake the required ESMP management actions and monitoring activities. It is vital that all personnel are adequately trained to perform their designated tasks to an acceptable standard. In addition to training, general environmental awareness shall be fostered among the project's workforce to encourage the implementation of environmentally sound practices throughout its duration. This ensures that environmental accidents are minimized and environmental compliance maximized.

All employees of BOG FZE and contractors shall undergo general Health, Safety and Environment (HSE) awareness training and specific. HSE training as may be required in order fulfil their responsibilities under the ESMP. The objective of the training is to ensure all employees understand their obligation to exercise due diligence for HSE matters. Employees in this instance include BOG FZE staff on site and all contractors. Generally, all BOG FZE employees and those of her sub-contractors shall undergo HSE induction, which will acquaint them with BOG FZE HSE policy regarding their line of duty. The HSE department which bears responsibility for promoting BOG FZE HSE policies shall conduct or organize training programmes as may be required.

As part of technological transfer, the proposed pipe threading plant will be provided with BOG FZE's Chinese partner (Foryouth) in the form of strategic alliance/collaborative venture. Payment for technology transfer shall be through issue of equity shares. The company shall also mobilise certified OCTG machinists and other relevant qualified operator's in-country to operate the equipment whilst training Nigerian nationals as understudies. The collaborative venture arrangement with Foryouth ensures mutual trust, which fosters full and timely technology transfer. The plan is to have the plant fully operated by nationals within three years of set up. For the valve assembly, testing, repair and maintenance, OMB shall provide technological support in form of licensing and contracting agreement. They will train Nigerian personnel to carry out the job within three years of set up.

Security personnel shall be trained adequately on the appropriate conduct towards the local communities and need to act and applicable rules/regulations. Other training and awareness programmes shall include but not limited to:

- Site specific HSE induction
- Tool Box meetings
- First Aid Awareness
- Slips, Trips and Falls
- Journey Management Plan
- Defensive Driving
- Incidents Reporting and Investigation
- Job Hazard Analysis

Health safety and Environment

The management of BOG FZE is committed to appropriate training of staff; all management and employees, contractors and visitors are informed on their role and responsibility especially on safety, health and environmental protection procedures and standards. Training shall be undertaken in order to ensure the technical knowledge necessary to maintain the BOG FZE standards.

The junior staffs shall be given on-the job training while the senior staffs are taken through both in-house and external seminars and workshops. To have the staff perform optionally, the training will run both locally and overseas. Overseas training programmes will hold at Shanghai China. Before the installation of the equipment, five personnel will be employed and they will receive theoretical and operational training at Shanghai, China. The proposed training programme are as highlighted be in accordance to **Table 7.1** and **Table 7.2**

Table 7.1: Proposed Oversea training for personnel

S/N	Training and content	Number of persons
1	Hydraulic Test Machine- Theoretical and operational training for main operator on; 1. API 5CT Standard training 2. Working principle and operation of the hydraulic test machine	1
2	Threading machine- Theoretical and operational training for main operator on; 1. API 5CT Standard training 2. Working principle and operation of the threading machine	1
3	Coupling make up machine- Theoretical and operational training for main operator on; 1. API 5CT Standard training 2. Working principle and operation of the coupling make-up machine	1

4	Measuring station- Theoretical and operational training for main operator on; 1. API 5CT Standard training 2. Working principle and operation of the measuring station	1
5	Thread inspection- Theoretical and operational training for main operator on; 1. API 5CT Standard training 2. Working principle and operation of the thread inspection	1

After the installation of the equipment and commission of the facility, seventeen (17) staff will be employed and trained in Lagos, Nigeria on the processes for operating the machines and threading

Table 7.2: Proposed Local training for personnel

S/N	Training programme and content	Number of person
1	Threading machine-Ordinary operator training on; 1. Process requirements for threading machine 2. Operation of threading machine	1
2	Thread inspection- Ordinary operator training on; 1. Process requirements for thread inspection 2. Operation of threading machine	1
3	Measuring Station- Ordinary operator training on; 1. Process requirements for measuring station 2. Operation of measuring station	1
4	Other ordinary position training on; 1. Process requirements for each position 2. Operation of each position	1

7.9 Community Relations

With the existing MoU between LFZ and captive communities, Bell Oil and Gas FZE intends to maintain this path on Community Relations, with a range of programmes and activities in this area. The objective is to ensure the sustainable development of the host communities:

- By helping to improve infrastructure, health and educational care facilities;
- By encouraging and supporting local capacity building enterprise;
- By effecting technology transfer in a manner consistent with the Oil and Gas's business principles.

In line with the guiding principles for managing community relations, the management of BOG FZE shall communicate with the host communities by the following:

- BOG FZE shall promptly respond to correspondence
- A formal agreements will be adopted between the parties;
- BOG FZE through its Community Relations Department will on a continuous basis interact with relevant groups in the community such as youth and

women groups etc.

7.10 Environmental Protection and Management Plan

The purpose of the Environmental Protection and Management Plan is to ensure the fulfillment of Bell Oil and Gas (BOG) FZE environmental commitments and responsibilities; and ensure compliance with all relevant regulatory requirements with respect to proposed Project. This Plan describes the environmental protection and management measures that will be applied throughout the life of the proposed project to avoid or minimize the potential effects on the environment associated with the project. This document is intended to be used in conjunction with site specific HSE Action Plan.

In view of the fact that this document is designed to address both environmental protection and project implementation related issues, and applies throughout the life of the project, it is necessary for all key project personnel to review this and all associated documentation prior to engaging in any aspect of the project that may have potential impacts on the environment.

Compliance with this Plan will ensure all environmental protection and mitigation measures taken into account. BOG FZE and all contractors' shall have commitment to the project Implementation to avoid or minimize potential impacts on the environments. Contributions from stakeholders, regulatory agencies were considered in the development of the environmental protection and mitigation measures.

It is worthy of mention that this Environmental Protection and Management Plan is intended as a field usable reference document providing clear and specific guidance to employees of all contractors engaged by BOG FZE in respect of the proposed project and will be updated regularly as required over the life of the project to address evolving site specific commitments and responsibilities. Both routine and abnormal conditions, as well as emergencies that can reasonably be anticipated, will be addressed.

The Plan is summarized in **Table 7.3, 7.4** and **7.5** below and it gives details of the Plan at different stages of the project development (pre- construction/construction phase, operational phase and decommissioning phase). The plan outlines the impacts, how the negative impacts will be mitigated, and institutions/individuals responsible for ensuring that mitigation activities are implemented. Detailed actions are tabulated in a matrix for ease of reference and review.

Table 7.3: Pre-construction/ Construction Phase EMP

Environmental Component	Source of impact	Objective	Management Plan	Responsible party	Monitoring frequency
Ambient Air Quality	- Noxious gas emissions from operation of vehicles and machinery - Suspended particulates from site clearing activities	- Reduction of gaseous pollutants/emissions from vehicles and machinery - Suppression of dust from project activities.	- All vehicles and machinery will be regularly serviced, equipped with catalytic converters and switched off when not in use - Only portions of the site required for construction will be devegetated and water bowser will be used for regular dust suppression	Bell Oil and Gas and the Construction Contractor's site supervisor	- Dust suppression will be carried out at least twice daily during the dry season -Air quality monitoring (emissions & particulates) will be conducted weekly
Noise Level	-Movement and operation of vehicles and machinery - Site clearing/preparation activities	-Minimize noise to acceptable levels - protect workers from noise exceeding acceptable levels	- Selection of low noise level equipment when Purchasing/leasing farm equipment - All activities shall be limited to daytime to avoid night time disturbance - All workers will be provided with appropriate PPEs - All machinery will be serviced regularly and installed with appropriate noise mufflers	Bell Oil and Gas and construction contractor's site supervisor	- Average ambient noise levels will be measured daily during this phase of the project
Water (Surface & Ground) quality	--fuel and oil leaks/spills from storage area and poor handling and surface runoff - Poor waste (sewage, vegetal and domestic) management practices	-to prevent water contamination from oil, diesel, sewage, refuse and chemical runoffs, spills, seepage and indiscriminate disposal and handling	- Fuel storage tanks will be placed within bunds with concreted surface and sump shall be constructed in such a way as to collect any oil that has spilled - Provision of mobile toilets for the construction workers shall be ensured - Daily toolbox talks and trainings will include spill prevention	Bell Oil and Gas and construction contractor's site supervisor	Water quality monitoring shall be conducted weekly

			- proper waste management practices such as segregation of waste and use of properly designated waste bins shall be enforced		
Soil	-fuel and oil leaks/spills from storage area and poor handling - Poor waste (sewage, vegetal and domestic) management practices -	To protect the soil from fuel, oil and other forms of contamination -To protect the soil from erosion	- Fuel and oil shall only be allowed in designated storage and handling areas which will be appropriately concretized to prevent seepage - Only portions of the site required for construction will be devegetated to reduce the possibility of water and wind erosion - Storm water drains will be constructed around construction sites to collect storm water and there to prevent soil erosion	Bell Oil and Gas and construction contractor's site supervisor	soil quality monitoring shall be conducted weekly
Flora and Fauna	- site clearing and vegetation stripping	- To prevent the unnecessary loss of ecologically important/sensitive local flora and fauna where applicable	- Noticed fauna in the proposed project site will be preserved by taking it or allowing it room to migrate to areas that will remain undisturbed. -where possible, important/sensitive flora will be left undisturbed or transplanted - Only portions of the site required for construction will be devegetated	Bell Oil and Gas and construction contractor's site supervisor	Flora and fauna will be assessed monthly
Waste (solid, sewage and hazardous) Management	- spent oil and used batteries from vehicles and machinery -vegetal waste from site clearing -sewage generated by site workers -refuse generated by site workers - Construction waste such as packaging waste,	- To safely keep generated hazardous waste and dispose of appropriately - To protect sewer waste from contaminating the soil and or ground water - To manage and appropriately dispose all refuse	- Used oil and used batteries storage areas shall be constructed according to environmental guidelines. Lockable, concreted and bunded shed shall be constructed. - Mobile toilets shall be provided for use for the site workers - Domestic waste will be collected in segregated bins prior to collection and final disposal by a LAWMA accredited operator - construction wastes such as wood, metal cuttings etc. will be collected and reused during construction activities where possible,	Bell Oil and Gas and construction contractor's site supervisor	Waste management activities shall be daily throughout the project's life span

	metal and wood cuttings etc	and vegetal waste generated on site	sold or given to the locals for domestic use		
Socioeconomics	Influx of project workers into the community could cause: - increased strain on communal amenities like roads, water etc. - - improved employment opportunities for indigenes	- To ensure harmony between project workers and the host community - To minimize public health and safety risks - To ensure the economic empowerment of the community via employment of community members	- Pre-employment and regular medical examinations will be carried out on all employees to ascertain their health -continuous consultation with the community to ensure continued peace and support for the project shall be ensured - safety and security of all project equipment and materials will be of high priority to prevent incidents and accidents - Indigenes with the requisite skills will be considered for the various types of available jobs	Bell Oil and Gas and construction contractor's site supervisor	Consultation shall be continuous throughout the project's life span

Table 7.4: Operational Phase EMP

Environmental Component	Source of impact	Objective	Management Plan	Responsible party	Monitoring frequency
Ambient Air quality	- noxious gas emissions from operation of vehicles and machinery - suspended particulates from farming activities and fish feed processing	- Reduction of gaseous pollutants/emissions from vehicles and machinery - Suppression of dust from farm activities regularly.	- All vehicles and machinery will be regularly serviced, equipped with catalytic converters and switched off when not in use - Water bowser will be used for regular dust suppression -Pipe threading and Valve production plant shall be installed with scrubber to reduce release of particles into the air - Selection of low noise level equipment when Purchasing/leasing farm equipment	Bell Oil and Gas HSE Department	Air quality monitoring (emissions & particulates) will be conducted monthly

Noise Level	-Movement and operation of vehicles and machinery - Production activities	-Minimize noise to acceptable levels - Protect workers, residents and guests from noise exceeding acceptable levels	- All noisy activities shall be limited to daytime to avoid night time disturbance - All workers will be provided with appropriate PPEs - All machinery will be serviced regularly and installed with appropriate noise mufflers Power generating set will be soundproofed	Bell Oil and Gas	- Average ambient noise levels will be measured weekly during this phase of the project
Water (Surface & Ground) quality	--fuel and oil leaks/spills from storage area and poor handling and surface runoff - Poor waste (sewage and domestic) management practices	-To prevent water contamination from oil, diesel sewage, refuse and chemical runoffs, spills, seepage and indiscriminate disposal and handling	- Fuel storage tanks will be placed within bunds with concreted surface and sump shall be constructed in such a way as to collect any oil that has spilled - Provision of proper sewage and drainage systems - Daily toolbox talks and trainings will include spill prevention and chemical material handling - proper waste management practices like designated/segregated waste bins shall be enforced to discourage littering and dumping in the water body	EMO and Farm Manager	Water quality monitoring shall be conducted monthly
Soil	-fuel and oil leaks/spills from storage area and poor handling - Poor waste (sewage, vegetal and domestic) management practices -	To protect the soil from contamination by fuel, oil and hazardous substances. - To prevent soil contamination by hazardous materials and chemicals -To protect the soil from erosion	- Fuel and oil shall only be allowed in designated storage and handling areas which will be appropriately concretized to prevent seepage - Hazardous chemicals / materials shall only be stored in designated areas. - Storm water drains will be constructed around the facility to collect storm water and there by prevent soil erosion -Trees will be planted along road	Bell Oil and Gas HSE Department	soil quality monitoring shall be conducted monthly

			periphery to protect the soil from erosion		
Waste (solid, sewage and hazardous) Management	- spent oil and used batteries from vehicles and machinery, vegetal waste, sewage, refuse generation	- To safely keep generated hazardous waste and dispose of appropriately - To protect sewer waste from contaminating the soil and or ground water - To manage and appropriately dispose all refuse and domestic waste generated on site	- Used oil and used batteries storage areas shall be constructed according to environmental guidelines. - A septic soak way system shall be used to manage sewage. - Domestic waste will be collected in segregated bins prior to collection and final disposal by a LAWMA accredited operator	Bell Oil and Gas HSE Department	Waste management activities shall be continuous throughout the project's life span. Waste disposal records shall be tracked and checked monthly
Socioeconomics	Influx of project workers into the community could cause: - increased strain on communal amenities like roads, water etc. - improved employment opportunities for indigenes -increased revenue to government in taxes	- To ensure harmony between project workers and the host community - To ensure the economic empowerment of the community via employment of community members - To enhance all positive impacts of the project on the indigenes and government	- Pre-employment and regular medical examinations will be carried out on all employees to ascertain their health - Continuous consultation with the community to ensure continued peace and support for the project shall be ensured - Indigenes with the requisite skills will be considered for the various types of available jobs - Implementation of CSR projects to provide additional amenities to the community	Bell Oil and Gas	Consultation shall be continuous throughout the project's life span
Health and Safety	-incidents and accidents during Plant operations	- To minimize public health and safety risks such as the spread of STDs and other communicable diseases -To minimize accidents	-the use of PPEs by all staff and contractors shall be enforced with appropriate signage and fire-fighting equipment strategically placed - Access restriction to unauthorized individuals on the farm's construction	Bell Oil and Gas HSE Department	Continuous throughout the operation of the Plant

		during routine and scheduled Plant operations	and operational areas - safety and security of all project equipment and materials will be of high priority to prevent incidents and accidents - To reduce increased pressure on existing health facilities, the proponent will put up a Sick Bay for workers prior to being referred to a hospital with which the Company has a contract.		

Table 7.5: Decommissioning Phase EMP

Environmental Component	Source of impact	Objective	Management Plan	Responsible party	Monitoring frequency
Ambient Air quality	- noxious gas emissions from operation of vehicles and machinery - suspended particulates from decommissioning activities	- Reduction of gaseous pollutants/emissions from vehicles and machinery - Suppression of dust from project activities.	- All vehicles and machinery will be regularly serviced, equipped with catalytic converters and switched off when not in use - Natural revegetation of all exposed portions of the land will be allowed pending a final decision on the eventual use of the land - water bowser will be used for regular dust suppression	Bell Oil and Gas HSE Department	Monitoring will be throughout this phase
Noise Level	-Movement and operation of vehicles and machinery - Site clearing/decommissioning activities	-Minimize noise to acceptable levels - protect workers from noise exceeding acceptable levels	- Selection of low noise level equipment when Purchasing/leasing farm equipment - All activities shall be limited to daytime to avoid night time	Bell Oil and Gas HSE Department	Monitoring will be throughout this phase

			disturbance - All workers will be provided with appropriate PPEs		
Land use	-Demolition/removal of existing infrastructure	-To safely alter the land use pattern without serious consequences	- Demolition of all surface infrastructures, grading and re-profiling of the surface and re-vegetation will be done. If possible land use will change to the original one.	Bell Oil and Gas	Monitoring will be throughout this phase
Soil	-Demolition/removal of existing Plant infrastructure - oil, fuel and chemical spills	- To protect the soil from contamination and erosion	-Removal of all potential soil contaminants by appropriately qualified personnel will be ensure before the decommissioning of oil, fuel and chemical storage/handling areas -Natural revegetation of the site will be encouraged to stabilize the soil and deter erosion -All trenches and drainage channels will be backfilled to ensure soil stabilization	Bell Oil and Gas	Monitoring will be throughout this phase
Water (Surface & Ground) quality	-Demolition/removal of existing Plant infrastructure -	- To prevent surface and ground water contamination	- Removal of all potential soil contaminants by appropriately qualified personnel will be ensure before the decommissioning of oil, fuel and chemical storage/handling areas to prevent spills and seepage into water resources	Bell Oil and Gas	Monitoring will be throughout this phase
Waste (solid, sewage and hazardous)	- spent oil and used batteries from vehicles and machinery, vegetal	-To ensure the safe disposal of all wastes generated during	- All Demolition waste will be sorted and disposed, recycled, sold and/or given to the locals	Bell Oil and Gas HSE Department	Monitoring will be throughout this phase

Management	waste, sewage, refuse generation	decommissioning	for domestic use according to the State's waste management regulations		
Socioeconomics	-loss of livelihood -reduced local revenue	-To reduce the negative impact of lost jobs on workers	- All employees and customers of the farm will be informed well ahead of time before final closure of Plant operations -All appropriate compensations will be paid to the disengaged workers	Bell Oil and Gas	Monitoring will be throughout this phase

7.11 Institutional Arrangements - Construction Phase

The institutional arrangements for environmental management in the Construction Phase of the Project are established by the overall contractual and management framework with roles and responsibilities as assigned by the agreements between the Lekki Free Zone Development Company as the Landlord and Bell Oil and Gas FZE as the Project Proponent. Within this framework, the roles, staffing and responsibilities for implementation of the EMP in the Construction Phase are foreseen as indicated by **Table 7.6**. The roles, responsibilities and staffing implications are discussed from the "bottom-up" (i.e., from the job site to upper management) reflecting the flow of environmental information from its origins to higher levels in the hierarchy.

Table 7.6: EMP Implementation Responsibilities: Construction Phase

Entity	**EMP Roles & Responsibilities**	**EMP Staffing**
Contractor's Environmental Specialist (CES)	Contractors are responsible for the preparation of Environmental Action Plans (CEAPs). The CEAP must be based the EMP and the full set of environmental specifications for the CEAP provided by the Conditions of Contract. Prior to the initiation of the work, the ESIA Act and EMS requires appointment and approval of an Environment/Safety Officer (ESO). Responsibilities of the ESO include day-to-day issues of environmental management. During the course of the work, the Contractor is required to monitor of relevant environmental parameters (using in-house or contracted resources). The ESO is required to conduct weekly inspections of certain environmental parameters and to monitor (or arrange third party monitoring of) air, water, noise and vibration on a monthly basis or more often if determined warranted. Responsibilities include the preparation of Routine Monthly Reports and other reporting responsibilities as determined by circumstances.	Contractors are required to hire a licensed environmentalist or firm for the preparation of the CEAP and must retain that environmentalist/firm to oversee the operation throughout the contract period. The CES staff may conduct the required monitoring and/or may arrange with certified service providers.
Construction Supervision Team (CST)	The roles and responsibilities of the CST are to supervise construction activities to ensure that they are in compliance with the contracts and specifications for the work, including the implementation of the EMP. The CST is required to review the monthly monitoring reports, identify significant environmental issues and to redress these issues as may be required on a case-by-case basis. Unannounced periodic site inspections are required, including on-site measurements of maximum noise levels and	Given the size and complexity of the Project and the need for periodic site visits, etc., it is estimated that the CSt team will comprise of the LFZDC Monitoring team and BOG FZE representative.

	verification to ensure that the environmental specifications are fully met.	
Bell Oil and Gas FZE	In its role as the Proponent for the Project, the Facility will be ultimately responsible for the implementation of the EMP, as well as all aspects of the Project. These responsibilities will require the resolution of environmental issues based on the recommendations of the CST and others; and taking into account additional factors and BOG corporate policy considerations, as it considers appropriate.	It is estimated that staffing of BOG FZE Project team to fulfil its role in the implementation of the EMP and coordination with the CST will require one full time environmental position.

7.12 Environmental Monitoring

The overall objective of monitoring shall be to identify any unanticipated changes to the biophysical and social environment brought about by the proposed project. Baseline information against which post-project impacts can be measured has been established. BOG FZE shall ensure deviations from the baseline beyond reasonable limits shall trigger corrective actions so that monitoring becomes a dynamic activity as opposed to passive collection of data. The objectives of the monitoring programme are to:

1. Monitor alterations in the existing biophysical and socio-economic characteristics
2. Determine whether any detected changes in the environment are caused by the project or by other factors
3. Determine the effectiveness of the mitigation and enhancement measures for adverse and beneficial impacts respectively
4. Ensure continual interactions and flow of information between BOG FZE and the stakeholders

In monitoring specific environmental and socio-economic parameters during the proposed project lifecycle, BOG FZE shall comply with all relevant regulatory requirements and it shall be the responsibility of the BOG FZE-HSE Department to ensure that the monitoring programme is fully implemented while the regulatory Agencies shall provide oversights as necessary during the monitoring. Periodic reviews shall also be conducted to check the effectiveness or otherwise of the monitoring programme.

For the purpose of this project, monitoring would be done on all aspects of the project lifespan that have the potential to influence the environment. These are the general accepted environmental aspects that are related to the proposed unified duct project with the potential to change the immediate environment.

Environmental Monitoring and Inspection

The impact monitoring activities that must be carried out are described in this section of the ESMP and it concerns the empirical monitoring and environmental sampling and data collection that must be done during the operational phases of the project. The inspection activities to be done refer to the non-empirical monitoring or qualitative monitoring involving visual inspection and documentation through photography and regular self-reported inspection and monitoring activities conducted by the Contractor and the BOG FZE HSE department on daily basis to ensure compliance with the recommended mitigation measures.

On a weekly basis, the inspection and monitoring should be made available to the BOG FZE Project Team. Visual inspections, field note writing, photograph records, environmental sampling, and in-situ measurements of environmental monitoring parameters for soil, water and air quality samples etc., are all the methods that will be employed during the monitoring and inspection activities. Thus the empirical sampling during environmental impact monitoring and qualitative analysis shall be distinct from the non-empirical monitoring and visual inspection activities (qualitative monitoring) for mitigation measure compliance.

Table 7.7: Monitoring plan for Environmental Parameters

Environmental Parameter	Components to monitor
Ambient air quality	CO, NOx, SOx, VOC, Particulates
Noise	Ambient noise level and vibration
Water (surface and ground) quality	BOD, COD, TSS, pH, cations, anions, heavy metals and coliform
Soil	
Waste	Types and volume of wastes generated, collected and disposed

Table 7.8: Environmental Monitoring Plan for the Proposed Project

Project Activity	Description of impact	Mitigation Measures	Monitoring	
Pre-Construction Phase			**Responsibility**	**Time and Frequency**
Movement of workers, equipment, and materials	1. Increase in road traffic volume 2. Risk of accidents/injury. 3. Movement of heavy equipment to worksite which may cause risk of accident/injury to site workers 4. Increase in Noise level within the	**BOG FZE** *shall ensure:* *1. Visible warning signs are placed on roads within the project area and project vehicles* *1. Defensive driving course and medical fitness checks are carried out on all Project Drivers* *2. Movements of material, equipment/ machineries and men are scheduled*	BOG FZE HSE Department	As soon as when the project development commences. Regular Inspection to ensure compliance

	project area 5. Reduction in air quality as a result of emissions from vehicles and machineries	*for off-peak periods and an efficient journey management plan is put in place* *3. Community awareness of unusual activities with respect to the implementation of the project is created* *4. All project vehicles and Machineries are properly serviced and maintained in good working conditions.* *5. Noise attenuation devices are provided and installed on machineries and equipment.*		
Site Preparation / Construction Phase				
Vegetation Clearance and demolition of structures - Excavation - Transportation -Fuel utilization -Waste generation	Soil Degradation and soil/ Groundwater contamination Degradation of surface water quality	**BOG FZE shall ensure** . *Site clearance is limited to area required for the proposed project* . *Cleared vegetation are properly disposed through the services of approved Waste Operators.* . *Excavated materials are properly staked to reduce turbidity effect on surface runoffs;;* . *Trenches are backfilled and compacted to minimize the mobilization of highly turbid surface runoffs from the site to receiving waters.*	BOG FZE HSE Manager/Department	Regular Inspection during the construction activities
	Increase noise nuisance-noise emission generated by project activities.	**BOG FZE shall ensure:** . *Noise attenuation measures such as installation of acoustic mufflers on large engines and equipment are put in place;* . *Personal Protective Equipment such as Ear Muffs is provided for*	BOG FZE HSE Manager/ Department	Regular Inspection during the construction activities

	workers on site and visitors to the site.		
Reduction in air Quality-dust emissions from excavation of structures leading to high suspended particulates in the atmosphere	**BOG FZE shall ensure** . *Movements of men and materials are properly coordinated to optimize vehicle use and reduce resultant emissions.* . *All mobile and stationary internal combustion engines are properly maintained.* . *Low emission/high efficiency engines are used.*	BOG FZE HSE Manager/ Department	Regular Inspection during the construction activities
Solid waste Generation-impact on existing disposal facility	**BOG FZE shall ensure:** . *System of waste avoidance and reduction is put in place.* . *Waste generated are properly containerized and stacked at designated points to avoid contamination of groundwater* . *Government approved Waste Disposal Company is contracted to handle waste generated on site.*	BOG FZE HSE Department	Regular Inspection during the construction activities
Reduction in biodiversity/Loss of flora and fauna	**BOG FZE shall ensure:** . *Cleared area is limited to what is required for the project* . *Site clearing commences from developed (e.g. roads) to underdeveloped areas to provide escape routes for wildlife.*	BOG FZE HSE Department,	Regular Inspection during the construction activities
Pressure on existing infrastructure	**BOG FZE shall ensure***:* . *Support as much as possible within her limited resources is given to the host community for the provision of some other essential amenities.*	BOG FZE Community Liaison Officer	Upon request by the community
Transportation-increase in road traffic volume by heavy duty trucks and risk of	**BOG FZE shall ensure**: . *Visible warning signs are put on roads and project vehicles*	BOG FZE HSE Department	Regular Inspection during the construction

	accidents/injury	*Transportation of equipment/materials is planned to coincide with low traffic periods*		activities
	Health & safety-Injury/fatalities in workforce/communities	**BOG FZE shall ensure*:*** *Safety awareness training is put in place for workforce.* *Emergency Response Procedures is put in place and enforced.* *Use of PPE by workers and visitors to the site is enforced.*	BOG FZE HSE Manager	Regular Inspection during the construction activities
	Increase in respiratory diseases & Communicable disease	**BOG FZE shall ensure**: *Workers on site use appropriate PPEs such as nose masks during (dusty) operations* *Site is regularly watered to douse dust and Particulate Matter emissions* *Community based training on the prevention of common communicable diseases, water protection/purification techniques and basic sanitation are organized.*	BOG FZE FZEHSE Manager	Twice a year during the construction activities
Operation Phase				
Operation and maintenance of the road network	Reduction in air quality-fugitive emission from vehicular traffic and maintenance machines	**BOG FZE shall ensure:** Equipment leaks that could result in emission of VOCs and PAHs are controlled through the use of leak detection protocol.	BOG FZE HSE Department	Regular Inspection during operations Every quarter of the year during operation
	Increase noise nuisance	**BOG FZE shall ensure**: *Operational activities are planned such that regulatory limits are not to be exceeded.* *Appropriate Personal Protective Equipment such as Ear Muff is provided for workers*	BOG FZE HSE Department	Regular Inspection during operations Every quarter of the year during operation

		and visitors to the site and the use enforced. . *Areas situated outside the project area are controlled to prevent permanent settling of people in an area especially where limits may be exceeded.*		
	Soil degradation and erosion	**BOG FZE shall ensure:** . *Proper stacking of excavated soil, proper backfilling and soil compaction is done along duct route*	BOG FZE HSE Department	Regular Inspection during operations
	Solid waste generation-impact on existing waste disposal facility might lead to contamination of soil/groundwater as well as the River	**BOG FZE shall ensure:** . *Wastes bins are provided at strategic locations around project area for properly containerization of wastes* . *Approved waste disposal company is contracted to handle wastes generated and stored in the waste bins*	BOG FZE HSE Department	Weekly Inspection during operations
	Health & safety-Injury/fatalities in workforce/communities	**BOG FZE shall ensure:** . *Safety Signs and Signage's shall be placed at strategic locations.* . *Adequate and accessible muster point shall be provided in the case of emergencies and evacuation.* . *The use of PPEs shall be strictly enforced*	BOG FZE HSE Department	Regular Inspection during operations

Parameters and Frequency

The environmental monitoring parameters to be monitored and inspected for the BOG FZE construction site and the frequency of monitoring and inspection are as shown in table below. There will be one impact monitoring and inspection during the site preparation and construction activities and a second impact monitoring activities during the post-construction and commissioning activities, thus covering the operation phase of the project.

Table 7.9: Environmental components, parameters and frequency of monitoring for the project

S/N	Environmental Component	Empirical Parameters / Non-Empirical Observations	Monitoring Frequency	Responsible Parties
1	Air Quality	Combustion efficiency CO_2, CO TSP $PM_{2.5}$ and PM_{10} NO_x SO_2 THC CH_4 VOC Atmospheric depositions rate Rainwater pH Noise	Two air quality sampling per day for 4 stations for 2 field visits at 2 days per visit (32 Samples Noise monitoring 2 times in four (4) locations per day in 2 field visits	BOG FZE Management, HSE Manager, Independent Environmental Consultant
2	Water Quality Water quality samples should be collected from groundwater wells/borehole close to the project site	Temperature pH, salinity, TDS, TSS, DO, conductivity Heavy metals TSS and Turbidity DO, BOD, TOC, COD, THC, TPH NO_3, PO_4 Chloride, sulphate, bicarbonate Microbiology	Once at the beginning of construction works and once at the end.	BOG FZE Management, HSE Manager, Independent Environmental Consultant
3	Soil	Soil erosion monitoring and evaluation of the restoration of site topography	Three times at the beginning, midway and the end of construction works	BOG FZE Management, HSE Manager, Independent Environmental Consultant
4	Vegetation	Survey and verify the presence of any endangered or protected plant species within the project site before site clearance and preparation	Once before site clearing and preparation	BOG FZE Management, HSE Manager, Independent Environmental Consultant
5	Socio-economics	Employment status during construction works and community relations	Three times at the beginning, midway and the end of construction works	BOG FZE Management, HSE Manager, Independent Environmental Consultant
6	Waste Management	Waste Management Practices	Weekly	

7.13 Environmental Reporting

The Environmental reporting acts as an internal control process to ensure that environmental protection and management procedures are vigorously enforced. Periodic reports of environmental monitoring activities such as Environmental Compliance Monitoring (ECM) Reports and Environmental Audit reports (EAR) will be prepared and submitted as per finalized monitoring protocol and regulatory requirements while detailed in-house monitoring reports of activities such as trainings, waste management/collection etc. will be judiciously kept and made available to government on request.

Throughout the lifespan of the project, the Company will keep regulatory authorities informed of the project performance with respect to EHS matters by way of written status reports and face-to-face meetings.

7.14 Environmental Review/Audit

Environmental review process provides for regular assessment and evaluation of the environmental performance during the operation and maintenance phase of the project. Each environmental review/audit shall:

- Evaluate the management systems, plant operations, monitoring practices, plans and procedure;
- Identify current and potential environmental problems;
- Recommend improvement to the management of operations
- Evaluate company policy; and
- Evaluate compliance with regulatory requirements.

7.15 Emergency Response Plan

This Emergency Response Plan is a guide to respond to emergency situations, which may arise in the cause of implementing of the proposed project. The plan identifies likely emergency situations together with their causative factors followed by an elaboration of the proposed response. The plan finally identifies the respondents in order of priority. It is anticipated that implementation of the plan would help minimize the risks associated with implementation of the proposed project within acceptable levels. The plan is however subject for review each time there is a new, unforeseen emergency situation and incorporates all causative factors resulting in such emergency situations for improved future response performance.

Purpose of the Plan

- Provide guidelines for responding to and managing a variety of emergency situations;
- Reduce liability and loss of assets and business;
-

- Protect the community and the public;
- Ensure employees have the skills and abilities to act efficiently and effectively during emergency situations;
- Mobilization of appropriate resources to manage the emergency; and coordinate effectively.

Table 7.10 Emergency Response Plan

Emergency Situation	Likely cause	Proposed Response	Respondents
Road Traffic Accidents	- over speeding of project vehicles on the road -lack of speed control bumps and signs -vehicle malfunction such as brake failure -Driver error such an drunk driving or fatigue	- Create speed limit signs on the road and sensitize school children and indigenes on safe road usage. - Construct speed humps to control speed of vehicles within the Plant. - Regular training and advocacy with vehicle drivers. - Provide first aid treatment for accidents victims at the Plant prior to reference to the nearest health centre or hospital with which Bell Oil and Gas have retainership.	Plant Manager, HSE Manager, the Police and health centre medical personnel.
Staff Injury	- Unskilled labour - Neglect of safety procedures - Faulty equipment and tools - Sheer Accidents - No safety induction	- Apply appropriate First Aid. -Document all incidents and accidents. - Evacuate to hospital if necessary. - Investigate causative factor and institute appropriate measures to prevent similar occurrence	Environmental Management Officer, First Aid Attendant on Duty, and Hospital Staff
Fires outbreak on machinery and buildings.	-Neglect of safety procedures. - Act of arson - Equipment failure	- Sound alarm and instruct all to assemble at Fire Assembly point. - Conduct roll Call. - Fight the fire using appropriate firefighting equipment like extinguishers, sand, water on buildings and equipment. - Document incident	HSE Manager, Emergency Response Team, Fire Brigade, Police Force
Oil, Fuel and Chemical spills	- Neglect of safety procedures - Equipment/machinery malfunction -Act of sabotage	- Contain spillages by applying suitable material to stop material flow and spread (e.g. Spill Kits). - Inform LASEPA and other relevant agencies. - Clean up affected areas. - Document incident	HSE Manager, Emergency Response Team, LASEPA

Emergency Preparedness and Response

Bell Oil and Gas FZE have developed plans and procedures to identify the potential for and response to environmental accidents and health and safety emergency situations and for preventing and mitigating potentially adverse environmental and social impacts that may be associated with them. Appropriate emergency preparedness and response plans shall be developed to ensure the effective management and mitigation of emergency incidents. Procedures shall be developed based on the appropriate classification of the possible incidents. The following aspects of emergency preparedness and response shall be addressed:

- The identification of the emergency scenarios and the development of appropriate and specific emergency response procedures for each scenario.
- The training of emergency response teams on the appropriate procedures and the use of emergency response equipment.
- The identification of emergency contacts and support services and the development of effective communication systems / protocols (including communication with potentially affected communities).
- As part of the development of emergency preparedness and response plans, involve the appropriate government authorities to determine procedures for engagement, communication and reporting (emergency, health, environmental authorities).
- Emergency equipment and facilities must be provided (e.g., first aid stations, firefighting equipment, spill response equipment, personal protection equipment).
- Identification and availability of the appropriate personal protective equipment and equipment.
- Clarification of roles and responsibilities of individuals or groups as well as the decision process for assessing severity of the release and determining appropriate actions with the Emergency Services

Emergency preparedness and response for the proposed project activities will be jointly reviewed with Lekki Free Zone Development Company and other relevant agencies on at least an annual basis and after the occurrence of any accidents or emergency situations to ensure that lessons learnt inform continuous improvement. Emergency exercises will be undertaken on a regular basis to confirm adequacy of response strategies. Investigations of accidents or incidents will follow formal documented procedures.

Table 7.11: Emergency Contacts

Names/ Agency	Phone Number
Facility Manager -	
Project Operations Manager	
Lagos State Command Centre/ Distress call	767, 112
Rapid Response Squad (RRS)	08056250710,08033482380,08023127350,08033355544

	, 01-7750715,01-4970389,01-4970062,01-4931261 , 01-4920388
Ambulance service (LASAMBU /LASEMS}	O8022887777, 08022883678, 08022887788, 7413744, 01 – 7930490, 01 – 7639939
Distressed/ Collapsed Building	O1 – 5931947, 4933658, 4931940, 7630854
Emergency Management (LASEMA)	O8060907333, 08023127654, 01 – 6574706, 01 – 6574714
Environmental Monitoring	08033183477, 08043705057, 08023036632
Flooding Blocked Drainage (EFAG)	08056145481, 08023298197,
Radio Lagos Eko FM (NEWS ALART)	01726761
Open corpse (SHEMU)	08186510121, 08023356540,08081061497
Traffic Control (LASTMA)	08075005411,08023111742,08077551000
BRT	08023146096
LAGBUS	08033036816
Pot Hole/Collapsed Road	07060907493
Broken Pipe /Water Leakage	0800-LAGOS WATER {08005246793827)
Cutting of roads/Mast Erecting (UFRU)	0803306096
Environmental/Noise pollution (LASEPA)	07027951351
Lagos state Fire Service	08033235892, 08023321770, 080552824914
Lagos State safety Commission	08181002233
Environmental & Special offences Task Force	08033183477
Nigerian Police	08033011052, 08056250710, 08033183477
Waste Management (LAWMA)	5577 (Toll Free) 07080601020, 080231289099

Medical Emergency (chest pains, loss of consciousness, fall from a height, etc.)

- Upon discovering a medical emergency, call 767 or 112.
- Call ("767 or 112") and report the nature of the medical emergency and location.
- Stay with the person involved being careful not to come in contact with any bodily fluids, unless properly trained and equipped.

Workplace Violence

- All employees will be implored to report the presence of firearms or other Weapons to the Project HSE Officer immediately regardless of the threat.
- Any employee who feels that she/he has been threatened will immediately report their concern to their manager and to Human Resources.
- If any person is observed exhibiting threatening behaviour or making threatening statements, the person discovering the situation should warn others in the area and immediately notify the Project HSE Officer and stay away from the person exhibiting threatening behaviour.

- Employees will be advised to never attempt to confront any person exhibiting threatening behaviour.

Fire Prevention

1. Fire Extinguishers: Appropriate fire extinguisher type will be available on each project site within reasonable access to the work area. The use of extinguisher will be for controlling the fire danger and protection of workers.
2. Fire Prevention and Safety Employee Training: Employees will receive training in the prevention of fires and safety measures to be taken in the event that a fire should occur.
3. Flammable and Combustible Materials: Flammable and combustible materials will not be stored on the project site in large quantity. All contractors and subcontractors will be required to maintain a fire extinguisher within 20 feet or reaching distance of all welding and cutting operations. Compressed gas cylinders will be stored in an upright position with caps on and securely fastened to prevent them from falling over.
4. Fire Watch: A fire watch will be designated for 30 minutes following any hot work. Where circumstances required, fire blankets will be used.
5. Relevant certificates will be obtained from Lagos State Fire Service, Lagos State Safety Commission and Lagos State Building Control Agency

First Aid Procedures

<u>Minor first aid treatment</u>

First aid kit will be available at designated offices and areas on site, where adequate control of the kits will be maintained. If any worker sustain an injury or are involved in an accident requiring minor first aid treatment:

1. Worker will inform his supervisor, Project HSE Officer or the Site Nurse
2. Assigned first aider will administer first aid treatment to the injury or wound
3. The first aid register will be completed by the first aider and forwarded to Project HSE Officer for investigation
4. Access to a first aid kit is not intended to be a substitute for medical attention.

<u>Non-Emergency Medical Treatment</u>

For non-emergency work-related injuries requiring professional medical assistance, arrangement will be made for Site Nurse, who will attend to this. If any worker sustains injury that requires treatment other than first aid:

1. Injured worker will inform his supervisor
2. Proceed to the site clinic. The supervisor will assist with transportation, if necessary.
3. Site Nurse treat the injured worker

4. Appropriate medical treatment register is completed and forwarded to the Project HSE Officer for investigation.

Emergency Medical Treatment

If any worker sustains a severe injury requiring emergency treatment:

1. Call for help and seek assistance from a co-worker
2. The co-worker inform the supervisor to request assistance and transportation to the local hospital emergency room (provision will be made with local hospitals closer to each project sites)
3. The injured worker is treated and appropriate report forwarded to the Site Nurse and Project HSE Officer.

7.16 Traffic Management and Pedestrian Arrangement

In order to improve the safety practice within the proposed Steel Pipe threading and Valve Assembly facility and its environment, the design of the project sites will be done to minimize transport incidents in addition to enforcement of 5km/hr. speed limit within the facility, and adequate system of work will be maintained by:

- Avoiding the need for reversing by better layout design.
- Using a safe system of work for reversing.
- Ensuring a safe system of work for loading and unloading vehicles.
- Segregating pedestrian and vehicles traffic routes on the facility that are feasible.
- Where segregation is not feasible, appropriate measure will be put in place to avoid vehicular and pedestrian collision.
- Posting adequate warnings in conspicuous places.
- Ensuring suitable pedestrian crossing points on vehicle routes.
- Introducing a one-way traffic system, if possible to reduce the risk of head-on collision.
- Keeping the floor and road surfaces in good condition.

Other measures will also consider:

- Suitable direction, speed limit and priority signs.
- Suitable physical speed restrictions such as speed bumps will be provided where applicable.
- Ensure that all vehicles are properly maintained.

All drivers will be instructed and reminded that they should:

- Ensure that traffic measure put in place by LFZDC such as the compliance to the traffic light within the zone will be strictly adhere to
- Not drive when their physical abilities are impaired, e.g. ill health or poor vision.

- Be conversant with operating procedures and understand the safe operating limits of vehicles.
- Carry out daily checks and report all problems.
- Understand and comply with sire rules and procedures, including those for emergencies.
- Keep the vehicle within safe speed limits.
- Slow down and take special care when approaching bends.
- Turn the engine off before making any adjustment, removing guards, loading or unloading.

7.17 Waste Management Plan

This Waste Management Plan (WMP) is designed to provide guidance to Bell Oil and Gas FZE Project Management Team and contractors on the roles and responsibilities required for managing waste and raw material use on the Lagos State Government Unified Duct Infrastructure project.

Management of waste in each project site will be the responsibility of the individual subcontractors (listed in **Table 7.12** below). There are also responsibilities and actions that will lie with Bell Oil and Gas FZE, to ensure compliance with relevant waste management legislation and best practice including:

i. Segregation of waste;
ii. Secure storage for waste;
iii. Adopting the waste hierarchy:
   a. avoid;
   b. reduce;
   c. reuse;
   d. recycle
iv. Collaborating with other sectors, waste generators and government initiatives for cumulative benefits.

Table 7.12: Waste types, sources, roles and responsibilities

Project phase	Project activities	Type of emission/waste/pollutant	Quantity
Preconstruction phase	Mobilization of equipment and transportation of workers to the site	• CO, NO_X, SO_X	123.7 μg/m^3
	Site preparation	• CO, NO_X, SO_X,	0.11 μg/m^3
		• paper, plastic bottles, sewage, oil grease	1.11 tons
Construction phase	Transportation of construction material to the site	• CO,, NO_X, SO_X	202.6 μg/m^3

	Excavation;	Excavated soil, rubbles	100.8 tons
	Civil works (building, roads, utilities etc.)	• CO,NO_X, SO_X, • Metal scraps, cement sludge, paper, plastic bottle container, nylon	381.4 $\mu g/m^3$
	Fabrication of steel and iron parts and assemblage	• Metal scrap, • Ethylene	29.7 tons 107 ps
Operational Phase	Transportation of material inputs	• CO,NO_X, SO_X, • Particulate matter (PM_{10})	1.19 $\mu g/m^3$
	Domestic activities	Kitchen waste, wastewater, sewage, plastic wastes	
	Pipe threading	Pipe off-cut, degreasers, painting filters, used nose masks, adhesive packs, glass fiber dust/chips, emery cloth, inner sander and flapper wheel, paper cover-all, leather hand glove, used rags, used laminating kits	3.11 tons/annum
	Hydro testing of threaded pipes and repaired valve	Wastewater	50.24/annum
	Cooling activities	High temperature / Contaminated water	
	Storage of raw materials (chemical/solvents, adhesive)	VOCs, nylon	30.2
	Maintenance operation	Metal scraps, VOCs, oil and grease, effluent,	1.11MT
Decommissioning	Dismantling of structures and ancillary utilities	Metal scrap and cutting VOCs, plastics, oil and grease, TSS, particulate matter (PM_{10})	1.11MT
	Transportation of waste material out of the decommissioned site	CO, NO_X, SO_X, particulate matter (PM_{10})	1.02 MT

Vegetal waste	Site clearing and preparation activities	All vegetal waste will be collected in designated waste receptacles for disposal by LAWMA accredited PSP waste disposal operator	Site manager, HSE supervisor, LAWMA PSP operator
Sewage	Daily onsite activities by contractor's employees	Mobile toilets will be provided onsite for employees and contractors during construction phase. These will be managed by an accredited mobile toilet operator for proper management and disposal Proper Toilet facilities with water closet shall be provided. These	Site manager, HSE supervisor, licensed mobile toilet operator

		shall be connected to Soak Away System which shall be dislodged as at when due	
Solid waste (Refuse) such as food waste, PET bottles, Water sachets etc.	Daily onsite activities by employees	All wastes will be sorted at source and collected in segregated bins before collection by accredited PSP waste disposal operator for onward recycling or disposal	Site manager, HSE supervisor, LAWMA PSP operator
Plastic and Metal cuttings	From HDPE duct pipe and construction of manholes	Plastic and metal cuttings would be reused and all unused cuttings will be sold as scrap for recycling.	Site manager, HSE supervisor
Hazardous waste like Spent oil and disused batteries	Operation and maintenance of equipment and machines (where required)	Spent oil and disused batteries will only be temporarily stored on site before daily collection (as required) by an accredited PSP waste disposal operator	Site manager, HSE supervisor, licensed hazardous waste PSP operator

Hazardous waste

The hazardous wastes from the proposed project include adhesive cans, chemical gloves, glass fiber dust/chips, used laminating kits. They are generated mainly during cleaning, maintenance and treatment operations. The details of the hazardous waste and the mode of disposal is given in **Table 3.13**.

Table 7.13: Anticipated hazardous waste and mode of disposal for the proposed project

Type of waste	Estimated quantity per annum (MT)	Mode of disposal
Adhesive cans	0.001	To be reused or sold to recycler
Chemical gloves	0.021	To be disposed at Epe landfill site
Glass fiber dust/chips	1.19	To be disposed at Epe landfill site
Used laminating kits	2.7	To be disposed at Epe landfill site
Oil contaminant waste	3.1	Co-processing
Contaminated rags or other cleaning materials	0.45	To be disposed at Epe landfill site

Implementation of WMP

1. Collection and Storage: The Contractor will provide dedicated and clearly marked areas at their laydown site for storage of waste prior to their final disposal by LAWMA or her accredited PSP contractor. Hazardous wastes such as spent oil and disused batteries will only be temporarily stored in designated spots and collected daily (as required) by licensed hazardous waste PSP operator. It will be in compliance with the ESMP in covered watertight areas.

2. On-site: The Contractor will ensure that all employees understand how the waste management system (housekeeping, sorting and storage) will work on-site, including bin placement and access.
3. Disposal: The Contractor will establish with the PSP operator, the most appropriate time to arrange for the collection/delivery of the various solid waste streams. Transportation of solid waste from the laydown site to the designated areas must be by a LAWMA licensed PSP service provider only.
4. Clearly assign and communicate responsibilities: ensure those involved in the project are aware of their responsibilities in relation to the WMP.
5. Monitor: to ensure the plan is being implemented, monitor on-site as per the ESMP monitoring plan.

Wastewater Treatment

Sewage collection tank shall be built in accordance to specification as provided in the facility layout. The system shall be used for the collection of human and associated liquid wastes generated from the proposed project. The collection tank is designed with capacity to collect an estimated 920 m^3 of wastewater. As part of the guideline for wastewater management within the zone, operator of each facility is expected to channel her liquid waste to the Central Treatment Plant (CTP) provided by the Lekki Free Zone Company. In this connection, the proposed sewage facility shall be connected to the CPT through the existing infrastructure.

7.18 Stakeholders Engagement

Sustained Stakeholder Consultation and engagement shall be undertaken during all phases of the project. A robust Stakeholder Forum shall be established including directly affected parties, representatives from the local municipality and other identified persons. The forum shall serve to communicate project progress, material changes to the project, grievances received and corrective action taken. The Stakeholder Engagement Plan (SEP) is a live document and shall be revised regularly to document all consultation activities proposed and undertaken. The appropriateness and effectiveness of methods of stakeholder engagement shall be reviewed on a regular basis and existing methods revised and alternative methods implemented as required. Specific consideration shall be given to the inclusiveness of the method utilized to ensure all stakeholders including individuals, communities and groups and organizations are included.

7.18.1 Grievance Management Mechanism

A fair grievance management mechanism shall be adopted. A grievance/ complaint can be submitted in the following ways:

- By communicating the grievance/ complaint to the local Authority/ community Development Associations (via letter/note or verbally) who will be responsible for reporting the issue to BOG FZE;
- By submitting the grievance directly to BOG FZE (either verbally or in writing); and

- By submitting the grievance to the concerned contractor who will then be responsible for informing BOG FZE
- All grievances received shall be forwarded to the Project Manager who shall be responsible for recording them in a Grievance/Complaints Register and for implementing the grievance response mechanism.

7.18.2 Grievance Response Mechanism

When a grievance is received, the mechanism for dealing with it shall be as follows:

- Grievance received;
- Grievance recorded in the Grievance/ complaints Register;
- For an immediate action, the complainant shall be informed of corrective action;
- Implement corrective action, record the date and close case;
- For a long-term corrective action, the complainant shall be informed of proposed action; and Implement corrective action, record the date and close case.

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7.19 Operational Control

The environmental standard for ISO 14001 requires that operations related to identified significant environmental aspects, which are carried out in an initial environmental review when setting up an environmental management system; establish documented procedures to control situations where their absence could lead to deviations, stipulating the operating criteria. Documents assist in ensuring that internal controls are complete, properly approved, and maintained and revised when changes occur.

It is the responsibility of the BOG FZE HSE Department and the project team to identify specific operations/ activities associated with identified potential adverse environmental and social impacts that require operational control measures consistent with the BOG FZE HSE policy, objectives and targets. These operational controls are to ensure and facilitate the implementation of the impact mitigation measures and other beneficial site management practices. The operational controls specify the appropriate procedure, work instructions, best management practices, roles, responsibilities, authorities, environmental monitoring, measurements and record keeping that are all designed to mitigate any environmental impacts.

7.20 Proponent's Commitment for Monitoring

The proponent intends to follow the monitoring programme proposed in this report and commits to make budgetary allocations from the planned project based on the prevailing market rate for consultancy of this nature.

CHAPTER EIGHT

DE-COMMISSIONING AND ABANDONMENT PLAN

8.1 Introduction

Projects are usually designed with an expected lifespan and so, no matter how long the design life, all projects eventually close out. The lifespan may sometimes be less than planned, while in some cases; it can be extended with proper planning and maintenance. The longevity of any development project is primarily dependent on a number of factors including:

- Availability of raw materials
- Durability of equipment and machinery
- Profitability of the project
- Usefulness and acceptability of project performance

This project is planned to last for at least 50 years. However, if and when the likely operator of the proposed Steel Pipe Threading and Valve Assembly facilities project is to be demolished, the project proponent would need to decommission the entire system. While this is not expected to occur within the next twenty to thirty years, it is, all the same, necessary to start planning, at this stage, for the closure stage, when the use of the facilities have to be discontinued.

A general approach will be to commence detailed planning of decommissioning and abandonment activities about five years in advance. This should ensure a safe, environmentally friendly, and efficient decommissioning/abandonment programme.

Before abandonment, Bell Oil and Gas FZE will develop decommissioning plans that will establish:

- Facilities to be abandoned or removed
- Environmental aspects of the decommissioning activity
- Methods for facility re-use, recycling, disposal, removal or abandonment
- Proper consultation with all stakeholders (communities, other land users and regulators)
- Efforts to mitigate negative environmental impacts and appropriately rehabilitate the site
- Programmes for restoring the environment in accordance with national and international best practices and regulatory requirements.
- Scope of work to assess possible residual impacts of the facility on the environment; specifically any future restrictions on other activities.

At this stage, likely environmental impact and mitigation measures that could arise from the decommissioning activities are briefly stated below:

8.2 Decommissioning Phase Impacts

Impact on Ambient Air Quality

Demolition activities and removal of equipment that will involve the use of machineries will generate emissions and dusts that will contribute to the reduction in ambient air quality. This impact will however be short-term as decommissioning activities are expected to last for few weeks; therefore the impact significance is rated **moderate**

Impact on Noise

Decommissioning activities including the demolition of structures and removal of fittings would result in increase in noise level around the project area. Though short-term the possibility of occurrence is high. However, it is expected to be confined within the project area and with the implementation of the appropriate mitigation measures, the impact significance is rated **low**

Impact on Waste Management

Demolition of structure and fittings would result in generation of solid wastes such as demolition debris, disused unserviceable machineries and equipment. Also, iron rods, metal cuttings, roofing materials and other solid wastes would be generated. These wastes if not properly stacked and disposed would constitute serious environmental and health hazards.

Impacts on Employment/Income

Decommissioning/Closure of the facility would lead to loss of both temporary and permanent jobs. It would also result in loss of direct jobs by workers within the facility and indirect jobs by those who had to do business with the facility. Food vendors and sellers of other sundry articles may also experience drastic reduction in income; the significance of this impact is rated **high.**

Impact on Health and Safety

Decommissioning activities if not properly coordinated will impact on health and safety of workforce and community members. Demolition activities may cause injuries and sometimes fatalities if appropriate safety controls are not put in place. There could be emotional disturbance and in some cases health challenges such as High Blood Pressure as a result of loss of jobs.

These impacts are mostly minor in significance, because they are of limited spread and the duration is short, being a one-off occurrence that will not exceed 3 to 6months. Therefore, the overall significance of these impacts is minor.

Table 8.1: Potential Impact Identification, Qualification and Rating

Decommissioning Phase	Closure, restoration, equipment removal and site decommissioning	**Biophysical**							
		Solid waste generation and impact on disposal facility		X	x		X		L
		Alteration of natural soil profile		X	x		x		L
		Soil degradation and erosion		X	x		x		L
		Increased noise nuisance		X	x		x		L
		Reduction in air quality		X	x		x		L
		Health And Safety							
		Injury/fatalities in workforce/communities		x	x		x		L
		Increase in respiratory disease		x	x		x		L
		Increase in road traffic volume, accidents/injury		x	x		x		M
		Noise level and dust generation		x	x		x		L
		Socio-Economics							
		Loss of job		x		x		x	H
		Change in economic conditions/activities		x		x		x	H
		Land availability for alternative use	x			x	x		M
		Emotional disturbances		x		x	x		M

8.3 Mitigation Measures for Decommissioning Phase Impacts

Impact on Noise

Decommissioning activities including the demolition of structures and removal of fittings would result in increase in noise level around the project area. Though short-term, the possibility of occurrence is high. Bell Oil and Gas FZE shall ensure mobile and stationary internal combustion engines are properly maintained.

Impact on Waste Management

Demolition of structure and fittings would result in generation of solid wastes such as demolition debris, disused unserviceable machineries and equipment. Also, iron rods, metal cuttings, roofing materials and other solid wastes would be generated. These wastes if not properly stacked and disposed would constitute serious environmental and health hazards.

Bell Oil and Gas FZE shall

- *Ensure the project's waste management plan are strictly followed*
- *Ensure all wastes arising from demolition and decommissioning of facilities will be properly stacked and disposed off through the services of LAWMA accredited PSP Operators*
- *Assists in skill acquisition for all workers that would be disengaged*
- *Ensure worker who will be disengaged are properly counseled*

- *Ensure enough notice on disengagement from employment is given.*

Impacts on Employment/Income

Decommissioning/Closure of the facility would lead to loss of both temporary and permanent jobs. It would also result in loss of direct jobs by workers within the facility and indirect jobs by those who had to do business with the facility. Food vendors and sellers of other sundry articles may also experience drastic reduction in income.

Bell Oil and Gas FZE shall

- *Assists in skill acquisition for all workers that would be disengaged*
- *Ensure worker who will be disengaged are properly counseled*
- *Ensure enough notice on disengagement from employment is given*

Impact on Health and Safety

Decommissioning activities if not properly coordinated will impact on health and safety of workforce and community members. Demolition activities may cause injuries and sometimes fatalities if appropriate safety controls are not put in place. There could be emotional disturbance and in some cases health challenges such as High Blood Pressure as a result of loss of jobs.

Bell Oil and Gas FZE shall ensure:

- *Safety awareness training are put in place for workforce*
- *Emergency response procedures are put in place and enforced*
- *Use of PPE is enforced.*

8.4 Decommissioning Plan

The content of the decommissioning plan will further take into consideration the extent of the decommissioning (temporary or permanent, partial or complete shutdown), plans for future use of the site, and the condition of the site and environment at the time of decommissioning. A detailed post-operational study of the impact of the project on the environment will be conducted to determine appropriate restoration and remedial measures. Additional details will be developed as the project progresses.

In general, however, decommissioning activities will be conducted in compliance with applicable regulations and guidelines, or any other regulations that are in force at the time of decommissioning. The plans will also include regulations and a risk and cost analysis of the various options. The abandonment plan will consider all facilities associated with the proposed Steel Pipe Threading and Valve Assembly facilities Project. The regulators will be notify on the decommissioning plan developed and taking into account the most cost-effective and best practicable methods, legal requirements and industry practices at the time. This plan is submitted to FMEnv, LSMEnv and other relevant regulators.

8.5 Consultation

The project decommissioning and abandonment plan will include consultation with various stakeholders including employees from various departments within Bell Oil and Gas FZE, Lekk Free Zone Development Company, communities, regulators and experts. The decommissioning team will include competent personnel from various departments within Bell Oil and Gas FZE as well as the regulatory authorities.

8.6 Wind-Down Operations

As the BOG Steel Pipe Threading and Valve Assembly facilities Project approaches the end of its economic viability, plans will be put in place to wind down operations. These will include a review and rationalisation of operations and personnel and a possible gradual shut down of some facilities. The decommissioning of the BOG Steel Pipe Threading and Valve Assembly facilities Project will be planned for a significant period before the cessation of production. This will allow for a carefully planned redeployment and, where necessary, disengagement of personnel as appropriate. An adequate compensation will be provided the disengaged personnel to tide over before getting their hands on new jobs.

8.7 Decommissioning of Facilities

At the end of the facilities' utility, all equipment will be decommissioned. Machineries will be dismantled using a standard process for BOG Steel Pipe Threading and Valve Assembly facilities operations. All installed facilities on project sites will be adequately dismantled and removed to allow for proper remediation of the project site. BOG Health Safety and Environmental Management Systems will be implemented to assure safety of personnel and the public during decommissioning as well as minimise negative environmental impacts. Particular attention will be paid to the following:

- Protection from air pollutant emissions
- Protection from noise
- Waste handling
- Spill containment and management

Once the facility has been properly and safely decommissioned, water and power supply lines would be disconnected and removed. All surface buildings and structures would be dismantled and removed from the site. Disturbed areas on the plant site will be identified and restored using native species.

8.8 Re-Use/Recycling of Equipment

All facility components that can be used or recycled will be identified and quantified. Buildings will either be sold or converted to other uses. Alternatively, the buildings may be donated to host communities. Vehicles and other facilities will be scrapped and possibly resold or moved to other locations. Cleared locations will be re-vegetated using fast growing native species. All pits and excavations shall be reclaimed and vegetated contaminated environmental component attributable to project activities will be restored.

8.9 Reporting

As required by regulations, a post decommissioning report will be prepared and submitted to the Federal Ministry of Environment and other relevant Regulators. The report will provide the following details.

- Overview of decommissioned facilities
- Details of methods used for decommissioning
- Nature of decommissioning (partial or whole)
- Record of consultation meetings
- Details of recyclable/reusable materials/facility components
- Decontaminated facilities
- Decommissioning Schedule
- State of the surrounding environment
- Waste Management Plan
- Plans for restoration/remediation where necessary

CHAPTER NINE

CONCLUSION AND RECOMMENDATION

9.1 CONCLUSION

The proposed Steel Pipe Threading Plant and Valve assembly facilities project within the Lekki Free Zone development at Ibeju Lekki Local Government Area, Lagos by Bell Oil and Gas FZE will achieve the highlighted benefits in a sustainable manner if the recommended measures are strictly implemented, and the monitoring and management program for the environment are equally handled in proper perspectives.

9.2 RECOMMENDATION

With the present drive of the Federal Government to promote the Nigeria content through the Nigeria Content Act especially in the Oil and Gas Industry, the planned project is one of the results and should be encouraged. However, this development should be achieved with sound environmental sustainability. With the detailed description of environmental baseline characteristics of the project area, and the exhaustive impact identification that have been presented in earlier sections of this report, we can conclude that the development will lead to a number of significant positive impacts if all recommended mitigations strictly adhere to. For instance, all precautionary measures applicable to the construction works like dust suppression measures, noise pollution control, watercourse protection, prevention of untreated wastewater discharge during the operational phase to the existing storm water catchment channel located beside the site in order to avoid surface water contamination must be implemented before and during the construction phase.

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ANNEXES

ANNEX 1
FEDERAL MINISTRY OF ENVIRONMENT
CLEARANCE LETTER FOR FIELDWORK ACTIVITIES

ANNEX 2

DETAILED ENGINEERING DESIGNS FOR THE VARIOUS SECTIONS OF THE PROPOSED FACILITIES

ANNEX 3

ATTENDANCE LIST FROM THE SCOPING WORKSHOP AND FGD CONDUCTED

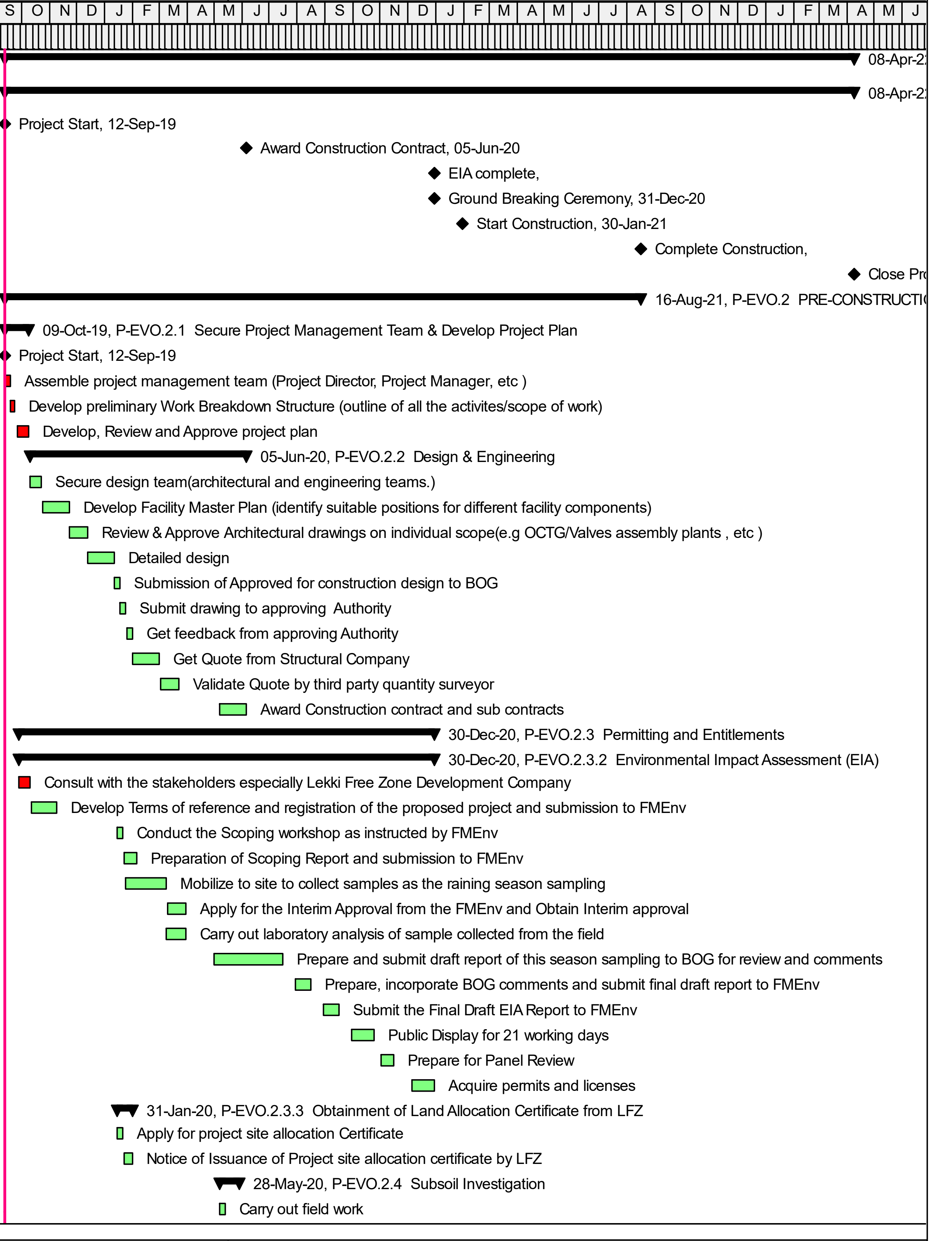
ANNEX 4

SOCIO–ECONOMIC IMPACT ASSESSMENT QUESTOINNAIRE

PIPE THREADING WITH VALVE ASSEMBLY AND RELATED ACTIVITIES

Bell Oil & Gas

Activity ID	Activity Name	Original Duration	Start	Finish
P-EVO	**PIPE THREADING WITH VALVE ASSEMBLY AND RELATED ACTIVITIE:**	940	12-Sep-19	08-Apr-22
P-EVO.1	**SCHEDULE OF KEY MILESTONES**	940	12-Sep-19	08-Apr-22
A10079	Project Start	0	12-Sep-19	
A10080	Award Construction Contract	0	05-Jun-20	
A10081	EIA complete	0		31-Dec-20
A10085	Ground Breaking Ceremony	0	31-Dec-20	
A10086	Start Construction	0	30-Jan-21	
A10092	Complete Construction	0		15-Aug-21
A10093	Close Project	0		08-Apr-22
P-EVO.2	**PRE-CONSTRUCTION PHASE**	705	12-Sep-19	16-Aug-21
P-EVO.2.1	**Secure Project Management Team & Develop Project Plan**	28	12-Sep-19	09-Oct-19
A1000	Project Start	0	12-Sep-19	
A10083	Assemble project management team (Project Director, Project Manager, etc)	7	12-Sep-19	18-Sep-19
A1100	Develop preliminary Work Breakdown Structure (outline of all the activites/scope of work)	5	19-Sep-19	23-Sep-19
A1200	Develop, Review and Approve project plan	14	26-Sep-19	09-Oct-19
P-EVO.2.2	**Design & Engineering**	240	10-Oct-19	05-Jun-20
A7600	Secure design team(architectural and engineering teams.)	14	10-Oct-19	23-Oct-19
A7700	Develop Facility Master Plan (identify suitable positions for different facility components)	30	24-Oct-19	22-Nov-19
A7800	Review & Approve Architectural drawings on individual scope(e.g OCTG/Valves assembly plants ,	20	23-Nov-19	12-Dec-19
A7900	Detailed design	30	13-Dec-19	11-Jan-20
A8000	Submission of Approved for construction design to BOG	6	12-Jan-20	17-Jan-20
A8100	Submit drawing to approving Authority	7	18-Jan-20	24-Jan-20
A8200	Get feedback from approving Authority	7	25-Jan-20	31-Jan-20
A8300	Get Quote from Structural Company	30	01-Feb-20	01-Mar-20
A8400	Validate Quote by third party quantity surveyor	21	02-Mar-20	22-Mar-20
A8500	Award Construction contract and sub contracts	30	07-May-20	05-Jun-20
P-EVO.2.3	**Permitting and Entitlements**	461	27-Sep-19	30-Dec-20
P-EVO.2.3.2	**Environmental Impact Assessment (EIA)**	461	27-Sep-19	30-Dec-20
A2100	Consult with the stakeholders especially Lekki Free Zone Development Company	14	27-Sep-19	10-Oct-19
A2200	Develop Terms of reference and registration of the proposed project and submission to FMEnv	29	11-Oct-19	08-Nov-19
A2300	Conduct the Scoping workshop as instructed by FMEnv	7	15-Jan-20	21-Jan-20
A2400	Preparation of Scoping Report and submission to FMEnv	15	22-Jan-20	05-Feb-20
A2500	Mobilize to site to collect samples as the raining season sampling	45	24-Jan-20	08-Mar-20
A2600	Apply for the Interim Approval from the FMEnv and Obtain Interim approval	22	10-Mar-20	31-Mar-20
A2800	Carry out laboratory analysis of sample collected from the field	22	09-Mar-20	30-Mar-20
A6400	Prepare and submit draft report of this season sampling to BOG for review and comments	76	01-May-20	15-Jul-20
A7100	Prepare, incorporate BOG comments and submit final draft report to FMEnv	17	30-Jul-20	15-Aug-20
A7200	Submit the Final Draft EIA Report to FMEnv	17	30-Aug-20	15-Sep-20
A7300	Public Display for 21 working days	26	30-Sep-20	25-Oct-20
A7400	Prepare for Panel Review	15	01-Nov-20	15-Nov-20
A7500	Acquire permits and licenses	26	05-Dec-20	30-Dec-20
P-EVO.2.3.3	**Obtainment of Land Allocation Certificate from LFZ**	17	15-Jan-20	31-Jan-20
A9100	Apply for project site allocation Certificate	7	15-Jan-20	21-Jan-20
A9200	Notice of Issuance of Project site allocation certificate by LFZ	10	22-Jan-20	31-Jan-20
P-EVO.2.4	**Subsoil Investigation**	22	07-May-20	28-May-20
A8600	Carry out field work	6	07-May-20	12-May-20



Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

PIPE THREADING WITH VALVE ASSEMBLY AND RELATED ACTIVITIES

Activity ID	Activity Name	Original Duration	Start	Finish
A8700	Carry out Laboratory work	5	13-May-20	17-May-20
A8800	Analyse Test Results	5	18-May-20	22-May-20
A8900	Compile Geotechnical Report of Findings	5	23-May-20	27-May-20
A9000	Submit Report	1	28-May-20	28-May-20
P-EVO.2.5 Procurement		412	01-Jul-20	16-Aug-21
A10087	Procure equipment required for threading plant	200	01-Jul-20	16-Jan-21
A10088	Procure equipment required for valve assembly plant	200	01-Jul-20	16-Jan-21
A10089	Shipping, clearing, arrival on site of valve and threading equipment	150	17-Jan-21	15-Jun-21
A9400	Arrival of installation teams	2	15-Aug-21	16-Aug-21
P-EVO.3 CONSTRUCTION PHASE		235	31-Dec-20	22-Aug-21
A10078	Ground Breaking Ceremony	1	31-Dec-20	31-Dec-20
A3200	Start order approval by FZE/Conduct Kick-off Meeting	0	31-Dec-20	31-Dec-20
P-EVO.3.1 Fence		80	31-Dec-20	20-Mar-21
A10020	Excavation	30	31-Dec-20	29-Jan-21
A10021	Foundation work	30	05-Jan-21	03-Feb-21
A10022	Blockwork and column	30	10-Jan-21	08-Feb-21
A10023	Cast iron installation	30	09-Feb-21	10-Mar-21
A10024	Painting	10	11-Mar-21	20-Mar-21
P-EVO.3.2 Road & Drainage		230	05-Jan-21	22-Aug-21
A10025	Excavation for Road	20	05-Jan-21	24-Jan-21
A10026	Road bed	20	10-Jan-21	29-Jan-21
A10027	Excavation for drainage	30	10-May-21	08-Jun-21
A10028	Block drainage	30	09-Jun-21	08-Jul-21
A10029	Road concrete work	30	09-Jul-21	07-Aug-21
A10030	Installation of kerbs	15	08-Aug-21	22-Aug-21
P-EVO.3.3 Gate House		38	30-Jan-21	08-Mar-21
A10031	Excavation	2	30-Jan-21	31-Jan-21
A10032	Foundation work	5	01-Feb-21	05-Feb-21
A10033	Ground slab	4	06-Feb-21	09-Feb-21
A10034	Block wall	5	10-Feb-21	14-Feb-21
A10035	Windows and doors fixing	4	15-Feb-21	18-Feb-21
A10036	Electrical work	3	19-Feb-21	21-Feb-21
A10037	Plumbing & Sewage work	3	22-Feb-21	24-Feb-21
A10038	Floor tiling	5	25-Feb-21	01-Mar-21
A10039	Other Interior finishing	7	02-Mar-21	08-Mar-21
P-EVO.3.4 60x20m Workshop		146	30-Jan-21	24-Jun-21
A10040	Excavation	10	30-Jan-21	08-Feb-21
A10041	Foundation work	24	09-Feb-21	04-Mar-21
A10042	Steel structure production	40	05-Mar-21	13-Apr-21
A10043	Steel structure installation	30	14-Apr-21	13-May-21
A10044	Block work	7	14-May-21	20-May-21
A10045	Roof system fittings	10	14-May-21	23-May-21
A10046	Wall system fitting	10	24-May-21	02-Jun-21
A10047	Ground slab	8	03-Jun-21	10-Jun-21
A10048	Installation of gantry crane	7	11-Jun-21	17-Jun-21
A10049	Doors and windows installation	7	18-Jun-21	24-Jun-21

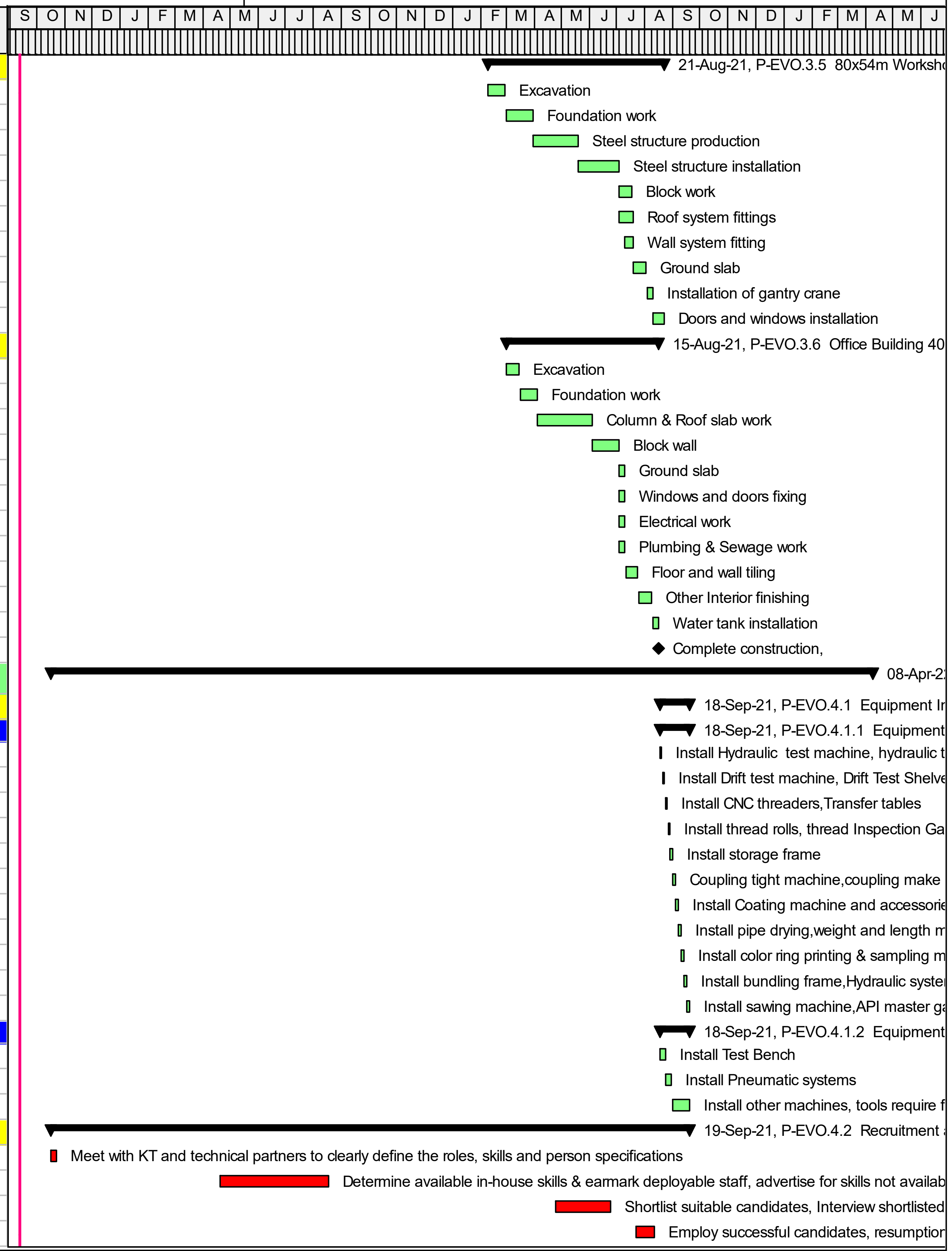
Actual Level of Effort | Remaining Work | ◆ Milestone
Actual Work | Critical Remaining Work | summary

Actual Level of Effort | Remaining Work | ◆ Milestone
Actual Work | Critical Remaining Work | summary

PIPE THREADING WITH VALVE ASSEMBLY AND RELATED ACTIVITIES

Bell Oil & Gas

Activity ID	Activity Name	Original Duration	Start	Finish
P-EVO.3.5 80x54m Workshop		194	09-Feb-21	21-Aug-21
A10050	Excavation	20	09-Feb-21	28-Feb-21
A10051	Foundation work	30	01-Mar-21	30-Mar-21
A10052	Steel structure production	50	31-Mar-21	19-May-21
A10053	Steel structure installation	45	20-May-21	03-Jul-21
A10054	Block work	14	04-Jul-21	17-Jul-21
A10055	Roof system fittings	15	04-Jul-21	18-Jul-21
A10056	Wall system fitting	10	09-Jul-21	18-Jul-21
A10057	Ground slab	15	19-Jul-21	02-Aug-21
A10058	Installation of gantry crane	7	03-Aug-21	09-Aug-21
A10059	Doors and windows installation	12	10-Aug-21	21-Aug-21
P-EVO.3.6 Office Building 40x18m		168	01-Mar-21	15-Aug-21
A10060	Excavation	15	01-Mar-21	15-Mar-21
A10061	Foundation work	20	16-Mar-21	04-Apr-21
A10062	Column & Roof slab work	60	05-Apr-21	03-Jun-21
A10063	Block wall	30	04-Jun-21	03-Jul-21
A10064	Ground slab	7	04-Jul-21	10-Jul-21
A10065	Windows and doors fixing	7	04-Jul-21	10-Jul-21
A10066	Electrical work	7	04-Jul-21	10-Jul-21
A10067	Plumbing & Sewage work	7	04-Jul-21	10-Jul-21
A10068	Floor and wall tiling	14	11-Jul-21	24-Jul-21
A10069	Other Interior finishing	15	25-Jul-21	08-Aug-21
A10070	Water tank installation	7	09-Aug-21	15-Aug-21
A10082	Complete construction	0		15-Aug-21
P-EVO.4 POST-CONSTRUCTION PHASE		906	16-Oct-19	08-Apr-22
P-EVO.4.1 Equipment Installation		33	17-Aug-21	18-Sep-21
P-EVO.4.1.1 Equipment Installation for OCTG Threading Plant		33	17-Aug-21	18-Sep-21
A9500	Install Hydraulic test machine, hydraulic test shelves	3	17-Aug-21	19-Aug-21
A9600	Install Drift test machine, Drift Test Shelves	3	20-Aug-21	22-Aug-21
A9700	Install CNC threaders,Transfer tables	3	23-Aug-21	25-Aug-21
A9800	Install thread rolls, thread Inspection Gages,thread inspection shelves	3	26-Aug-21	28-Aug-21
A9900	Install storage frame	3	29-Aug-21	31-Aug-21
A9910	Coupling tight machine,coupling make up machine, coupling shelves, thread protector tight	3	01-Sep-21	03-Sep-21
A9920	Install Coating machine and accessories	3	04-Sep-21	06-Sep-21
A9930	Install pipe drying,weight and length measuring machine	3	07-Sep-21	09-Sep-21
A9940	Install color ring printing & sampling machines	3	10-Sep-21	12-Sep-21
A9950	Install bundling frame,Hydraulic system ,	3	13-Sep-21	15-Sep-21
A9960	Install sawing machine,API master gauges,API gauges set,other small_scale equipment	3	16-Sep-21	18-Sep-21
P-EVO.4.1.2 Equipment Installation for Valve Assembly Plant/GRE Spooling Yard		33	17-Aug-21	18-Sep-21
A9970	Install Test Bench	7	17-Aug-21	23-Aug-21
A9990	Install Pneumatic systems	7	24-Aug-21	30-Aug-21
A9991	Install other machines, tools require for valve/GRE Spooling works	19	31-Aug-21	18-Sep-21
P-EVO.4.2 Recruitment and Training of Personnel for OCTG Threading and Valve Related Works		705	16-Oct-19	19-Sep-21
A9992	Meet with KT and technical partners to clearly define the roles, skills and person specifications	7	16-Oct-19	22-Oct-19
A9993	Determine available in-house skills & earmark deployable staff, advertise for skills not available	120	20-Apr-20	17-Aug-20
A9994	Shortlist suitable candidates, Interview shortlisted candidates	60	25-Apr-21	23-Jun-21
A9995	Employ successful candidates, resumption at BOG by successful candidates, Induct new staff	21	22-Jul-21	11-Aug-21



Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

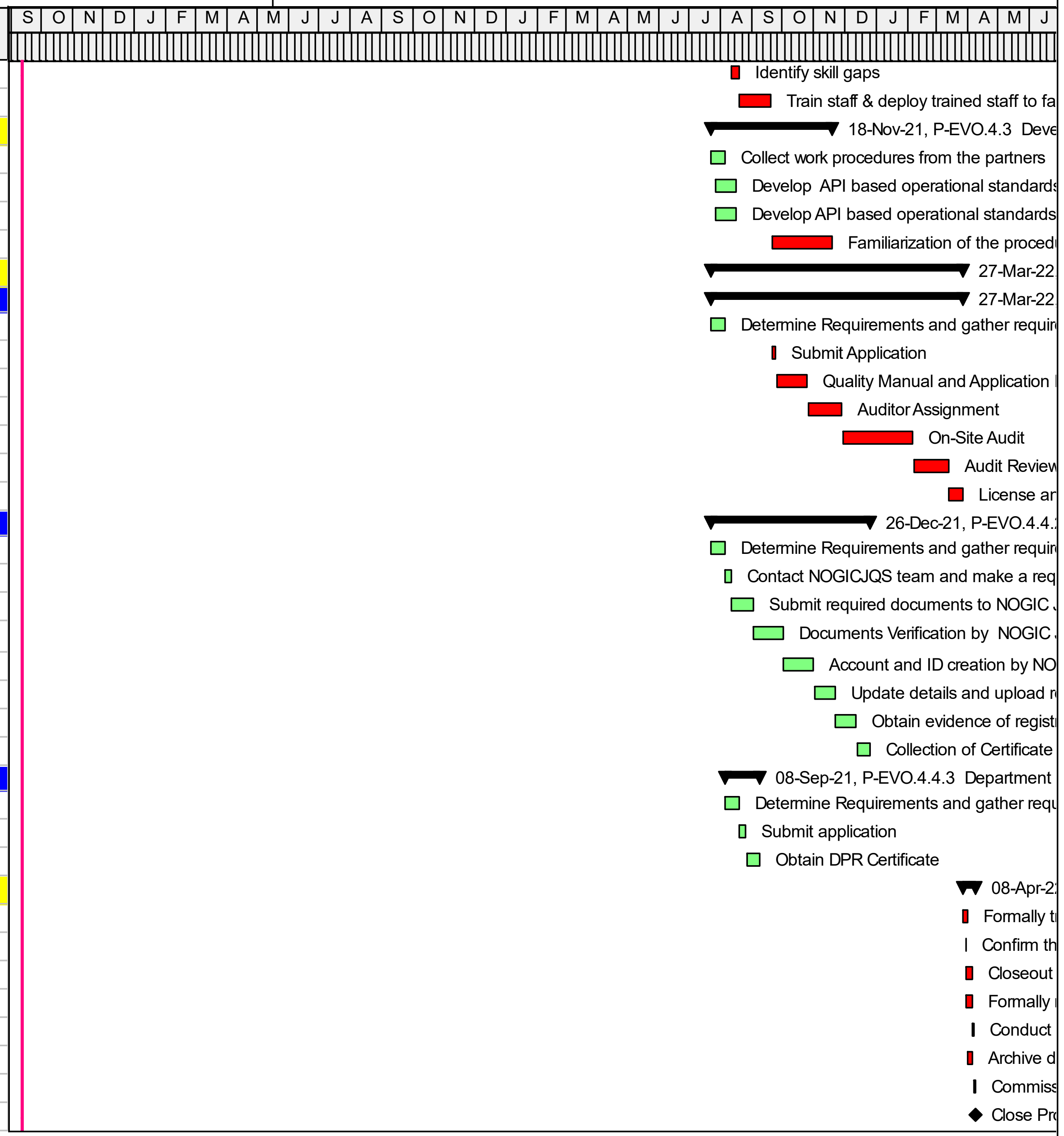
Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

Bell Oil & Gas

PIPE THREADING WITH VALVE ASSEMBLY AND RELATED ACTIVITIES

Bell Oil & Gas

Activity ID	Activity Name	Original Duration	Start	Finish
A9996	Identify skill gaps	7	12-Aug-21	18-Aug-21
A9997	Train staff & deploy trained staff to facilities	32	19-Aug-21	19-Sep-21
P-EVO.4.3	**Development of Operational Standards**	120	22-Jul-21	18-Nov-21
A10018	Collect work procedures from the partners	14	22-Jul-21	04-Aug-21
A10019	Develop API based operational standards, procedures for OCTG related works	21	27-Jul-21	16-Aug-21
A10090	Develop API based operational standards, procedures for valve related works	21	27-Jul-21	16-Aug-21
A10091	Familiarization of the procedures by the trained staff	60	20-Sep-21	18-Nov-21
P-EVO.4.4	**Application & obtainment of Relevant Certifications**	249	22-Jul-21	27-Mar-22
P-EVO.4.4.1	**American Petroleum Institute Certification - API**	249	22-Jul-21	27-Mar-22
A10000	Determine Requirements and gather requirements	14	22-Jul-21	04-Aug-21
A10001	Submit Application	5	20-Sep-21	24-Sep-21
A10002	Quality Manual and Application Review	31	25-Sep-21	25-Oct-21
A10003	Auditor Assignment	34	26-Oct-21	28-Nov-21
A10004	On-Site Audit	70	29-Nov-21	06-Feb-22
A10005	Audit Review by Quality Associate	35	07-Feb-22	13-Mar-22
A10006	License and Registration Granted	14	14-Mar-22	27-Mar-22
P-EVO.4.4.2	**Nigerian Content Equipment Certification - NCEC**	158	22-Jul-21	26-Dec-21
A10007	Determine Requirements and gather requirements	14	22-Jul-21	04-Aug-21
A10008	Contact NOGICJQS team and make a request for registration	7	05-Aug-21	11-Aug-21
A10009	Submit required documents to NOGIC JQS	21	12-Aug-21	01-Sep-21
A10010	Documents Verification by NOGIC JQS	30	02-Sep-21	01-Oct-21
A10011	Account and ID creation by NOGIC JQS	30	02-Oct-21	31-Oct-21
A10012	Update details and upload relevant documents on NOGIC JQS portal	21	01-Nov-21	21-Nov-21
A10013	Obtain evidence of registration from NOGIC JQS	21	22-Nov-21	12-Dec-21
A10014	Collection of Certificate by Authorize person	14	13-Dec-21	26-Dec-21
P-EVO.4.4.3	**Department of Petroleum Resource (DPR) Certification for OCTG -DPR**	35	05-Aug-21	08-Sep-21
A10015	Determine Requirements and gather requirements	14	05-Aug-21	18-Aug-21
A10016	Submit application	7	19-Aug-21	25-Aug-21
A10017	Obtain DPR Certificate	14	26-Aug-21	08-Sep-21
P-EVO.4.5	**Project Closeout Phase**	12	28-Mar-22	08-Apr-22
A10071	Formally transfer deliverables to relevant units	5	28-Mar-22	01-Apr-22
A10072	Confirm the project is complete	2	30-Mar-22	31-Mar-22
A10073	Closeout all contracts/procurements	7	30-Mar-22	05-Apr-22
A10074	Formally release resources from the project	7	30-Mar-22	05-Apr-22
A10075	Conduct a post-mortem to review the successes, failures, and challenges of the project	2	06-Apr-22	07-Apr-22
A10076	Archive documentation	6	01-Apr-22	06-Apr-22
A10077	Commission the project and Celebrate	2	07-Apr-22	08-Apr-22
A10084	Close Project	0		08-Apr-22



Actual Level of Effort	Remaining Work	Milestone
Actual Work	Critical Remaining Work	summary

Actual Level of Effort	Remaining Work	Milestone
Actual Work	Critical Remaining Work	summary

ATTENDANCE LIST FOR SCOPING WORKSHOP ON THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF PROPOSED PIPE THREADING AND VALVE ASSEMBLY FACILITIES AND RELATED ACTIVITIES AT LEKKI FREE ZONE, IBEJU LEKKI LOCAL GOVERNMENT AREA, LAGOS STATE

DATE: 21 - 01 - 2020

S/N	NAME OF PARTICIPANT	PARASTATALS/COMMUNITY	DESIGNATION	PHONE NO	SIGNATURE
1	Semiu Mustapha	Tiye	CDA Chairman	07080434829	[illegible]
2	Mondue Ogunsare	"	Chief Imam	08079255833	[illegible]
3	Chief K.R. Mustapha	Baale Tiye		07063909024	[illegible]
4	OLOWOLAYEMO - RASAQ	TIYE	Youth Chairman	07031513146	GAFFAR
5	Bisola Ote	"	Women leader	08082900067	[illegible]
6	Jubril Abisola M.	LSMOE & WR	CSO	08052117707	Amoruff.
7	Baale Imobido	Imobido	Baale	08023386884	[illegible]
8	SANNO MURAINO	" "	Youth Leader	07037413202	[illegible]
9	BALogun Saleh	" "	Balogun	07062980360	[illegible]
10	Adewunmi Sanwo	" "	Lagunna leader	08133938098	[illegible]
11	MASHA ADESANMOLA	Lag. State MOE	SSO	08036840328	masha
12	Femi-Falaye T.	FMEnv.		08023020985	saifalye
13	Oluwemiko Olesanya	–	Regulator	08033904230	[illegible]
14	Iyanuoluwa odesinde	LWIL	Asst. Manager	08060180150	[illegible]
15	Gerami Oguariko Esangbedo	BOG		09024025978	[illegible]
16	BISIRYU OLA	BOG	Info - Tech	09021911911.	[illegible]
17	Dada Olorunfunmi	LWIL	CRO	08068413318	[illegible]
18	CHRISTIAN OBASI	BOG	VI	07036775790	[illegible]
19	ATIKU T.O.M	LWIL	CRO	08036187640	[illegible]
20	Ofure Isenmila	Synergy capital	ESG manager	08074152907	Isenmila

P.T.O

21	Femi Jacobs	Bell Oil	Asst Manager	08036191770	[illegible]
22	Osho T. Babatunde	GIEC	M.D	08023148085	[illegible]
23	Prof A. Amusan	"	MD Consultant	"	[illegible]
24	Aminu Tomilola	"	consultant	"	[illegible]
25	Adebayo Adenike	"	office Assistant	"	
26	Bayo Opeyemi	Ibeju-Lekki L/G	Env. Health officer	09032659413	[illegible]
27	BUKES OKUKULABE	LFZDC	Deputy Manager	09043297048	[illegible]
28	Alhaji Tajudeen Jayeola	Imobido com.	Lekki Coastal	07026776480	[illegible]
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SOCIO-ECONOMIC (SIA) SURVEY QUESTIONNAIRE
FOR IMPACT ASSESSMENT STUDY

Name of Settlement/Community:…………………………….
Settlement Type: ………………………………………………..
(Town, Village, Fishing Port, Hamlet, other)
L.G.A/State:…………………………………………………….
Ethnic Group:…………………………………………………...
Name of Interviewer:……………………………………………
Date:………………………………………………………………

Section A: Respondent's Socioeconomic/Health Data

1. Sex
1.1. Male
1.2. Female

2. Age
2.1 20-29 years
2.2 30-39 years
2.3 40-49 years
2.4 50-59 years
2.5 60-69 years
2.6 70+ and above

3. Respondent's highest level of education
3.1 Primary school
3.2 Secondary school
3.3 Vocational/Technical school
3.4 Tertiary school
3.5 No Formal Education
3.6 Any other (please specify) …………………….

4. Highest level of education of respondent's spouse
4.1 Primary school
4.2 Secondary school
4.3 Vocational/Technical school
4.4 Tertiary school
4.5 No Formal Education
4.6 Any other (please specify) …………………….

5. Marital Status of Respondent
5.1 Single
5.2 Married
5.3 Divorced
5.4 Separated
5.5 Widowed

6. If married: i. Number of wives (if male): ………………………..
ii. Number of children: ………………………………………………
iii. No. of males: …………….. Females: …………………………
iv. Number of dependants: ………………………..
v. Total number of persons in Household: ……………………………………………………………………

7. Age and Sex structure of household members

Age in years	Male	Female	Total
0-4			
5-12			
13-18			
19-25			
26-59			
60-69			
70+ and above			

8. How many of your children presently attend the following categories of schools?

School	Boys	Girls	Total
Primary			
Secondary	`		
Vocational/Tech			
Tertiary			
Any other			

9. Please state your religion:………………………………………

10. How long have you lived in the settlement/community?
10.1 Less than 1 year
10.2 1-5 years
10.3 6-10 years
10.4 11-15 years
10.5 16-20 years
10.6 Above 20 years
10.7 Since birth

11. If non-native, where do you come from: ………………………………… (Village/LGA/State)?

12. What is your main source of income (Occupation)
12.1 Farming
12.2 Fishing
12.3 Technician/Artisan
12.4 Trading
12.5 Business/Contractor
12.6 Civil Servant
12.7 Retired
12.8 Student/Apprentice
12.9 Unemployed
12.10 Others (specify):……………………………………………

13. Which is/are your other source(s) of income (secondary occupations)?
13.1 Farming
13.2 Fishing
13.3 Trading
13.4 Technician/Artisan (specify): ……………………………
13.5 Others (specify): …………………………………………..

14 Estimated income of Respondent in a month (N)
14.1 Less than 20,000
14.2 20,000-30,000
14.3 40,000 - 50,000
14.4 80,000-100,000
14.5 100,000-150,000
14.6 150,000-200,000
14.7 200,000-250,000
14.8 300,000-400,000
14.9 450,000- 500,0000
14.10 Above 550,000

15 If engaged in more than one economic activity, please estimate amount and percentage income from each:

Occupation	Amount	%
Farming		
Fishing		
Trading		
Business/Contract		
Civil Servant		
Technician/Artisan		
Others (please specify)		

16 If you are a farmer, how did you acquire the land on which you farm?
16.1 Family inheritance
16.2 Rented/leased it
16.3 Bought it
16.4 Sharecropping
16.5 Others (Specify) ………………………………

17 What crops do you grow in your farm? (Please mention according to importance)
17.1:…………………………………………………………………………

17.2: …………………………………………………………………………..
17.3: ………………………………...
17.4: …………………………………………………………………………
17.5: …………………………………………………………………………

18. How would you describe your crop harvest in the most recent past (five years back)?
18.1 Increasing
18.2 Decreasing
18.3 The same

19 If decreasing, what in your opinion is responsible? (Record verbatim)
…………………………………………………………………………
…………………………………………………………………………
…………………………………………………………………………
…………………………………………………………………………..

20. As a farmer, what constraints do you experience that work against maximum productivity?
20.1 Insufficient land to farm
20.2 Inadequate/lack of capital/money
20.3 Poor technology/local tools used
20.4 Insufficient labour hands
20.5 Any other (specify): ……………………………………………….

21 If fishing is your primary or subsidiary occupation, where do you carry out your fishing?
21.1 River/Creek (please name river/creek) …………………
21.2 Ponds
21.3 Flooded areas
21.4 Sea/Ocean

22. What fishing gear(s) do you use?
22.1 Net (with canoe)
22.2 Hook
22.3 Trap/basket
22.4 All of the above
22.5 Any other (specify) …………………………………………………

23. How would you describe your fish catch/harvest in the most recent times (past five years)?
23.1 Increasing
23.2 Decreasing
23.3 The same

24. If decreasing, what in your opinion do you think is responsible?
…………………………………………………………………………
…………………………………………………………………………
…………………………………………………………………………

25. Is there any restriction on where you fish?
25.1 Yes
25.2 No

26. If yes, what is/are the restriction(s)?
……………………………………………………………………
……………………………………………………………………
……………………………………………………………………

27. Which of the following type of house do you own or live in?
27.1 Sticks/bamboo with thatch roof
27.2 Mud with thatch roof
27.3 Mud with zinc roof (indicate if plastered) ……………..
27.4 Wood/plank with zinc roof
27.5 Zinc with zinc roof
27.6 Concrete/block with thatch roof
27.7 Concrete/block with zinc roof
27.8 Others (specify). ……………………………………..

28 Which is your MAIN source of water supply in the DRY SEASON
28.1 Rain water
28.2 River/Creek/Stream/pond water (please specify which and name) …………………..
28.3 Public hand-dug well system
28.4 Own hand-dug well in residence/compound
28.5 Public tap
28.6 Piped water in residence/compound
28.7 Community Bore-hole (provided by whom?) ………………………………………………………..
28.8 Vendor/buys from private borehole
28.9 Others (specify). ………………………………….

29 Which is your MAIN source of water supply in the RAINY SEASON
29.1 Rain water
29.2 River/Creek/Stream/pond water (please specify which and name) ……………………………………
29.3 Public hand-dug well system
29.4 Own hand-dug well in residence/compound
29.5 Public tap
29.6 Piped water in residence/compound
29.7 Community bore-hole (provided by whom?) …………………………………………………………
30.8 Personal borehole/buys from private borehole (please specify which): ………………………………………….
29.8 Others (specify). ………………………………………

30 Where do you or spouse (wife) go for child delivery?
30.1 Attends hospital/clinic/Community health center (tick exact one)
30.2 Attended to by Traditional birth attendant (TBA)
30.3 Delivers in religious houses /Church
30.4 Any other (specify): …………………………………………

31 How many births have occurred in your household in the last 1year? ………… (Male: …… Female:…..)

32 How many deaths have occurred in the last 12 months in your house? …………… (Male: …….. Female: ……….)

33. What was the cause of the death?…………………......................

34. What kind of toilet facility (sewage disposal) does your household use?
34.1 No facility/open bush
34.2 Pit latrine
34.3 Flush toilet
34.4 Pier/jetty toilet
34.5 Others (specify)...

34. Where do you dispose of your domestic refuse/garbage?
34.1 Depositing refuse at backyard of house
34.2 Dumping in river/creek
34.3 Dumping in community refuse/garbage pit/burying
34.4 Local incineration (burning) when dry
34.5 Others (specify): …………………………………………………

35. To what other use do you put the River/Creek water close to your community?
35.1 Washing of clothes/household articles
35.2 Swimming/bathing
35.3 Fishing
35.4 Sand extraction

36. Which health services are available in your settlement/community?
36.1 Chemist/Pharmacy
36.2 Traditional care
36.3 Private Clinic/Hospital
36.4 Govt./Community Health Centre

36.5 Govt. Hospital
36.6 None
36.7 Other (specify)……………………………………………………

37. Which of the above do you personally use when you or family member are ill?
37.1 Chemist/Pharmacy
37.2 Traditional care
37.3 Private Clinic/Hospital
37.4 Govt. /Community Health Centre
37.5 Govt. Hospital
37.6 None
37.7 Other (specify)……………………………………………………….

38. Why do you use the health service mentioned above?
…………………………………………………………………………….
…………………………………………………………………………….

39. What is the name of the nearest Health Facility to you? ……………………………………………………………………………………

40. Which is your USUAL means of transport to the health facility?
40.1 I do not use orthodox health service
40.2 Trekking
40.3 Hand-dug Canoe
40.4 Speed boat
40.5 Bicycle
40.6 Motorcycle/Car/bus (specify): …………………………………..
40.7 Other (specify)……………………………………………………

41. How long does it take for you to get to the place?.....................1) Hour: ……..... 2) Minutes……..

42. What are the common types of ailment you suffer from MOST FREQUENTLY?
………………………………………………………………………
………………………………………………………………………

43. How would you describe your present state of health?
43.1 Well/healthy
43.2 Not well /sick

44 If you are ''not well/sick'', what is the problem/nature of sickness?
………………………………………………………………………

Section B: Socioeconomic Sensitivity/ Attitudes/Perceptions

45. What period of the year is important to you/ your community for:
45.1 Farming ……………………………………………………………..
45.2 Fishing ……………………………………………………………..
45.3 Trading ……………………………………………………………
45.4 Festivals ……………………………………………………………

46. Which of the following important environmental resources in your community do you value most?
46.2 Forest resources
46.3 River/Creek water
46.4 Ancestral sites
46.5 Animals
46.6 Others (please specify): .....…………………………........................

47. Please indicate the environmental problems which your settlement/community experiences
47.2 Soil infertility
47.3 Pest attack/invasion
47.4 Erosion problems
47.5 Flooding
47.6 Oil pollution/spillage of water resources/fisheries
47.7 Others (specify): …………………………………………………..

48. Would you say your economic activity has been affected in any way in the past (5 years or so?
48.2 Yes
48.3 No

49. If yes, in what specific way(s) have you been affected?
…………………………………………………………………………
…………………………………………………………………………
………………………………………………………………………..

50. What in your opinion may have caused the situation?
………………………………………………………………………
………………………………………………………………………
………………………………………………………………………

51. Do you think that the proposed Lagos Free Trade Zone activities and subsequent use would affect you in any way?
51.1 Yes
51.2 No

52 If yes, in what specific way?…………………………………………

53 Do you have any objection to the proposed project?
53.1 Yes
53.2 No

54 If 'yes", please state reason(s)
…………………………………………………………………..
…………………………………………………………………...

55 Which of the under-listed social problems have your community experienced in the recent past (tick as many as applicable)?
55.1 Youth delinquency
55.2 Land dispute
55.3 Chieftaincy tussle
55.4 Inter-family problems
55.5 Inter-village tribal conflicts
55.6 Unemployment
55.7 Alcoholism/prostitution

56 Please state reasons or causes of observed behaviors/problems
…………………………………………………………………………
…………………………………………………………………………

57 What are your recommended solutions to observed community problem(s)?
………………………………………………………………………
………………………………………………………………………

58 Please state your expectations from the proposed project construction and eventual commissioning for use in this your area
…………………………………………………………………………
…………………………………………………………………………
…………………………………………………………………………