ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR RECONSTRUCTION OF 138KM ALAOJI-ONITSHA 330kV SINGLE CIRCUIT TRANSMISSION LINE TO 330KV DOUBLE CIRCUIT QUAD CONDUCTORS

TCN/AfDB PROJECT

ESIA REPORT

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR RECONSTRUCTION OF 138KM ALAOJI-ONITSHA TRANSMISSION LINE TO 330KV DOUBLE CIRCUIT QUAD CONDUCTORS

A TCN/AfDB PROJECT

ESIA Report

Submitted to

The Project Implementation Unit

AfDB TCN-PIU

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR

RECONSTRUCTION OF 138KM ALAOJI - ONITSHA 330KV SC TRANSMISSION LINE TO 330kV DC QUAD CONDUCTORS TRANSMISSION LINE

Client: TCN

Date of Report: **NOVEMBER, 2019**

Project Consultant: **GEOMATICS NIGERIA LIMITED**

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LIST OF ABBBREVIATIONS

AAC -	All Aluminum Conductors
ACSR-	Aluminum Conductor Steel Reinforced
AfDB -	African Development Bank
AIDS-	Acquired Immune Deficiency Syndrome
ALARP-	As Low As Reasonably Practicable
AMWH-	Abia State Ministry of Works and Housing
AMWH-	Anambra State Ministry of Works and Housing
AnSEPA-	Anambra State Environmental Protection Agency
AnSMEnv-	Anambra state Ministry of Environment
AnSMEnv-	Anambra state Ministry of Environment
AnSMT-	Anambra State Ministry of Transport
AoO-	Area of Occurrence
ASEPA-	Abia State Environmental Protection Agency
ASMEnv-	Abia State Ministry of Environment
ASMEnv-	Abia State Ministry of Environment
AsMEnv-	Anambra State Ministry of Environment
ASMLS-	Abia State Ministry of Land Survey
ASMLS-	Anambra State Ministry of Land Survey
ASMLST-	Anambra state Ministry of Lands, survey and Town planning
ASMLSUP-	Abia State Ministry of Land Survey and Urban planning
ASMPPUD-	Abia state Ministry of Physical Planning and Urban Development (renewal)
ASMT-	Abia State Ministry of Transport
ASMWA-	Abia State Ministry of Women Affairs
ASWMA-	Anambra State Waste Management Agency
ATR-	Animist/ African Traditional Religion
BCG-	Bacille Calmette Guerin
BMP-	Biodiversity Management Program
BOD-	Biochemical Oxygen Demand
CA -	Community Agitation

CBOs-	Community Based Organizations
CH_4-	Methane
CITES ACT-	Convention to regulate International Trade in Endangered Species Act
CLO-	Community Liaison officer
CMS-	Conservation of Migratory Species
CO-	Carbon monoxide
CO_2 -	Carbon dioxide
CoC-	Code of Conduct
COD-	Chemical Oxygen Demand
CSO-	Civil Society Organization
dB-	Decibels
DBH-	Diameter at Breast Height
DFIs-	Developmental Financial Institutions
DisCos-	Distribution Companies
DO-	Dissolved Oxygen
DPT-	Diphtheria, Pertussis, and Tetanus Immunization
DSF-	Derived Savanna Forest
DSS-	Department of State Security
EC-	Electrical Conductivity
ECN-	Energy Commission of Nigeria
EEE/UEEE-	Electrical/Electronic Equipment
EHS -	Environmental Health and Safety
EIA-	Environmental Impact Assessment
EMF-	Electromagnetic Fields
EMS-	Electricity Management Services
EMSF-	Environmental and Management System Framework
EMSL-	Electricity Management Services Limited
EN-	Endangered
EOO-	Extent of Occurrence
EPC -	Engineering, Procurement and Construction

EPC-	Environmental Protection Consultant
EPSR-	Electric Power Sector Reform
EPSRA-	Electric Power Sector Reform Act
ESAP-	Environmental and Social Assessment Procedures
ESIA-	Environmental and Social Impact Assessment
ESME-	Environmental and Social Management System
ESMP-	Environmental and Social Management Plan
F-	Feeding
FEPA-	Federal Environmental Protection Agency
FGM-	Female Genital Mutilation
FGN-	Federal Government of Nigeria FAO- Food and Agriculture Organization
FL-	Flight
FLMS-	Federal Ministry of Land Survey
FMEnv-	Federal Ministry of Environment
FMPWH-	Federal Ministry of Power Works and Housing
FRSC-	Federal Road Safety Commission
GBV-	Gender Based Violence
GEMIS-	Global Emission Model of Integrated Systems
GenCos-	Generating Companies
GHG-	Greenhouse Gases
GIS	Geographic Information System
GNL-	Geomatics Nigeria Limited
GPS-	Global Position System
GSI-	Gonado Somatic Index
GW-	Groundwater
GZTACSR-	Gap-type ZT-aluminum conductor steel reinforced
HC-	Hydrocarbon
HDT-	Heavy Duty trucks
HIV-	Human Immunodeficiency Virus
HS-	Health and Safety

HSE-	Health, Safety and Environment
HSEQ-	Health, Safety and Environment Quality HCN- Hydrogen Cyanide
HSS-	Health, Safety and Security
HUB-	Hydrocarbon utilizing Bacteria
HUF-	Hydrocarbon Utilizing Fungi
ICNIRP-	International Commission on Non-Ionizing Radiation Protection
IEE-	Initial Environmental Evaluation
IFC-	International Finance Corporation
ILO-	International Labour Organizations
IMWH-	Imo State of Works and Housing
IPP-	Independent Power Producers
ISBST-	Imo State Bureau of Sanitation and Transport
ISEPA-	Imo State Environmental Protection Agency
ISMEnv-	Imo State Ministry of Environment
ISMHWASD-	Imo State Ministry of Health, Women Affairs and Social Development
ISMLS-	Imo State Ministry of Land Survey
ISMLSHUP-	Imo State Ministry of Land Survey, Housing and Urban Planning
ISMPEnv-	Imo State Ministry of Petroleum and Environment
ISMW-	Imo State Ministry of Works
ISO-	International Organization for Standardization
ISS-	Integrated Safeguards Standards
IUCN-	International Union for the Conservation of Nature
LC-	Least Concern
LCD-	Liquid Crystal Detector
LFN-	Legal Framework of Nigeria
LGA-	Local Government Authority
LGAs-	Local Government Areas
LI-	Land Use Impact
LO-	Liaison Officers
LWR-	Length – Weight Relationship

MC-	Male Circumcision
MCNL-	Mifor Consult Nigeria Limited
$MTCO_2$ –	Metric Tonnes of carbon dioxide
NA-	Not Available
NBET-	Nigerian Bulk Electricity Trading Plc
NBS-	National Bureau of Statistics
NCP-	National Council on Privatization
ND-	Not Detected
NEEDS-	National Economic Empowerment and Development Strategies
NELMCO-	Nigerian Electricity Liability Management Company
NEMSA-	Nigerian Electricity Management Services Agency
NEPA-	National Electric Power Authority
NEPP-	National Electric Power Policy
NERC-	Nigerian Electricity Regulatory Commission
NES-	Nigeria Environmental Society
NESI-	*Nigerian Electricity Supply Industry*
NESIS-	Nigerian Electricity Supply and Installation Standards
NESREA-	National Environmental Standards and Regulations Enforcement Agency
NGOs-	Non-Governmental Organizations
NIDs-	National Immunization days
NOX-	Oxides of Nitrogen
NPC-	National Population Commission
NSCDC-	Nigerian Security and Civil Defense Corps
NTEP-	Nigeria Telecommunication Expansion Program
OHL-	Over Head Lines
OPGW-	Optic Protective Ground Wires
OPV-	Oral Polio Vaccine
OS-	Operational Safeguards
OVC-	Orphans and Vulnerable Children
Pa-	Pascal

PACs-	Project Affected Communities
PAPs-	Project Affected Persons
PCB-	Poly Chlorinated Biphenyl
PHC-	Primary Health Centres
PHCN-	Power Holding Company of Nigeria
PIU-	Project Implementation Unit
PM-	Particulate Matter
PPAs-	Power Purchase Agreements
PPEs-	Personal Protective Equipments
QHSE-	Quality Health, Safety and Environment
R-	Resting
RAP-	Resettlement Action Plan
REA-	Rural Electrification Agency
RoW-	Right of Way
SCEG-	Security in Complex Environments Group
SCs-	Successor Companies
SEA-	Sexual Exploitation and Abuse
SEP-	Stakeholder Engagement Plan
SF-	Secondary Forest
SHE-	Safety, Health, Environment
SHE&S-	Safety, Health, Environment, Security
SO_2 --	Sulfur dioxide
SOX-	Oxides of Sulfur
SPV-	Special Purpose Vehicle
SQ-	Soil Quality
SSF-	Seasonal Swamp Forests
STDs-	Sexually Transmitted Diseases
SPL-	Sound Pressure Level
STIs-	Sexually TransmissibleInfections
SW-	Surface Water

TBD-	To Be Determined
TCN-	Transmission Company of Nigeria
TDS-	Total Dissolved Solid
TEP-	Telecommunication Expansion Program
THB-	Total Heterotrophic Bacteria
THC-	Total Heterotrophic Count
THC-	Total Hydrocarbon Content
THF-	Total Heterotrophic Fungi
TL-	Transmission Line
TMP-	Traffic Management Plan
ToR-	Terms of Reference
TPM-	Total Particulate Matter
UNFCCC-	United Nations Framework Convention on Climate Change
UNFPA-	United Nations Population Fund
UNICEF-	United Nations Children's Fund
VI-	Visual Impact
VOC-	Volatile Organic Compounds
VU-	Vulnerable
WC-	Water Closet
WHI-	Western Highlands
WHO-	World Health Organization
WMP-	Waste Management Plan
WP-	Western Plains
WQ-	Water Quality
WRM-	Water Resource Management

EXECUTIVE SUMMARY

ES 1 Overview of the Project

The project involves the decommission of the existing Single Circuit 330kv Alaoji - Onitsha line and the reconstruction and upgrade of the transmission line to double circuit Quad Conductor of 330kV type with a total length of about 138 km. The transmission line starts from Alaoji substation in Abia state, linking the Ihiala substation and terminating at the Onitsha substation both in Anambra state. The goal of the proposed Abia and Anambra States Transmission Project is to strengthen the national grid around the country for a more reliable electricity supply. The project shall involve;

- ✓ Validationof existing Right of Way of the existing 330kV SC TL
- ✓ Decommissioning of the existing Transmission line
- ✓ Reconstruction of same 330kV double circuit Quad Conductor line
- ✓ Commissioning of the line
- ✓ Operation of the line
- ✓ Final decommissioning

ES 1.1 Project Alternatives

The options and alternatives considered for the proposed project are presented in the Table ES-1.

Table ES-1: Options and Alternatives Considered for Proposed Project

Design Consideration	Alternatives Considered	Preferred Alternative
Substation Type	Air Insulated Systems	Air Insulated System (AIS)
	Gas Insulated System	
Transmission line design	Overhead	Overhead
	Underground	
Foundation Type	Concrete spread footing	Concrete spread footing
	Raft Foundation	
	Pile Foundation	
Conductor type	Gap-type ZT-aluminum conductor steel reinforced (GZTACSR)	Gap-type ZT-aluminum conductor steel reinforced (GZTACSR)
	Aluminum Conductor Steel Reinforced (ACSR)	
	All Aluminum Conductor (AAC)	

Number of conductors	Single circuit conductors	Double circuit conductors
	Multi-Circuit conductors	
	Double circuit conductors	
Tower type	Lattice	Lattice, Tubular
	Tubular	
Route Alternatives	Route 1	Route 3
	Route 2	
	Route 3	

ES 1.2 Description of the Project Site and Valued Environmental and Social Components

The project area cuts across three (3) States (Abia, Anambra and Imo) and sixteen LGAs as shown in Figure ES-1. These are Ekwusigo, Idemili South, Ogbaru and Ihiala in Anambra state, Osisioma, Aba North, Aba South and Ugwunagbo in Abia state, Owerri municipal, Mbatoli, Ngor-Okpala, Owerri North, Oru East, Oru west, Owerri west and Ngor Okpala in Imo state. The Project's direct impacts outside of the footprint area include the biophysical and socioeconomic impacts. It is expected that all direct biophysical impacts resulting from initial decommissioning, reconstruction and operation of the transmission line will be limited within a corridor centred in the TL alignment, with maximum width of 1 km (500 metres on either side of the Transmission line RoW and is 1.5km^2 base radius for each sub stations. The socioeconomic ADI is illustrated using a 2km wide corridor centred on the line's route and epicentre of the substation. The project area is drained by the Njaba River and Imo River. The project region is characterized by tropical rain forest. The project area is characterized by Secondary Forest, Derived Savanna and Seasonal Swamp forests. The only protected area around the project zone is the Anambra game reserve which is more than 65km away from the project area.the project area lies in and beyond the swamp zone with an elevation of 51m to 62 m. The project area is predominantly underlayed by sedimentary rocks. Abia state has two principal geological formations namely Bende-Ameki and the Coastal Plain Sands otherwise known as Benin Formation, Anambra State lies in the Anambra Basinp and has about 6,000 m of sedimentary rocks.

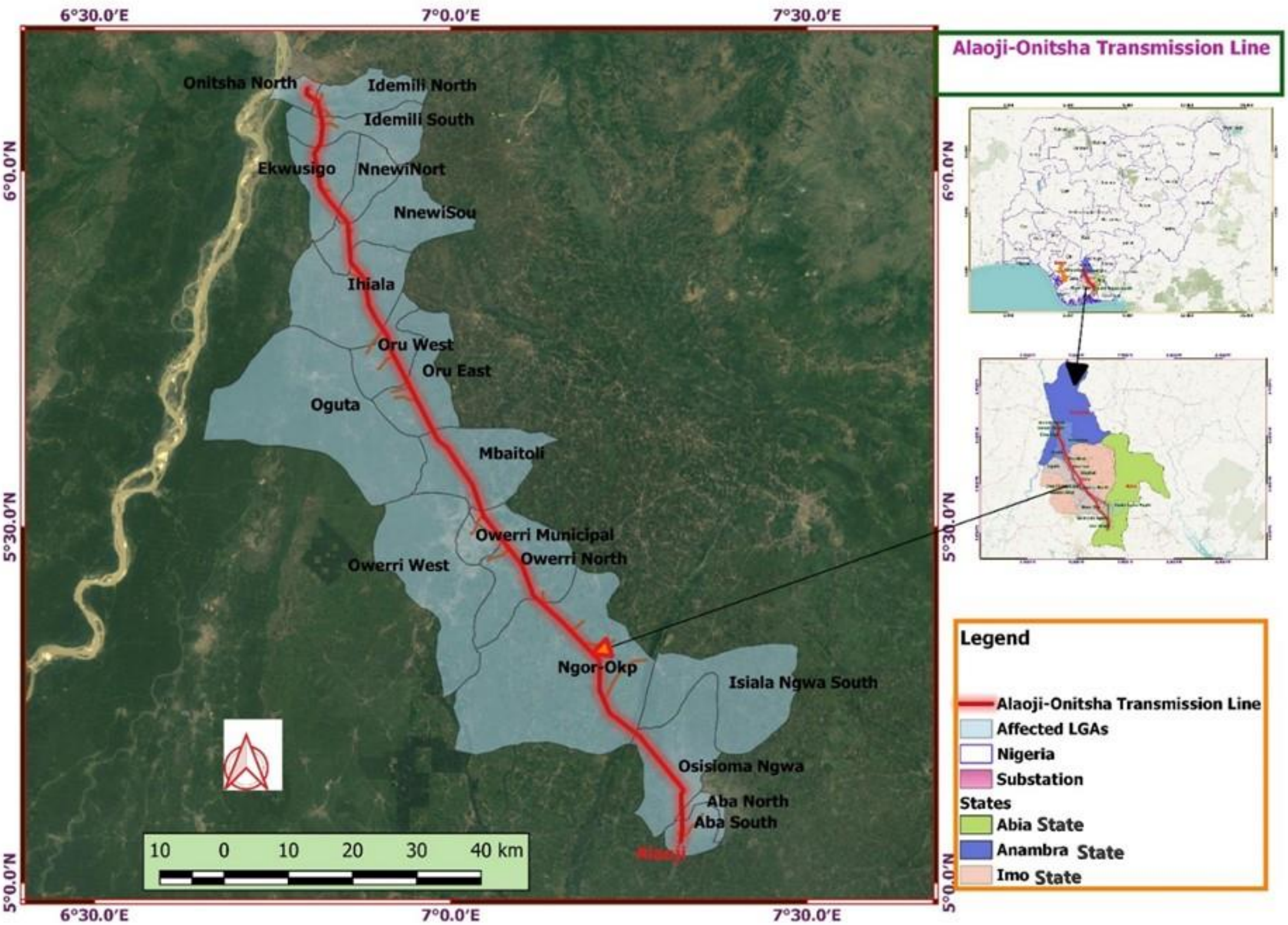

Figure ES-1: Map of the project area

ES 1.2.1 Land Cover

The Transmission Line Right of Way for the project is approximately 138km in length and 50m wide, thereby giving a total area of about 1,083,990m^2.

ES 1.2.2 Baseline condition of Bio-Physical and Socio-economic Environment

Table ES-2 is a summary of the baseline result of the biophysical environment.

Table ES-2: Summary of Baseline Result of the Biophysical Environment of the Project Area

PARAMETERS	SUMMARY
Study area	The study area is located in Abia, Anambra and Imo states, all in South- Eastern Nigeria. The project is anticipated to begin from Alaoji and traverse through Imo with a turn in and turn out at Ihiala330kV Substation to Onitsha 330kV DC sub station.
Climate/meteorology	The annual rainfall average usually varies from 1,383mm to 2,219mm (60 to 80 inches). The relative humidity is usually high throughout the year (about 75%), reaching a maximum during the rainy season when values above 87% are recorded. The temperature in the region is generally high all year round and usually range between 27.1 – 24.2^{0}C between June and December and can rise to 28.4 – 25.7^{0}C between January and April. The monthly mean wind speed varies from 1.6 to 2.0 metres per second (m/s). Wind speed is strongest at the middle of the rainy season during August and September.
Topography	The elevations of the route ranged from 51.014m to 62.472 m. On the average the topography revealeda slightly sloppy area with visible signs of erosion
Ambient Air quality	All parameters were within the FMEnv/WHO regulatory limits except for SO_2. Concentrations of all criteria pollutants measured were generally above WHO and FMEnv detection limit in all sampling stations for both SO_2. Possible sources of SO_2 are combustion from vehicular activities,
Noise quality	The results indicated an elevated noise level above the daytime threshold stipulated for the various environments (school, hospital, residential and farmlands) for all the sections. However, these results were within the general noise level of short exposure of 105dB (A) or that of prolonged exposure of 90dB (A) and compared favorably well with the obtained secondary data.
Geology	The area is predominantly underplayed by sedimentary rocks with the following stratigraphic units underlying most part of the region: the Benin Formation, The late Tertiary-Early Quaternary Benin Formation,the Anambra Basin, the Bende-Ameki Formation, Imo Shale Formation, Nsukka Formation ,Ajali Formation, the Nkporo Shaleand the Mamu Formation.
Pedology	Three soil types characterized the project area -Ferruginous tropical soils: Soil texture ranged between loamy sand to sandy clay loam soils which is prone to run offs and erosion. Alluvial/ Hydromorphic: Waterlogged areas along the route are characterized by hydromorphic soils. -Alluvial soil zone found in most part of Imo and Abia sections of the route are characterized by erosion. Areas with alluvial deposits are known for its leaching effects.
Soil quality	All physicochemical parameters measured in the soil samples were within WHO/FMEnv threshold values.*Cladosporium sp, Mucor sp, Trichoderma, Fusarium, Rhizopus, Candida sp, Aspergillus, Penicillium* are the THF taxa while *Chromobacterium, Flavobacterium, Actinomyces, Arthrobacter, Enterobacter*, *Staphylococcus, Serriatia, Protues, Klebsiella, Escherichia, Micrococcus, Pseudomonas* and *Bacillus* are the THB. Possible organic

	waste substrates for this organism could include nitrogenous, peptide rich and sugar rich food sources.
Groundwater	Physicochemical parameters analyzed for the three groundwater samples revealed concentrations within WHO/FMEnvlimits.The result compared well with reviewed secondary data.
Hydrology/drainage	The Principal rivers in the project area are the Njaba River and Imo river. The Njaba River is a tributary of the Imo River.
Surface water	Surface water was collected in ten points. All physicochemical parameters analyzed in the water samples were within FMEnv/WHO threshold values, except for Turbidity, PCB and DO. These are indicative of run off from polluted terrestrial environmentinto the adjoining water bodies. The microbial study revealed the presence of faecal indicator species indicating of open defecation system. *See section 6.2.10.10.*
Sediment	Allphysico chemical parameters analyzed in the sediment samples were within ISQG and FMEnv threshold values. The microbial composition of sediments is similar to those observed in the surface water samples. See section 6.10.8.
Hydrobiology	A total of eighty-nine (89) species were observed with 32 phytoplankton, 37 zooplankton and 20 macro benthowith the presence of pollutant sensitive species in the area such as *Nereis sp* of the Polycheate group as well as some diatoms.
Fisheries	Overall, 19 fishspecies were censored in the water bodies consisting of mainly freshwater species. *Clarias* was censored as the dominant genus with 3 species. The age structure of the fishermen was mostly in the range of 25 to 60 years old. The commonest fish processing and preservation method is smoke-drying*(Smoking)*
Vegetation	The study area consists of three habitats; Secondary forest about 46%, Derived Savanna (DSF) about 26% and Seasonal Swamp forests (SSF) takes 26%. A total of ninety-one (91) species were censored for the entire study, Notree speciescensored had a DBH of 6inches or above and height of 20m, hence no vegetal waste is expected during pre-construction activities. The Shannon index of 2.98 is indicative of a disturbed habitat. Fivespecies of conservation concern were recorded. These are Sericanthetoupetou (Endangered) and *Afzeliaafricana, Dalbergialatofolia, Ricinidendronheudelotii* and *Lophiraalata* in the Vulnerable category. Fifteen (15) species representing about 36% have indigenous uses. *Gmelina aborea, Elaeisguinnensis, Lophiraalata, Pentaclethra macrophylla*and*Bambusa vulgaris*are the most used plant species in the study area. A review of the alien species showed that two (2) of these species (*Ageratum conyzoides,* and *Chromolaen aodorata* occur in the study area. On the other hand, three (3) species (*Chromolaena odorata, Dalbergia sisso* and *Mimosa pudica*) were invasive.

Fauna and wildlife	Herpetofauna -Six Amphibians and six reptilian species were censored in the study area. -Secondary forest recorded the highest number of species and species abundance. There was no species of conservation interest in the study area. However, the censored reptilian taxa are under localized threat from biological resource use and Agricultural activities.
	Avian study -A total of twenty-five (25) sighted avian species were censored in the area. Some of the species include*Delerinis*, *Bleda, Hylia, Malimbus and Sylvietta*. - The Secondary forest accounted for the highest bird diversity. -A total of 79 individuals were censored across the counting and observation stations. The findings revealed that *Nicator chloris, Phyllastrephusicterinus, sylviettavirens and Baeopogon indicator* accounted for about 40% the total counts. -Three behavioural tendencies were evaluated at the time of censoring, feeding, resting and flight/flying. - *Halyconbadia, Oriolusnigripennis and Dyaphorophyiacastanea*was observed always resting. *Tricholaema hirsute* on the other hand was always on flight. -The birds were observed flying in three main directions. -Flight altitude was also evaluated and the findings. All individuals of *Tricholaema hirsute, Dyaphorophylanigriipennis, Muscicapacomitata*were observed flying in the 50-75 m range only, *Hyliaprasina* and *Malimbusrubricolis* had 2 individuals flying in the 75m altitude. - Other species observed in the 50-75 and above the 75m active were in flight. *-Polyboroides typhus was the only migratory species in the area*. A total of 5 raptor species, belonging to Alcedinida, Ploceidae, and Muscicapidae families were sighted. -None of the species censored in the study area were of conservation interest as all species were categorized as Least Concern (LC).
	Mammals -A total of 12 Mammalian species were censured in the study area. -These include the 7 species that were sighted, and the 5 species censured via indirect evidences. -The Secondary forest was the preferred habitat for mammals in the study area. -All sighted species were of Least Concern (LC) status using the IUCN Red list 2019 version one criterion. -The major threat for all the species is hunting. No endemic mammalian species was recorded.
Protected areas	The only protected area is the National Park around the project zone is Anambra game reserve which is more than 65km away from the project area.

Table ES-3 is a Summary of Baseline Result of the Socio-economic Environment of the Project Area.

Table ES-3: Summary of Baseline Result of the Socio-economic Environment of the Project Area

Parameters	Summary
Political context	Anambra State is made of 21 local governments, including, Alaoji, Idemli North and South Ogbaru and Ihiala. Each of the LGAs is run by an elected Executive Chairman and elected Counselors. The Chairman appoints cabinet to assist in performing the executive functions of the local government. Abia State has 17 local governments including Osisioma, Aba North and South Ugwunagbobo and Ukwa West. Imo State has 17 LGAs including Owerri West, Oru East, Oru West and Ngorokpala
Demography	Based on the Projected population (2018 based on an exponential growth rate of 3.2%). Abia State has a demography of 39,380,05.9 and 4,900km^2 of land area. The State has a population density of 580.698 persons/ km², Anambra State has a demography of 57,821,13.9 and a land area of 4,865km$^{2.}$ the state has a population density of 858.752 persons/ km²and Imo state has a demography of 40,748,46.6 and a land area of 5,288km^2. The State has a population density of 742.731 persons/ km². In all three States, male population is marginally above that of females. Age group of 0-14 years constituted 41.8% of the population of all three States. Literacy level stood at 85.1, 82.1 and 74.3, respectively.
Conflict Resolution	Civil cases in the communities are arbitrated by the Chiefs-in-Council, Elders-in-Council, religious leaders, traditional priests, age grade, women groups or family heads. On the other hand, inter-communal conflicts are resolved by the representatives (Chiefs) of the communities involved. If it cannot be resolved at that level, the case is taken to the Paramount ruler for adjudication. Criminal cases are referred to the government law enforcement agents.
Household and Community Characteristics	A total of 600 household questionnaires were administered and 560 retrieved representing a success rate of 93.3 % while 110 community questionnaires were recovered out of 118 initially administered representing a success rate of 93.2%.
Gender of heads of household	In Anambra, the 83% male house heads is less than the Nigerian average of 85.7%, though all areas in the line route have more male house heads. In Abia, the 88.2% male househead is less than the Nigerian average of 85.7%. In Imo, 55.7% male househead is less than the Nigerian average of 85.7%.
Marital Status of Head of Household	The marital status of respondents in the project area of Anambra, Abia and Imo are52% (18% single and 21% widowed), 50% (30% single and 14 widowed) and 47% (17% single and 24% widowed).

Nature of Marriage in Households	The 89% of monogamous marriages across all the communities in the project area is above the Nigerian and South-East averages of 76.1 and 70.7% respectively.
HOUSEHOLD SIZE	The most prevalent household sizes in the project areas are those made up of 3-5 persons and 6-10 persons accounting for about 87% of the households. The findings are in tandem with 2012 NBS statistics which put the average family size in Anambra State at 3.9 persons as against Abia State with 3.7 persons and Imo state with 3.7.
Ethnic Composition	Expectedly, the data revealed dominance of the landowners (Ibo) where the proposed project is to be sited. The results also revealed high relationship between project area and the contiguous ethnic group. This was evident in the presence of Anioma/ibo, Iteskiri, Ijaw, Afemai, Ishan and Isoko. The presence of Yoruba and the Hausa/Fulani ethnic groups reflects the cosmopolitan nature of the dominant cities within the project area (Aba, Owerri, Alaoji, Ihiala and Onitsha).
Religion	The people are adherents of three religions. Christianity was the most practiced religion with about 97.6% of the respondents across the LGA's. Followed by ATR with an average of 2.8%. While about 0.06% were adherents of the Islamic Faith
Educational Facilities	Over 219 primary schools, 106 secondary schools and 4 tertiary institutions in communities within the spatial boundary of the project area.
Water facilities	The number of privately-owned boreholes is higher compared to communally owned ones. Less than 1% of the respondents depend on communal borehole boreholes for their water needs.
Household facilities	Result on the survey of these facilities revealed that power generator, gas stove/kerosene, television, radio cassette player and refrigerator were the most common facilities among households in the project area. Cars and Motorcycle are the common means of transportation while the combined percentage of persons that own houses and/or land is less than 6% of the sampled population.
Roofing materials	Over 60% of houses in the project area are roofed with corrugated Iron Sheets except in communities in Imo state which a bulk of the buildings (33.8%) had also roofed with aluminum sheet.
Walling Materials	On the average, the use of concrete blocks as walling materials is predominant.
Flooring Material	Five flooring materials were observed to be in use.

	Smooth cement and ceramic tiles accounted for well about 80.1%, sand, wooden planks and smothered muds observed in Aba, Ihiala, Owerri, Ekwusigo accounted for the remainder 19.9%. The data provided closely mirrors The Nigeria average for Flooring Materials.
Transport Facilities	The project area is traversed by several roads, amongst which are: The Aba – Portharcourt express way Owerri – Onitsha express Way Umuikaa – Owerri road Smaller feeder roads linking the major roads with the impacted communities, and Unpaved roads connecting small villages and settlements.
Communication Facilities	The people in all the communities have access to mobile communication through fixed wireless lines provided by communication service providers like MTN, GLO, AIRTEL and 9 Mobile. There are postal services in most of the communities in Abia, also there are no postal service in the communities in Anambra and Imo, but the inhabitants obtain news about other parts of Nigeria and the world through radio, television and the mobile handsets.
Health Facilities	The health facilities in the area comprise of twent- four (24) Primary Health Centres (PHC) and twenty-nine (29) hospitals.
Prevalence of Diseases in the study area	The most prevalent diseases affecting all age groups in the communities are Malaria Fever (39.2%), Upper Respiratory Tract Infection (19.2%), Typhoid Fever (10.5%), Diarrhoea/vomiting (5.2%) and Hypertension (7.2%). Other common ailments in across all project LGAs: include Worm Infestation, Diabetes Mellitus, Lower Respiratory Tract Infection, and Arthritis.
Sexual Activities and Knowledge of Sexually Transmissible Infections (STI)	A greater percentage of the respondents are aware of the causal methods and preventive measures of STIs
Condom Availability and Use	Less than 30% of males and 35% of females aged above 15 years had never used condom before while over 20% of males and 30% females claimed they used condom only occasionally, mainly either for prevention of pregnancy or STI. Only less than 10% of sexually active males and 2% females use condom all the time (i.e. during every episode of sexual intercourse).
Land planning and uses	Land ownership in the project site is either by community or family. However, by virtue of the Public Lands Acquisition Law, the state government may acquire land compulsorily for public purpose from individual landowners, subject to the payment of compensation to such landowners. The wayleave is served by the existing road infrastructure and other rural roadways from which access along the way-leave is provided.

	The residential areas are mostly rural settlements except Ohabiam, Owerri, Ala-Oji, Ariaria, Aba and Umuochamthat are urban settlements. The population in the PACs is predominately made up of low and middle with few high-income earners in the mentioned urban towns. The residential areas and the surrounding sub-places consist largely of single unit residential homes. On the other hand, the rural settlements such as Umuode, Obosi, Aba, Ihiala, Ozubulu, Ngor andall other communities except the listed semiurban/urban are sparsely populated with low cost, single unit dwellings on small stands. Majority of theinhabitants of these areas live on lower income (see discussion on livelihood).
Occupation	The respondents are mainly into Farming (24%), Pastoralist (8%), Self-employed (20.3%) Private employee (10.7%), Public employee (27%) and Trading (32.3%).
Artisanal Skills	Taxi (car, tricycle, motocycle), Heavy machinery operator (*shovel operator, caterpillar, etc.),* Mechanic, Mason, Painter, Chainsaw operator, Commercial Farm workers, Plumbing, Experienced pylon assembler, Carpenter, Welder, Electrician, Truck driver
Income	The average income of households of the respondents were below ₦500, 000 per annum. It was observed that the basic challenges to income generating activities in the project area include: High cost of transportation, High level of post-harvest loss, Absence of electricity, Lack of access to credit facilities, Lack of productive inputs and inadequate extension visitation, Poor storage and processing facilities and High cost of labour among others.
Households' Main Source of Energy	Electricity from the national grid is the main source of lighting in the project area supplanted by privately owned AC supply sources. On the other hand, kerosene was the most used energy source for cooking. In addition, charcoal and electricity were the least patronized energy sources in the project area.
Households' Main Source of Potable Water	The prominent water source in the project area is water from boreholes. Other frequently used water sources are wells, water vendors and tanker trucks. The least used water sources were piped water, rainwater, unprotected spring, bottles water, surface water and rivers.
Waste Disposal by Households	Open dumping is the prevalent refuse disposal method in the area followed by refuse incineration. over 55% of households in the project area use the Water Closet (WC) system about 30% used pit latrine while about 15% of the households, use the bush.
Vulnerable Groups	The most vulnerable group across the LGA's are non-indigenes, children and women and land tenants.
Cultural Heritage Resources	There are no cultural sites within the way leave and within the 500m on either side of the RoW.

Gender Issues	**In terms of Circumcision,** all male individuals in the households are circumcised with no female circumcised. While in terms of **Land ownership**: There is a higher ratio of male landowners than female in project area. This is related to the culture of preferentially giving wealth to men over women on inheritance.

ES 1.3 Institutional and legal framework for implementation of the project

NATIONAL ENVIRONMENTAL & SOCIAL POLICIES

The following are the national environmental and social policies related to the proposed project

- ✓ National Policy on the Environment (1988)
- ✓ EIA Act Cap E12 LFN 2004
- ✓ National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2007
- ✓ National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991
- ✓ National Environmental (Sanitation and Wastes Control) Regulations, 2009
- ✓ National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991
- ✓ National Environmental (Electrical/Electronic Sector) Regulations, 2011
- ✓ National Environmental (Noise Standards and Control) Regulations, 2009
- ✓ National Environmental (Surface & Groundwater Quality Control) Regulations 2011
- ✓ Land Use Act CAP L5 LFN 2004
- ✓ Forest Law CAP LFN 1994
- ✓ Endanger Species (Control of International Trade and Traffic) Act CAP HI LFN 2004
- ✓ National Environmental (Soil Erosion and Flood Control) Regulations, 2011
- ✓ Factories Act (CAP F1), 2004
- ✓ Employee Compensation Act, 2010
- ✓ Nigerian Urban and Regional Planning Act CAP 138 LFN 2004
- ✓ EIA Procedural Guidelines, 1995
- ✓ Natural Resources Act CAP 268 LFN 1990

ENERGY SECTOR POLICIES AND LEGAL PROVISIONS

The following are the national energy sector policies and legal provisions related to the proposed project

- ✓ National Energy Policy, 2003

- ✓ Electric Power Sector Reform Act 2005
- ✓ Energy Commission of Nigeria Act CAP 109 LFN 1990
- ✓ Nigerian Electricity Supply and Installation Standards (NESIS) Regulations 2015
- ✓ Acquisition of Land Access Rights for Electricity Projects Regulations, 2012
- ✓ Roadmap for Power Sector Reform of 2010.

NIGERIAN GENDER RELATED POLICIES

The following are the Nigerian gender-based policies related to the proposed project

- ✓ The Gender Policy Framework in Nigeria
- ✓ National Gender Policy, 2006

NIGERIAN INSTITUTIONAL PROVISIONS AND ARRANGEMENT

The following are the Nigerian Institutional provisions and arrangement related to this project

- ✓ Federal Ministry of Environment
- ✓ National Environmental Standards and Regulations Enforcement Agency (NESREA)
- ✓ Federal Ministry of Power Works and Housing
- ✓ Nigerian Bulk Electricity Trading Plc (NBET)
- ✓ Nigerian Electricity Regulatory Commission (NERC)
- ✓ Nigerian Electricity Liability Management Company (NELMCO)
- ✓ Nigerian Electricity Management Services Agency (NEMSA)

STATE LAWS

Abia State Environmental Laws

The enabling legal instruments of the state include;

- ✓ Basic Environmental Law No. 1of 2004 amended in 2013
- ✓ Policy on Environment (2010)
- ✓ Flood and Erosion Control and Soil Conservation (2010)
- ✓ Flood Control and Water Conservation (2010)
- ✓ Watershed Management Policy (2010)
- ✓ Basic Environmental Law No. 1 of 2004 amended in 2013

Imo State Environmental Laws

The enabling legal instruments of the state include;

- ✓ Imo State Environmental Protection Agency Law
- ✓ Imo State Bureau for Sanitation & Transport Law

Anambra state Environmental Laws

The enabling legal instruments of the state include

- ✓ Environmental Protection Agency Act
- ✓ Waste Management Agency Act

LGAs Bye Laws on Environment

The project would trigger all the environmental and waste management bye laws of all the listed affected LGAs

International Conventions and Agreements applicable to the sector

Apart from the National Laws, Acts and Regulations, Nigeria is a signatory or party to many International Environmental Conventions and Treaties that are relevant to the energy sector. A list of some of the relevant International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria are;

- ✓ United Nations Framework Convention on Climate Change (UNFCCC). 1992
- ✓ Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989
- ✓ Montreal Protocol on Substance that Deplete the Ozone Layer, 1987
- ✓ Vienna Convention on the Ozone Layer, 1985
- ✓ ILO C155 and R164 2001; Management of work place Health and safety and Management of work place Hazards
- ✓ Convention on Conservation of Migratory Species of Wild Animals, 1979
- ✓ Convention on the Protection of the World Cultural and Natural Heritage (world Heritage Convention), Paris, 1975
- ✓ Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES), 1973
- ✓ Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention)

(Signatory only), 1988

- ✓ African Convention on the Conservation of Nature and Nature Resource, 1968
- ✓ Paris Agreement, 2015

The African Development Bank (AfDB) Integrated Safeguards System (ISS)

The ISS consists of four interrelated components as summarized in Figure ES-2.

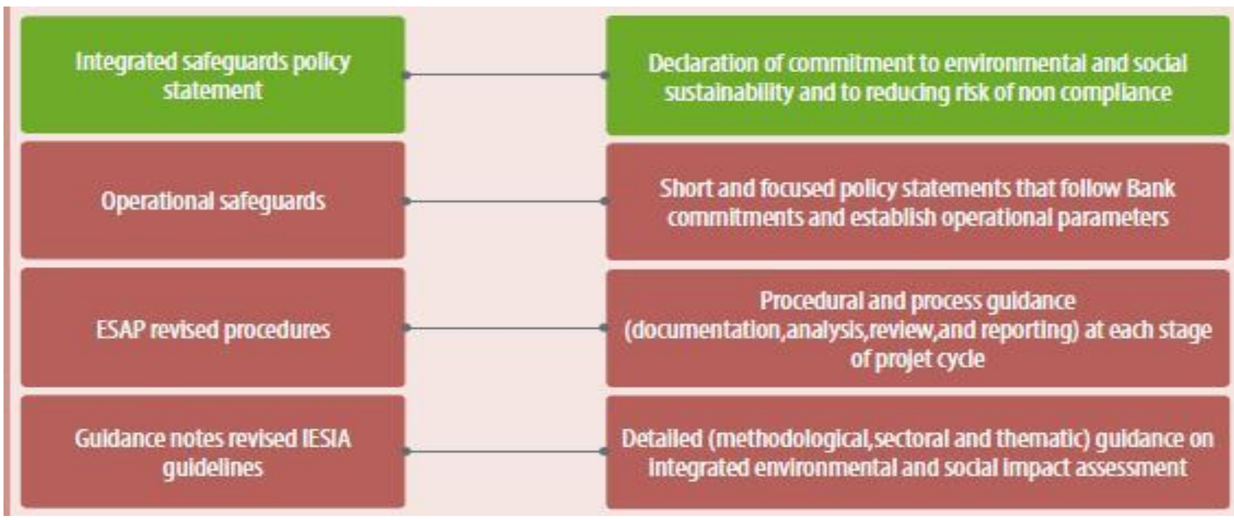

Figure ES-2: Structure of the AfDB ISS

TCN's HSEQ POLICY

TCN SHE & S Philosophy is anchored on

- ✓ nobody Gets Hurt during project planning and execution.
- ✓ safety and security are the project's highest priorities.
- ✓ any work performed at a facility must be done in the safest manner possible.
- ✓ safety is an integrated part of SHE&S policies, procedures and requirements and those are required to safely operate and maintain operating facilities.
- ✓ safety is everybody's concern and responsibility.

INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the TCN and the contractors. These include the following;

- ✓ The Federal Government of Nigeria (FGN)
- ✓ Federal Ministry of Environment
- ✓ Federal Ministry of Finance
- ✓ Transmission Company of Nigeria (TCN)
- ✓ AfDB Project Implementation Unit (PIU)
- ✓ Abia State Ministry of Environment (ASMEnv)
- ✓ Abia state Ministry of Physical Planning and Urban Development(renewal) (ASMPPUD)
- ✓ Abia State Environmental Protection Agency (ASEPA)
- ✓ Abia State Ministry of Land Survey and Urban planning (ASMLSUP)
- ✓ Abia State Ministry of Women Affairs (ASMWA)
- ✓ Abia State Ministry of Transport (ASMT)
- ✓ Anambra state Ministry of Environment (AnSMEnv)
- ✓ Anambra State Environmental Protection Agency (AnSEPA)
- ✓ Anambra State Ministry of Transport (AnSMT)
- ✓ Anambra state Ministry of Lands, survey and Town planning (ASMLST)
- ✓ Imo State Ministry of Petroleum and Environment (ISMPEnv)
- ✓ Imo State Environmental Protection Agency (ISEPA)
- ✓ Imo State Ministry of Health, Women Affairs and Social Development (ISMHWASD)
- ✓ Imo State Ministry of Works (ISMW)
- ✓ Imo State Ministry of Land Survey Housing and Urban Planning (ISMLSHUP)
- ✓ The Customary District Councils head of each affected LGA
    - Ekwusigo
    - Idemili South
    - Ogbaru
    - Ihiala
    - Osisioma

- Aba North
- Aba South
- Ugwunagbo
- Owerri municipal
- Mbatoli
- Ngor-Okpala
- Owerri North
- Orun East
- Oru west
- Owerri west and
- Ngor Okpala

✓ Village Chiefs of Affected Communities

ES 1.4 Project Impacts

The following are the key project impacts

- pollution/nuisance levels= SO_2 levels in air, copper levels in soil, iron and lead levels in groundwater, BOD, COD and DO levels in surface water and copper and manganese levels in sediment
- Noise =
- Surface water physico-chemical parameters above WHO/FMEnv regulatory = DO, Turbidity
- Invasive species= *Chromolaena odorata, Dalbergia sisso and Mimosa pudica*
- Alien species = *Ageratum conyzoides,* and *Chromolaena odorata*
- Threatened species= *Afzelia africana, Dalbergial atifolia, Ricinodendron heudelotti, Lophira alata* (Vulnerable) *Sericanthe toupetou* (Endangered)
- Avian Raptor species= *Halcyon badia, Polyboroides typus, Merops gularis, Miscicapa comitata* and *Muscicapa cassini*
- Migratory species = *Polybroides typhus*
- Estimated amount of greenhouse gas to be generated by project activity = 269.25 **$MTCO_2$ Equivalence**
- **Net amount of GHG to be reduced by project per year = 5,743,321.94 $MTCO_2$ Equivalence**
- Number of households to be displaced will be about 2,100
- Economic displacement of about N5.1 billion

ES 1.5 Consultations

Details of the first and second rounds of consultations held with various stakeholders of the project are presented in Table ES-4.

Table ES-4: Details of Stakeholder Consultation

	Objectives and Information Provided for Rounds 1 and 2							
Abia State Round 1			Imo State			Anambra State Round 1		
Target group	Date & Venue	Comment & Implementation	Target group	Date & Venue	Comment & Implementation	Target group	Date & Venue	Comment & Implementation
FMEnv	Government house, Umuahia 27/7/2019	Promised to cooperate with other environment regulators to fast track the ESIA Process for timely approvals and permitting.	FMEnv	Benconn Hotel, Owerri 25/7/2019	Advised we ensure maintenance of the ecosystem, ecological process and preserve biodiversity.	FMEnv	Beautiful Gate Resort, Awka (24 July 2019)	Advised TCN to develop the SEP and strictly implement it throughout the project lifespan, to ensure stakeholder confidence and sustainability.
FMAFNR	Government house, Umuahia 27/7/2019	Promised to be involved in the provision of agricultural extension services to PAPs, to achieve greater agricultural productivity.	FMAFN R	Benconn Hotel, Owerri 25/7/2019	Advised we watch out for flood plains and also construction be done above flood level.	FMAFNR	Beautiful Gate Resort, Awka (24 July 2019)	Compensation for PAPs and PACs was stressed while footprint for access route creation should be minimized
FMLS	Government house, Umuahia 27/7/2019	They advised that proper route studies should be carried out and also	FMLS	Benconn Hotel, Owerri 25/7/2019	promised to facilitate and fast track the processes to gazette the ROW when TCN applies and this should be	FMLS	Beautiful Gate Resort, Awka (24 July 2019)	Promised to send officers to join the TCN's consultant in

		affected land owners should be compensated			done before compensations / Resettlements are implemented			the field for enumeration exercise, if invited
FMPW&H	Government house, Umuahia 27/7/2019	The acquisition of government owned land but the project will be responsible for the processing charges.	FMPWH	Benconn Hotel, Owerri 25/7/2019	PAPs and PACs should be compensated without delay.	FMPWH	Beautiful Gate Resort, Awka (24 July 2019)	The design and type of equipment should be that which meet international best practice.
NESREA	Government house, Umuahia 27/7/2019	Commended TCN for an early good start in compliance to environmentalrequirements and admonished the Company to keep up thatway	NESRE A	Benconn Hotel, Owerri 25/7/2019	Advised compliance with environmental laws and regulation	NESREA	Beautiful Gate Resort, Awka (24 July 2019)	Promised to give full support in the best of their ability
NERC	Government house, Umuahia27/ 7/2019	Promised to give full support in the actualization of the project.	NERC	Benconn Hotel, Owerri 25/7/2019	Advised villagers to be hospitable and give full cooperation in the actualization of the project	NERC	Beautiful Gate Resort, Awka (24 July 2019)	Emphasized on the observation of Nigerian Electricity Regulatory Commission standards

NEMSA	Government house, Umuahia 27/7/2019	Requests to be involved in all phases of the project to inspect the standards of the project before commissioning and during operations.	NEMSA	Benconn Hotel, Owerri 25/7/2019	TCN should ensure that materials and equipment to be used are of international standards.	NEMSA	Beautiful Gate Resort, Awka (24 July 2019)	Promised to give technical support in the actualization of the project
DSS	Government house, Umuahia 27/7/2019	promised to provide the necessary security cover needed in all phases of the project	DSS	Benconn Hotel, Owerri 25/7/2019	Gadgets, Equipments and valuables should be carefully safeguarded to avoid theft and vandalism	DSS	Beautiful Gate Resort, Awka (24 July 2019)	Promised to give full support in the actualization of the project.
NSCDC	Government house, Umuahia 27/7/2019	Security guard should be employed.	NSCDC	Benconn Hotel, Owerri 25/7/2019	Promised to provide the necessary security cover needed in all phases of the project and requested that provisions for their logistics be made ab initio in the project budget.	NSCDC	Beautiful Gate Resort, Awka (24 July 2019)	presence of security personnel during any phase of the project activity
ASMEnv	Government house, Umuahia 27/7/2019	They advised we ensure safe health and safety environment	ISMEnv	Benconn Hotel, Owerri 20/3/2019	Waste should be disposed properly to avoid environmental pollution	ASMEnv	Beautiful Gate Resort, Awka (19 May 2019)	Compliance with the state environmental laws and regulation
AMWH	Government house, Umuahia 12/3/2019	Stressed on the gully erosion hazard in the state.	IMWH	Benconn Hotel, Owerri 20/3/2019	Stressed the need for Compensation to PAPs and PACs was stressed	AMWH	Beautiful Gate Resort, Awka (19 May 2019)	Transport Management Plan needs to bedeveloped for

								heavydutyvehicletoensureappropriatecontrolsduring transportation
ASMLS	Government house, Umuahia 12/3/2019	affected landowners should be compensated	ISMLS	Benconn Hotel, Owerri 20/3/2019	promised to provide necessary support needed in all phases of the project	ASMLS	Beautiful Gate Resort, Awka (19 May 2019)	All the communities sought to know the size of the RoW
Ariaria International *Market* Traders *Association*	*Ariaria* market Square 21-5-2019	Asked that PAPs be given adequate time prior to construction	Owerri market women association	Owerri market square 22-5-2019	Harped on the need for locals to be involved in the contracting process	Onitsha market trade union	Onitsha market square 23-5-2019	The project should fully understand the livelihood pattern within the area.
Aba market traders' association	Aba market square 21-5-2019	TCN should actively engaged all stakeholders throughout the project life cycle	Owerri market traders' association	Owerri market square 22-5-2019	affected landowners should be compensated	Onitsha market women association	Onitsha market square 23-5-2019	they asked for improvement of electricity supply in their village
Abia State Women Association	Government house, Umuahia 21-5-2019	Promised to give full support in the actualization of the project	*Anambra State Women Association*	Benconn Hotel, Owerri 22-5-2019	Requested for constant electricity in their community	Anambra market women association	Beautiful Gate Resort, Awka 23-5-2019	affected landowners should be compensated
Round 2 Consultations. The target group is Project Affected Communities								
Imo State			**Abia State**			**Anambra State**		

LGA	Community	Date & Venue	Comment & Implementation	LGA	Community	Date & Venue	Comment & Implementation	LGA	Community	Date & Venue	Comment & Implementation
Owerri Municipal	Owerri	Igwe's Palace 21-5-2019	They were concerned about the houses around the right of way and relocation measures put in place by the government.	Ossioma Ngwa	Umuode	Town hall 22-5-2019	The people of Umuode wants TCN improve electricity in their community	Idemili South	Obosi	Community primary school 24-7-2019	Compensation for PAPs and PACs must be paid before project commencement
	Nwaorie	Town hall 21-5-2019	The community requested for community development projects and employment opportunities for the youth		Umuocham		They welcomed the project and asked for improvement of electricity supply in their village		Umuoja	Town hall 22-7-2019	TCN must acquire the ROW now before embarking on the proposed reconstruction project
	Owerri Division	Igwe's Palace 21-5-2019	TCN must pay adequate compensation for the affected houses/structures and crops within the ROW. ✓		Abayi		They showed concern on corona and effect on human health		Obosi	Town hall 22-7-2019	The community requested for community development projects and employment opportunities for the youth

Mbatoli	Awo	Igwe's Palace 21-5-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community		Umuozuo	Igwe's Palace 22-5-2019	They complained about Dust and noise control during construction		Oba Aboji	Igwe's Palace 24-7-2019	The Igwe pledged to fully support the implementation of the project
	Orodo	Community primary school 20-5-2019	They were concerned about the houses and farmlands around the right of way and relocation Measures put in place by the government.		OsiaUmu Mgbede	Community primary school 22-5-2019	TCN must pay adequate compensation for the affected houses/structures and crops within the ROW. ✓		Oba	Igwe's Palace 20-7-2019	They welcomed the project and asked for improvement of electricity supply in their village
	Ohoba	Town hall 20-5-2019	They do not want TCN to build their houses for them but to compensate them in cash. ✓		AmaOkpu	Town hall 22-5-2019	They want the compensation/ resettlement to be implemented within months of enumeration, to avoid unnecessary hardship on the PAPs	Ogbaru	River idemili	Town hall 24-5-2019	The people of lasi showed major concerned on compensation to landowners affected by the project

	Nkwesi	Igwe's Palace 20-5-2019	They expressed their fear remaining in 'darkness', despite co-hosting a power project of this scale ✓		UmuOjima	Community primary school 22-7-2019	They requested for employment for the youth during the cause of the project		ErunaLagbe	Community primary school 24-5-2019	They requested compensation should be paid before project commencement to avoid by PAPs
	Mbieri	Town hall 21-5-2019	Compensation for PAPs and PACs must be paid before project commencement		Ogbu	Igwe's Palace 23-7-2019	The Igwe promised his full support during the cause of the project		Atani	Igwe's Palace 20-7-2019	The Igwe welcomed the development and pledged full support
	Obaku	Igwe's Palace 21-5-2019	They asked if TL won't cause electrocution in their communi**ty**		Umuobo	Community primary school 23-7-2019	They were concerned about the houses and farmlands around the right of way and relocation measures put in place by the government.		Eze	Community primary school 20-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community

Ngor-Okpala	Akabo	Community primary school 21-5-2019	TCN must acquire the ROW now before embarking on the proposed reconstruction project		Umumba	Community primary school 24-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community	Ihiala	Awgbu	Igwe's Palace 24-7-2019	They want the compensation/ resettlement to be implemented within months of enumeration, to avoid unnecessary hardship on the PAPs
	Umunoha	Community primary school 21-5-2019	They requested compensation should be paid before project commencement to avoid by PAPs		UmuAkpara	Community primary school 20-7-2019	They shoed their grievance for No compensation payment after the construction of the existing 330kV SC line.		Azira	Igwe's Palace 24-5-2019	The community demanded for community development projects
Owerri North	Umunahu	Igwe's Palace 26-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community		Umuaba	Town hall 24-7-2019	They were scared of corona effect and asked which measures was put in place to		Uli	Community primary school 24-5-2019	They want the compensation/ resettlement to be implemented within months of

							reduce the effect				enumeration, to avoid unnecessary hardship on the PAPs
	Mkpama	Town hall 26-7-2019	TCN must acquire the ROW now before embarking on the proposed reconstruction project		Okpuala	Igwe's Palace 23-7-2019	They asked for the project Benefits and also employment opportunities for the youths		Ihiala	Community primary school 24-5-2019	The Igwe pledged to fully support the implementation of the project
Oru East	Awomama	Town hall 25-7-2019	The Igwe pledged to fully support the implementation of the project		Mbuntu	Igwe's Palace 21-7-2019	The villages made enquiry on how long the project will take and its benefits to the community		Ozubulu	Igwe's Palace 23-7-2019	The Igwe welcomed the development and pledged full support
Oru West	Ofekata	Community primary school 25-7-2019	They showed their grievance for No compensation payment after the construction of the existing 330kV SC line		MbokoUmuete	Community primary school 23-7-2019	They requested compensation should be paid before project commencement to avoid by PAPs	Ekwusigo	Orifite	Igwe's Palace 24-7-2019	They were concerned about the houses and farmlands around the right of way and relocation

											measures put in place by the government.
	Owelu,	Igwe's Palace 20-5-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community		Ihie	Town hall 21-7-2019	They welcomed the project and asked for improvement of electricity supply in their village		Ihembosi	Igwe's Palace 23-7-2019	They showedtheir grievance for No compensation payment after the construction of the existing 330kV SC line.
	Orji,	Town hall 20-5-2019			AmaApu	Community primary school 23-7-2019	The Igwe promised his full support during the cause of the project		Ozubulu	Town hall 23-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community
	Oratta	Town hall 20-5-2019			Ife	Town hall 23-7-2019	They showed concern on corona and effect on human health		Oraifite	Town hall 23-7-2019	They showedtheir grievance for No compensation payment after the

											construction of the existing 330kV SC line.
Owerri west	Orogwe	Igwe's Palace 20-5-2019	They showedtheir grievance for No compensation payment after the construction of the existing 330kV SC line.		UmuMba	Igwe's Palace 21-7-2019	They welcomed the project and asked for improvement of electricity supply in their village		Ubuluisi uzo	Town hall 20-7-2019	TCN must acquire the ROW now before embarking on the proposed reconstruction project
	Ubomiri	Igwe's Palace 20-5-2019	They do not want TCN to build their houses for them but to compensate them in cash. ✓		Ariaria	Town hall 24-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community				
	Irete	Community primary school 24-7-2019	The community expressed concern over their farmland were the project cuts across and requested for compensation	Aba South	Asia UmuNka	Town hall 23-7-2019	The Igwe pledged to fully support the implementation of the project				
	Awoldemiri	Igwe's Palace	The Igwe pledged to fully support the		Asia Amanhie	Igwe's Palace	They requested for				

		24-7-2019	implementation of this project			20-7-2019	employment for the youth during the cause of the project				
Ngor-Okpala	Amaibo	Igwe's Palace 26-7-2019	The Igwe welcomed the development and pledged full support	Ugwunagbo	Ala Oji	Town hall 24-7-2019	They showed concern on corona and effect on human health				
	Alulu	Igwe's Palace 26-7-2019	TCN must pay adequate compensation for the affected houses/structures and crops within the ROW. ✓		UmulkuUko	Community primary school 27-4-2019	The Igwe pledged to fully support the implementation of the project				
	Ochicha	Community primary school 26-7-2019	The Igwe welcomed the project and pledge full support								
	Elelem	Igwe's Palace 26-7-2019	They were concerned about the houses and farmlands								

			around the right of way and relocation measures put in place by the government.								

ES 1.5 Environmental and social management plan (ESMP)

***The specific measures* addressing each significant/moderate impact are**

AIR QUALITY

- ✓ Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
- ✓ Regular cleaning of equipment
- ✓ Cover properly loose materials and keep top layers moist
- ✓ Speed limits on-site of 15kph on unhardened roads and surfaces
- ✓ Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area

SURFACE WATER, GROUNDWATER AND SOIL

- ✓ Regular checking and maintenance of all vehicles and equipment to minimize the risk of fuel or lubricant leakages.
- ✓ Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques
- ✓ Install oil/water separators and silt traps before effluent, leaves the site
- ✓ Rivers and streams shall not be dammed for the purpose of water abstraction
- ✓ Herbicides should not be used for vegetation clearing
- ✓ Avoid vegetation clearing along stream shores and on steep slopes

BIODIVERSITY

- ✓ Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads
- ✓ Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control
- ✓ Implementation of the invasive species management plan as part of the Vegetation Management Plan presented in Chapter
- ✓ Retention of native species where possible along the line route/protection of endangered species or threatened specues

ES 1.5.1 Management measures for STD - HIV and awareness programs

The Contractor will develop a policy and management plan to reduce the transmission of STIs, including HIV/AIDS. This strategy will:

- Make provision for awareness, counseling and testing for all Project personnel, including voluntary testing for STDs and HIV/AIDS as part of any health screening program (workers will not be denied employment or discriminated against in any way based on their HIVstatus);
- Provide guidance and counseling to workers with HIV/AIDS to access treatment through existing health facilities or NGO campaigns orprograms;
- Ensure that all Project personnel are given specific HIV and STD prevention training;
- Undertake information, education and communication campaigns around safe sexual practices and transmission of STDs and
- HIV/AIDS as well as condom distribution at stopping locations on key transport routes targeting commercial sex workers and truck drivers;
- Support public health or NGO initiatives to reduce STD transmission including working through schools, women’s and youth groups;
- The Contractor will provide non-local workers with a schedule and transportation that avoids limiting off-time activities at nearby communities;
- Conduct community awareness campaigns in communities crossedbytheline

ES 1.5.2 Management measures of employees-communities relationship

The contractor with the supervision of the PIU will ensure:

- Respect for local residents andcustoms;

- Non-Discrimination (for example on the basis of family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction);
- Compliance with applicable laws, rules, and regulations of the jurisdiction;
- Zero tolerance of bribery and corruption;
- Zero tolerance of illegal activities by Contractor personnel, including prostitution, illegal sale or purchase of alcohol, sale, purchase or consumption of drugs, illegal gambling or fighting;
- Policy and sanctions against alcohol and drugs policy during working time or at times that will affect the ability to work or within accommodation camps, or acquired from outside the camp while accommodated in the camp;
- A program for drug and alcohol abuse prevention and random testing that is equivalent in scope and objectives to the policies prescribed in the code of conduct;
- Policy including sanctions against sexual harassment (for example to prohibit use of language or behavior, in particular towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate);
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPEs), taking precautions/preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment);

ES 1.5.2 Gender equity and gender-based-violence (GBV)

The PIU and the Contractor will work together to continuously assess risks and identify and implement prevention, response and referral processes with respect to any cases involving Sexual Exploitation andAbuse/Gender-Based-Violence (SEA/GBV). This will focus on:

(i) training of PIU and Contractor personnel, (ii) community and worker awareness, (iii) making available safe and confidential channels of communication and complaints, and (iv) a referral system and mechanism for survivors of GBV/SEA;

PIU will develop and implement a GBV/SEA prevention and response framework that will address the following elements: How the project will put in place the necessary protocols and mechanisms to address the SEA/GBVrisks;

- How to address any GBV incidents that mayarise
- A policy against GBV/SEA including a CoC and agreed sanctions. These will be provided by the contractor and consultants as part of the Contractor ESMP. Have all employees of contractors (including sub-contractors), supervision consultants and other consultants with a footprint on the ground in the project area signCoCs;
- For purposes of the construction and operational phases of the project, develop an induction program, including a CoC, for all workers directly related to the project. *This is supposed to be recommendation as such supposed to be supported with a draft induction plan.*

ES 1.5.2 .1 Specific arrangements and management strategiesfor GBV risks

- Awareness Raising Strategy, which describes how workers, local communities and Project personnel will be sensitized to SEA/GBV risks, and the worker's responsibilities under theCoC;
- Referral Pathway: Identification of qualified GBV service providers (NGOs)and setting up are feral pathway so GBV survivors will be referred, and the services will be available (health, legal, psycho-social, safety planning, etc.)
- Establish a SEA/GBV Accountability and Response Framework, to be finalized with input from the contractor;

The SEA/GBV Accountability and Response Framework will include;

- Allegation Procedures: How the project will provide information to employees and the community on how to report cases of SEA/GBV, CoC breaches to the GRM;
- SEA/GBV Allegation Procedures to report SEA/GBV issues to service providers, and internally for case accountability procedures which will clearly lay out confidentiality requirements for dealing withcases;
- Mechanisms to hold accountable alleged perpetrators who breach terms stated in CoC.Disciplinary action for violation of the CoC by workers. It is essential that such actions be determined and carried out in a manner that is consistent with local labor legislation and applicable industrial agreements.

ES 1.5.3 FMEnv Environmental monitoring matrix

Table ES-5 is an example of the monitoring adopted for the project.

Table ES-5: Sample ESMP Matrix used for the project

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NOx, CO_2, PM)	Affected communities in area of influence	Minor	Use good international practice: Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators to be located to facilitate dispersion	Negligible	EPC Contractor	AfDB-PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

ES 1.5.4 key ESMP implementation indicators

The following are some of the key ESMP indicators

- ✓ Number and extent of invasive flora species patches
- ✓ Number of Bird collision (or electrocution) fatalities
- ✓ Concentration of SO_2 exceeds regulatory limit during periodic monitoring
- ✓ Number of accidental spills
- ✓ Number of corrective actions implemented in response to river sedimentation increase or erosion damage

ES 1.5.5 Institutional Framework for Implementation of the ESMP

The key roles and responsibilities for the implementation of the ESMP are presented as follows.

- ✓ TCN will have principal responsibility for all measures outlined in the ESMP for the construction phase.
- ✓ The Environment Division of TCN shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations the operations.
- ✓ Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organisations have responsibility for mitigation or enhancement measures.
- ✓ Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question. TCN's PIU is the responsible party
- ✓ TCN shall procure a RAP implementation Consulltant who shall inturn hire an experienced NGO to witness the implementation processes of RAP and ESMPduring the implementation ofthe proposed peoject by the EPC who shall also be procured by TCN.
- ✓ PIU is responsible for the supervision of both ESMP and RAP and Reporting to AfDB all through the entire project cycle. At the end of the project the project shall be handwd over to TCN and it shall be managed by the Regional office of the project locations.
- ✓ TheEnvironment Division of TCN shall be responsible for ensuring implementation of management measures during operational phase (post-commissioning), including daily compliance, quarterly monitoring of the operational activities in the facilities and auditing of the facility every three years in line with the EIA Act. 1992.
- ✓ The Federal Ministry of Environment (FMEnv) has the responsibility for the implementation of the EIA Act 86 of 1992 by carrying out Impacts Mitigation complianceMonitoring during the project implementationby the EPC which will enable them the issuance of final Certification.
- ✓ Responsibilities in the implementation, supervision and monitoring of the ESMP are shared between multiple stakeholders, including the client, the financier, theregulators with NGO (friends) of the project in order to assist EPC carry out his activities in an environmentally sound manner.(Figure ES-3).

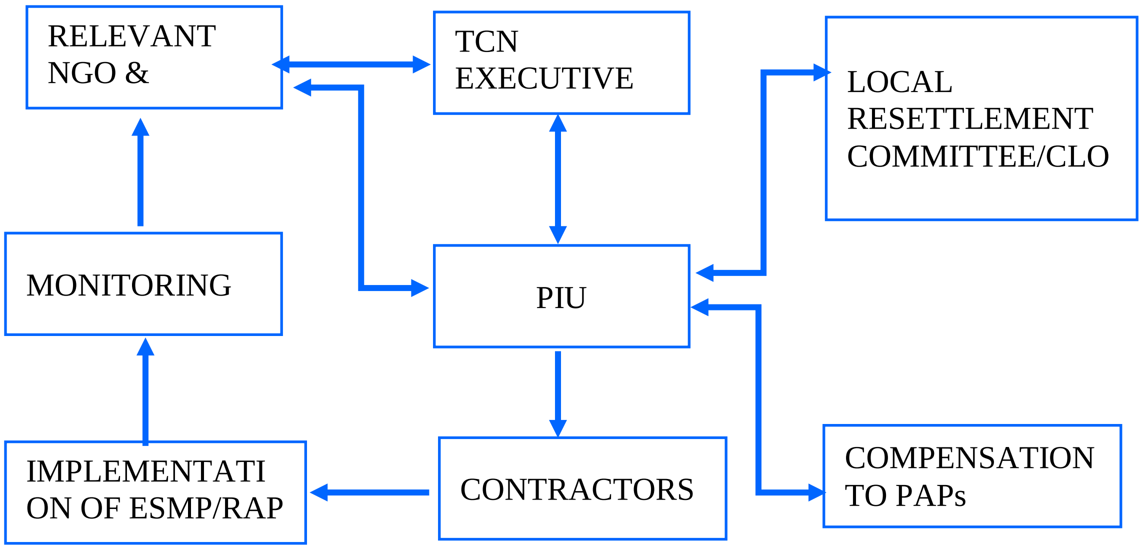

Figure ES-3: Roles and responsibilities for the implementation of the ESMP

Table ES-6: shows the components of each project implementation group.

Table ES-6: Detail of each Project implementation group

Concerned ministries	Competent authorities	Project implementation unit (PIU),	TCN and the contractors
• Federal Ministry of Environment (FMEnv) • Imo State Ministry of Petroleum and Environment (ISMPEnv) • Abia State Ministry of Environment (ASMEnv) • Anambra state Ministry of Environment (AnSMEnv)	• Federal Government of Nigeria • Imo State Environmental Protection Agency (ISEPA) • Imo State Ministry of Health, Women Affairs and Social Development (ISMHWASD) • Imo State Ministry of Works (ISMW) • Imo State Ministry of Land Survey Housing and Urban Planning (ISMLSHUP) • Abia state Ministry of Physical Planning and Urban Development(renewal) (ASMPPUD)	AfDB Project Implementation Unit (PIU)	• Transmission Company of Nigeria • Local Government Area Representatives

	• Abia State Environmental Protection Agency (ASEPA) • Abia State Ministry of Land Survey and Urban planning (ASMLSUP) • Abia State Ministry of Women Affairs (ASMWA) • Abia State Ministry of Transport (ASMT) • Anambra State Environmental Protection Agency (AnSEPA) • Anambra State Ministry of Transport (AnSMT) • Anambra state Ministry of Lands, Survey and Town planning (ASMLST) • Local Government Authority (LGA) • Village chiefs of affected Communities		

ES1.6.4 Estimated overall budget

Table ES-7 presents the summarized annual estimated ESMP budget without provision for compensation (RAP).

Table ES-7: Estimated annual overall budget for ESMP (without RAP)

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
Air quality	800,000	quarterly	3,200,000	Noise, vibration & EMF	880,000
Noise, vibration	600,000	quarterly	2,400,000	Pollution Control /Emmergency Response	10,900,000
Emergency Response (Risk	4,000,000	Daily at Project	16,000,000	Internal Monitoring environmental Internal Audit	3,700,000

Construction Phase				Operation Phase	
Component	Cost Estimates (NGN)	Frequency	Annual Estimates	Component	Estimate per three years
Management of Petroleum Products in use)		site/ Monthly during OPS		(Monitor operational Technology, Condition of Equipment, Facility, etc)	
Water quality	3,200,000	Twice a year	6,400,000	Vegetation integrity and Fauna protection	350,000
Aquatic ecology				Stakeholder relations Management/	10,900,000
Visual amenities	3.000,000	Quarterly	1,200,000	Health, Safety and Security	2,350,000
Sanitation/wastes management					
Vegetation integrity and Fauna protection	500,000	Once a year	350,000	House keeping/Sanitation/Sensitization	5,000 000
Stakeholder relations Management	10,200,000	quarterly	28,800,000	Environmental Audit (Holistic External Audit of TCN facility in line with EIA Act 86, 1992	15,000,000
Health, Safety and Security	3,300,000	Quarterly	1,200,000	Health, Safety and Security	350,000
Project Monitoring (Logistics)	2,000,000	Quarterly		Toolbox Training on Hazardous material handling, storage and disposal	7,000,000
Toolbox training on Hazardous materials	500,000	Monthly at the Regional Level	2,000,000	Waste management	12,000,000

Construction Phase				Operation Phase	
Component	Cost Estimates (NGN)	Frequency	Annual Estimates	Component	Estimate per three years
Develop and implement GBV/SEA Framework and Action Plan	1, 034, 125		4, 136, 500		
Total per project phase			61,550,000		63,430,000
Overall estimate	124,980,000				

CHAPTER ONE

INTRODUCTION

1.1 Background Project Information

Transmission Company of Nigeria (TCN) wholly owned by the Government is in charge of the responsibility of receiving bulk electricity generated by the various power generation stations to theload control centers across the country and out sode the country, ensuring efficient and cost-effective transmission, system operation, and improved service delivery. Huge gap between generation and wheeling capacity necessitated the launch of the Transmission, Rehabilitation and Expansion Program (TREP) involving several Developmental Financial Institutions (FDIs). The scope covers the entire country. To achieve the TREP goals, several subset programs were established, including the Nigeria Transmission Expansion Program (NTEP). To ensure efficiency and timely service delivery, NTEP was conceived to be developed in which the Re-construction of 330KV SC transmission line in the south-east (Alaoji - Onitsha) of Nigeria to be financed by African Development Bank (AfDB) is one.

The Abia and Anambra States targeted at improving power supply toAbia, Anambra and Imo States, in order to achieve transmission capacity of 20,000 MW by 2022.The upgrade of the transition line in Abia, Anambra and Imo States ("Alaoji, Ihiala and Onitsha Transmission Project") is to be financed through a loan from African Development Bank (AfDB). The Transmission Company of Nigeria (TCN) is the implementing agency and owners of the project when completed. This entire project plans reinforcement of transmission capacity, enhancement of wheeling capacity of electricity, improvement of reliability of electricity supply and reduced electric current lossesby intrtoducing N-1 transmissiom system by balancing the installed capacity across the country. It will contribute towards accelerated growth of the economy development and improve thesocio-economic activities of the communities.

In line with the EIA procedural Act, AfDB operational Safeguards and in alignment with the Environmental and Social Management Framework (ESMF), this type of project needs to undergo an environmental and social impact assessment as required by the EIA Act No. 86 of 1992.

This ESIA study will, therefore, aim to identify potential and significant adverse environmental and social impacts and to propose means of mitigating them to acceptable levels. The ESIA will also consider the capacity of existing institutions to manage the predicted environmental and social issues and implement an Environmental and Social Management Plan (ESMP) for this purpose.

This ESIA is also prepared in compliance to the Federal Government of Nigeria (FGN) Environmental Impact Assessment (EIA) Law, and the Federal Ministry of Environment Guidelines. It is also compliant to the Environmental and Social operational safeguards of the AfDB. The AfDB has various instruments for addressing the environmental and social impacts of projects. The development of the NTEP1 project initiative will trigger all the five AfDB Operational Safeguards (OS) including OS 1: Environmental and social assessment; OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and compensation; OS 3: Biodiversity and Ecosystem Services;OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials, Resource Efficiency; and OS 5: Labour Conditions; Health and Safety.

In light of the above, TCN commissioned Geomatics Nigeria Limited (GNL), an Environmental Consultancy firm based in Ibadan to conduct the ESIA/RAP studies. Other scopes to be covered by GNLinclude to

- identify and assess the potential environmental and social impacts and recommend appropriate mitigation strategies and prepare ESMP.
- identify and enumerate the Project Affected Persons, Communities and their economic activities based on AfDB operational Safeguards as outlined in the Resettlement Policy Framework.
- Prepare HSE management plan for the proposed project
- Prepare transport management plan for this project and amongst others
- Stakeholders engadement plan for the community enhancement programs.

1.2 The Proponent

The Proponent of the proposed project is the Transmission Company of Nigeria (TCN)

The mandate of TCN includes the following;

- Assets management of the High Voltage Transmission System Operations as well as generation dispatch functions.
- Operating as the provider of open access transmission service based on regulated transmission tariff and non-discriminatory system operations and economic dispatch services within a regulatory framework provided by the Nigerian Electricity Regulatory Commission (NERC), the Grid Code and Market Rules.
- Load forecasting and system expansion planning.

- Acquiring the necessary ancillary services for defined reliability and quality service standards.
- Managing the market settlement system.
- Development of the network through the construction of new transmission lines and substations for efficient Transmission and System operations,
- Ensuring that all stakeholders adhere to the Grid Code, Distribution Code and Market rules.

Table 1.1 provides contact details of the proponent.

Table 1.1: Proponents Contact Details

Project Proponent	Transmission Company of Nigeria (TCN)
Address	14, Zambezi Crescent, Maitama, Abuja
Project Manager	Engr. A. M. Abdulazeez
Contact Email	afdb.isdb@gmail.com

1.3 Purpose of the ESIA Report

The purpose of the study is to assess the potential environmental and social impacts of the proposed NTEP 1 project development and prepare an Environmental and Social Impact Assessment (ESIA) that includes a detailed project-specific, and implementable, stand-alone Environmental and Social Management Plan (ESMP), which will include necessary mitigation measures. The ESIA will establish modalities of implementing the rehabilitation works in line with the Nigeria Environmental policies and laws and the AfDB Integrated Social Safeguards (ISS).

1.4 Objectives of the ESIA

The specific objectives of the proposed studies are to

- To ascertain the viability of the project environmenyally, Socially and Economically
- ensure compliance with national and AfDB environmental regulations and policies, industry best practicable standards and identify existing/expected environmental regulations that will affect the development while profferingstrategies for the applications of the available standards and targets.
- establish the existing state of the environment including sensitive components within the project area and area of potential project influence.

- generate baseline data to characterize the existing environment as well as socio-economic and health conditions and for subsequent monitoring and evaluation of how well the mitigation measures have been implemented during the project life cycle;
- identify and analyze alternatives to the proposed projects, including sites, technology, layout, etc.;
- conduct an Environmental and Social Assessment of the proposed TL in order to identify and assess the anticipated potential environmental and social impacts of the proposed projects both positive and negative;
- propose cost-effective mitigation measures during decommissioning, re-construction and operation to avoid and mitigate identified adverse impacts and also enhance beneficial impacts
- Identify any future environmental issues and concerns which may affect the development;
- prepare and cost the ESMP, detailing mitigation measures as well as institutional roles and responsibilities in its operationalization.
- Recommend an environmental management program for the rehabilitation of the project including compliance, monitoring, auditing and contingency planning; provide the basis for co-operation and consultation with regulatory and non- regulatory authorities and the public.
- assist project design and planning by identifying those aspects across all phases of the project life cycle which may cause adverse environmental, social, health and economic impacts.
- Carry out consultations with relevant stakeholders, including potential project- affected persons, to obtain their views and suggestions regarding the environmental and social impacts of the proposed development of the NTEP project. The outcome of the consultations will be reflected in this ESIA report and will be incorporated into the project design as appropriate; and
- Provide an opportunity for interested and affected persons to be engaged/involved in the disclosure process.

1.5 Scope of the Study

The study will be divided into four major parts to ensure adequate coverage and ease of potential impact evaluations:

1. Legal and Administrative framework
2. Project and process description
3. State of the environment and

4. Socio-economic issues.

The scope of ESIA study usually entail but not limited to the following:

Review of approved secondary data and literature of the proposed study/project area, review of relevant legislative policies and frameworks, consultations with relevant project stake holders, field data sampling and laboratory/statitiscal analysis for baseline data acquisition, assessment of potential and associated impacts, proffering mitigation measures to adverse an negative impacts and enhancement measures to the positive and beneficial impacts, development of a transmission - line based implementable environmental and social management plan, etc**.**

1.6 The Project justification

Due to significant shortage of power supply capacity compared to demand, load allocation has been implemented nationwide in Nigeria. If all power stations currently being constructed under the Nigeria Transmission Expansion Program, a subset of the wider Transmission Expansion Program become operational, the installed generation capacity is expected to improve by the end of 2022. The existing and proposed transmission line system in Nigeria is shown in Figure 1.1.

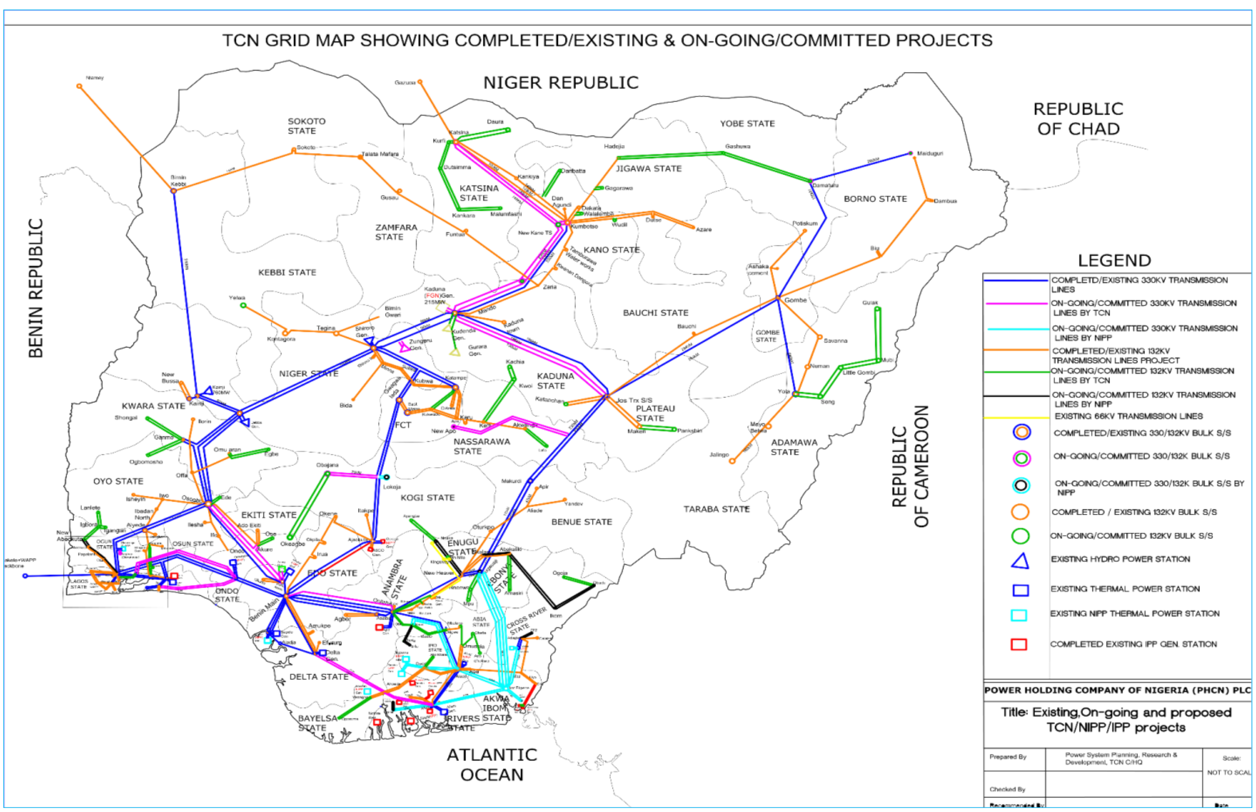

Figure 1.1 Existing On-Going and Completed Transmission and System Operation Infrastructure

Increase in the generating capacity without a commensurable expansion in the transmission architecture as shown in Figure 1.1, would result in the produced power unable to be wheeled into the national grid. Worst still, the existing transmission system do not provide detour routes for use when equipment accidents occur, and when system reliability is low. Nigeria descent into recession in late 2015 corresponded to period when transmission capacity (less than 40,00MW) was also at its lowest ebb (NERC 2018), implying a strong correlation between boost in economic activities and improved power availability.

1.7 Summary the Key Activities Undertaken in Line with the EIA Procedures in Nigeria

Table 1.2 outlines regulatory requirements within the Nigerian Regulatory framework.

Table1.2: ESIA Process in Nigeria

ESIA Step	Description	Status	Remark
ESIA registration	This step initiates the ESIA process providing draft terms of reference, letter of Introduction from the client and a covering letter	This step has been satisfied	EIA was duly registered by the FMEnv. See Appendix 1.1 for ToR
Reconnaisance/Site verification visits by the Client and regulator with the Consultant	This step provides the regulatory authorities (FMEnv, affected state and LGAs Environment Ministries and Departments respectively) and the supervisory Ministry (Ministry of Works, Power and Housing) opportunity to appraise the proposed project	This step has been satisfied	Authority visit was conducted and all revelant stakeholder of the project were in attendant
Preliminary Stakeholders' meeting	Meeting with the State's representatives for a kickoff before the scoping execise and hand over of site to the Consultant	This step was done	See Attendant register
Scoping	Scoping workshop was conducted to gain early stakeholders' input into the ESIA process	This step has been satisfied	See Appendix 1.1 for ToR
Report writing	Scoping Report was drafted from the data gathered through first Mission's Visit to the site	Was done in April	Draft Report has been submitted to FMEnv

Scoping Report and Minutes of the Preliminary stakeholders meeting Submission to Federal Ministry of Environment	The scoping report containing Minutes of the Preliminary stakeholders meeting was submitted to the FMEnv	Was done in May	Draft Report has been submitted to FMEnv
Project Categorization	Steps 2 and 3 provides the regulatory Ministry with the project overview, environmental settings and stakeholder concerns/perception to be factored into the categorization process	Official Terms of Reference was issued' The categorization has been changed from 2 to 1 due to the number of PAPs	See Appendix 1.4 for ToR Letter yet to be delivered by FMEnv
Data Gathering Exercise	Data gathering exercise was conducted with active involvements of FMEnv, State, LGAs and TCN officials	This was conducted from August 26th – 2nd September 2019.	Delegates from the FMEnv actively supervised the data gathering process
Submission of Draft ESIA report	FMEnv Specified copies of draft ESIA report is submitted	TBD	Not Applicable
Public Disclosure	This step provide avenue for the ESIA findings to be made available to the wider public over a 21-day period	TBD	Not Applicable
Panel Review	This step subjects the ESIA report to experts' evaluation, assessment and ventilation of stakeholders' observations	TBD	Not Applicable
Submission of Final ESIA report	On receipt of comments from FMEnv and incorporation, a final report is developed and submitted to FMEnv within a specified time frame.	TBD	Not Applicable
Issuance of Approval Certificate	This conveys the approval to construct on the client	TBD	Not Applicable

1.8 Report Structure

Table 1.3 provides structure of the report.

Table 1.3: Structure of the Report

Chapter	Content
Chapter 1	**Introduction** Provides a background to the proposed Project and the ESIA and provides information about the Proponent, the ESIA consultant team and the report's main goals and structure
Chapter 2	**Legal and Regulatory Framework** Outlines the legal framework within which the ESIA will be undertaken and identifies other environmental legislation, standards and guidelines applicable to the Project.
Chapter 3	**Project Justifications and Alternatives** presents the project justification, the need/value and its envisaged sustainability as well as the project development and site/route options considered
Chapter 4	**Project Description** Discusses the desirability of the Project and provides a description of the Project
Chapter 5	**Area of Influence** Defines the areas of direct and indirect influence of the Project
Chapter 6	**Baseline Assessment** Presents the approach and methodology for the ESIA process. It also describes the biophysical and socio-economic baseline of the Project's areas of influence including public participation process
Chapter 7	**Stakeholder Consultations** Presents the list of the stakeholders consulted and summary of the minutes of meeting held with the stakeholders
Chapter 8	**Impact Assessment and Mitigation Measures** Identifies and assesses potential Project impacts (biophysical and socio-economic impacts) and defines relevant mitigation measures to avoid, reduce, compensate or enhance Project impacts (as applicable).
Chapter 8	**Environmental and Social Management Plan** Presents the Project ESMP, organizing all mitigation, management and monitoring requirements set out in the EIS into thematic management programs.
Chapter 10	**Conclusions and Recommendations** Presents the main findings of the EIS report and recommendations for the following phases of the Project
Annexures	**Annexes** Provides support information to the EIS, in the form of annexes

The study will be divided into four major parts to ensure adequate coverage and ease of potential impact evaluations:

1. Legal and Administrative framework
2. Project and process description
3. State of the environment and
4. Socio-economic issues.

The scope of ESIA study usually entails but not limited to the following:

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- review of relevant legislative policies and frameworks,
- consultations with relevant project stake holders,
- field data sampling and laboratory/statitiscal analysis for baseline data acquisition,
- assessment of potential and associated impacts, proffering mitigation measures to adverse any negative impacts and enhancement measures to the positive and beneficial impacts,
- development of a transmission - line based on implementable environmental and social management plan, etc**.**

CHAPTER TWO

REGULATORY AND INSTITUTIONAL FRAMEWORK

2.1 Introduction

The constitution of Nigeria (1999), as the national legal order, recognizes the importance of improving and protecting the environment and makes provision for it in the following relevant sections:

Section 20 makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria.

Section 12 establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria.

Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively, have also been argued to be linked to the need for a healthy and safe environment to give these rights effect.

This Chapter provides the Nigerian administrative framework and describes the relevant Nigerian legislation, AfDBand industry standards and that the Project will follow. Specifically, this Chapter provides a summary of;

- Nigerian administrative and legislative organization;
- National environmental and social legislation deemed applicable to the Project;
- AfDB Operational Safeguards to be triggered by this project
- Other international conventions to which Nigeria is a signatory;
- International standards and guidelines to which the Project will also align; and
- TCN internal standards and guidelines with which the project will also be consistent.
- The affected States and LGAs Environmental Edicts and Bye-Laws respectively
- ISO 45001:2018 Occupational Health and Safety Management Systems Requirement
- ISO14001:2015 Environmental management systems: Requirements with guidance for use;

2.2 National Environmental & Social Policies

2.2.1 National Policy on the Environment (1988)

The National Policy on the Environment describes the conceptual framework and strategies for achieving the overall goal of sustainable development in Nigeria. Specifically, the goals of the Policy include to:

- Secure a quality of environment adequate for good health and human well-being;

- Conserve and use the environmental and natural resources sustainably for the benefit of present and future generations;
- Restore, maintain and enhance ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and promote understanding of the essential linkages between the environment, resources and development, and encourage individual and community participation in environmental improvement efforts; and
- Co-operate with other countries, international organizations and agencies to achieve optimal use of trans-boundary natural resources and effective prevention or abatement of trans-boundary environmental degradation.

2.2.2 EIA Act Cap E12 LFN 2004

The EIA Act No. 86 of 1992 as amended by EIA Act Cap E12 LFN, 2004 is the principal legislative instrument relating to activities that may likely or to a significant extent affect the environment. The Act sets the goals and objectives of EIA and procedures including the minimum requirements for the conduct of EIA of public or private projects. The Act makes EIA mandatory for all major development projects likely to have adverse impacts on the environment and gives specific powers to FMEnv. to facilitate environmental assessment of projects in Nigeria. The FMEnv categorizes mandatory study activities into three categories: Category 3 activities have beneficial impacts on the environment. Full EIA is not mandatory Category 2 activities (unless within the Environmentally Sensitive Area) while Category 1 activities requires full and mandatory EIA. The category 1 projects ESIA are also required to acquire or present data on the two seasons prevalent in the country. Projects are pre-listed into these categories based on type and whether it would involve physical intervention of the environment. Either the listing or the result of an Initial Environmental Evaluation (IEE) is used to determine projects requiring full EIA. All utility scale power projects, including construction of substations and transmission power lines, are listed under Category 1 and are therefore required to undertake ESIA.

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

The Act established a body known as NESREA to be the enforcement Agency for environmental standards, regulations, rules, laws, policies and guidelines in Nigeria. The Act empowers the Agency to have responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

2.2.4 National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991

These Regulations address handling and management of solid, radioactive and (infectious) hazardous waste. They define the objectives of management of solid and hazardous waste, the functions of appropriate Government agencies and obligations of industries. The Regulations mandate all industries to inform FMEnv of all toxic, hazardous and radioactive substances which they keep in their premises and/or which they discharge during their production processes. Schedule 12 and 13 of the Regulations provide a comprehensive list of all waste deemed to be hazardous and dangerous.

2.2.5 National Environmental (Sanitation and Wastes Control) Regulations, 2009

The Regulations provide the legal framework for the adoption of sustainable and environment friendly practices in sanitation and control of solid wastes, hazardous wastes and effluent discharges to minimize pollution. Part 3 of the Regulations states that all owners or occupiers of premises shall provide waste receptacles for storage before collection by licensed waste managers. In addition, the Regulations make it mandatory for facilities that generate waste, to reduce, re-use, recycle and ensure safe disposal to minimize pollution. The Regulations also spell out roles and responsibilities of State and Local Government Authorities.

2.2.6 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991

The Regulations prohibit industry or facility from release of hazardous or toxic substances into the air, water of Nigeria's ecosystems beyond the permissible limits of FEPA (now FMEnv). The Regulations further charge any industry or facility to:

- Establish and maintain a pollution monitoring unit within their premises;
- Ensure on site pollution control; and
- Assign the responsibility for pollution control to a person or body accredited by the FMEnv. Section 5 of the Regulations mandate industry or facility to submit to the nearest office of FMEnv a list of chemicals used in the manufacture of its products, details of stored chemicals and storage conditions and where these chemicals were obtained, bought or sold.

2.2.7 National Environmental (Electrical/Electronic Sector) Regulations, 2011

The principal thrust of this Regulation is to prevent and minimize pollution from all operations and ancillary activities of the Electrical/Electronic Sector. This Regulation covers both new and used Electrical/Electronic Equipment (EEE/UEEE). The principles of the Regulations are anchored on the 5Rs which are; Reduce, Repair and Re-use, Recycle and Recover as the primary drivers of the sector.

2.2.8 National Environmental (Noise Standards and Control) Regulations, 2009

The purpose of these Regulations is to ensure maintenance of a healthy environment for all people in Nigeria, the tranquillity of their surroundings and their psychological wellbeing by regulating noise levels. The Regulations prescribe the maximum permissible noise levels on a facility or activity to which a person may be exposed and provide for the control of noise and for mitigating measures for the reduction of noise.

2.2.9 National Environmental (Surface & Groundwater Quality Control) Regulations 2011

The purpose of these Regulations is to restore, enhance and preserve the physical, chemical and biological integrity of the nation's surface waters and to maintain existing water uses. The Regulations also seek to protect groundwater sources by regulating the discharge of hazardous wastes, fossil fuels energy and any other substances having the potential to contaminate groundwater. The Regulations also include amongst others, the application and general provisions of water quality standards for various uses such as agriculture, industrial, aquatic life and recreation.

2.2.10 Land Use Act CAP L5 LFN 2004

The Land Use Act is the legal framework for land acquisition and resettlement in Nigeria. The Act stipulates that all land in Nigeria is vested in the Governor of each State, to be held in trust for the use and common benefit of all people. The administration of urban land is directly under the control and management of the Governor, whereas non-urban land is under the control and management of the Local Government Authority. By implication, the Governor has the right to grant statutory rights of occupancy to land while the Local government has the right to grant customary rights of occupancy. At any rate, all lands irrespective of the category belongs to the State while individuals only enjoy a right of occupancy as contained in the certificate of occupancy, or where the grants are “deemed”. Thus, the Land Use Act is the key legislation that has direct relevance to resettlement and compensation in Nigeria. The Act makes it lawful for the Governor to grant statutory rights of occupancy for all purposes; grant easements appurtenant to statutory rights of occupancy and to demand rent. The local Government, under the Act can enter, use and occupy for public purposes any land within its jurisdiction that does not fall within an area compulsorily acquired by the Government of the Federation or of relevant State; or subject to any laws relating to minerals or mineral oils. In summary, the Acts gives the government the right to acquire land by revoking both statutory and customary rights of occupancy for the overriding public interest. In doing so however, the Act equally specifies that the State or Local Government should pay compensation to the current holder or occupier with equal value.

2.2.11 Other Applicable National E&S Legal Provisions

A summary of other relevant existing Nigerian laws and regulations is provided in Table 2.1.

Table 2.1: Other Relevant National E&S Laws and Regulations

Laws and Regulations	Summary of Provisions
Forestry Law CAP 51 LFN 1994	The Forestry Law prohibits any act that may lead to destruction of or cause injury to any forest produce, forest growth or forestry Property in Nigeria. The law prescribes the administrative framework for the management, utilization and protection of Forestry resources in Nigeria.
Endanger Species (Control of International Trade and Traffic) Act CAP	The Act provides for the conservation and management of Nigeria’s wildlife and prohibits the hunting, capture and trade of Endangered species.

E9 LFN 2016	
Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004	An Act to prohibit the carrying, depositing and dumping of harmful waste on any land, territorial waters and matters relating there to including penalty for offences for individuals and corporatebodies. The Act prohibits all activities relating to the purchase, importation, transit, transportation, deposit, storage or, sale of harmful wastes.
National Environmental (Ozone Layer Protection) Regulations, 2009	These provisions seek to prohibit the import, manufacture, sale and the use of ozone-depleting substances as well as materials that contain these substances.
National Environmental (Soil Erosion and Flood Control) Regulations, 2011	The overall objective of these Regulations is to control erosion and flooding by checking all earth-disturbing activities, practices or developments for non-agricultural, commercial, industrial and residential purposes.
Factories Act (CAP F1), 2004	The Act establishes a legal framework for the registration of factories and to make adequate provisions regarding the safety of workers against occupational hazards and to impose penalties for any breach of its provisions. All workplaces are covered by this Act.
Employee Compensation Act, 2010	The Act provides compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at workplace or in the course of employment. Payment of compensation (to the worker or to his dependents in case ofdeath) by the employer is

	rooted in the accepted principle that the employer has a duty of care to protect the health, welfare and safety of workers at work.
Nigerian Urban and Regional Planning Act CAP 138 LFN 2004	The Act is aimed at overseeing a realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. The Act establishes that an applicationfor land development would be rejected if such development would harmthe environment or constitute a nuisance to the community.
EIA Procedural Guidelines, 1995	Provides Procedural context and guidance for the conduct of EIA in Nigeria
Natural Resources	The Natural Resources Conservation Act CAP 268 LFN 1990 is the
Conservation Act CAP 268 LFN 1990	Most direct existing piece of legislation on natural resources conservation. The Act establishes the Natural Resources Conservation Council, which is empowered to address soil, water, forestry, fisheries and wildlife conservation by formulating and implementing policies, programs and projects on conservation of the country's natural resources.

2.2.12 Energy Sector Policies and Legal Provisions

2.2.12.1 National Energy Policy, 2003

The National Energy Policy highlights strategies for systematic exploitation of the energy resources, the development and effective use of energy manpower, supply of rural energy needs, efficient energy technology development and use, energy security, energy financing and private sector participation. The strategies are harmonized and grouped into short, medium and long – term measures for easier implementation. This policy is related to this program being an energy transmission program.

2.2.12.2 Electric Power Sector Reform Act 2005

This Act provides for the licensing and regulation of the generation, transmission, distribution and supply of electricity in Nigeria. The Act establishes the NERC and empowers it to license and regulate persons engaged in the generation, transmission, system operation, distribution and trading of electricity. The Act also makes special provisions for acquisition of land and access rights as it relates to generation, transmission and distribution companies. The EPSR Act also affords any aggrieved party the opportunity of being heard publicly in accordance with Sections 36 and 44 (1) (b) of the 1999 Constitution, as amended.

2.2.12.3 Energy Commission of Nigeria Act CAP 109 LFN 1990

The Act was promulgated to create the Energy Commission of Nigeria (ECN) with responsibility for coordinating and general surveillance over the systematic development of the various energy resources of Nigeria. Subject to this Act, the ECN is charged with the responsibility for the strategic planning and co-ordination of national policies in the field of energy in all its ramifications. The mandates of ECN include statistical analysis of Electricity Generation, Transmission and Distribution.

2.2.12.4 Nigerian Electricity Supply and Installation Standards (NESIS) Regulations 2015

These Regulations provide guidance, license terms and conditions to any person engaged in the generation, transmission, distribution, system operation, and trading in electricity or in any aspect in the value chain of electricity supply, including but not limited to engineering designs, installations, commissioning, decommissioning and maintenance of electric power systems for the purpose of achieving safe and reliable supply, and utilization of electricity in Nigeria. The regulation also states among other things Health, Safety and Environment issues including approved Right of Way for Transmission and Distribution lines in Nigeria. According to the NESIS 2015, Right of Way (RoW) is the distance of any structure from the middle conductors of overhead power lines of any voltage level. The approved Right of Way for different voltage Levels are presented in Table 2.2.

Table 2.2: Right of Way of Transmission Lines in Nigeria

Voltage Levels	Right of Way in Metres
330kV	50
132kV	30
33kV	15
11kV	11

Source: NESIS 2015

2.2.12.5 Acquisition of Land Access Rights for Electricity Projects Regulations, 2012

This is a Nigerian Electricity Regulatory Commission Act which provides a regulatory framework for the acquisition of land and access rights for electricity projects in Nigeria. This Act also stipulates provisions for the payment of compensation and resettlement of persons affected by the acquisition of their land for the establishment of electricity projects as well as the monitoring and evaluation of project designs of licensees to ensure compliance with environmental standards. The Regulations apply to the acquisition of land access rights for electricity in Nigeria, including projects related to generation, transmission and distribution of electricity.

2.2.12.6 Roadmap for Power Sector Reform of 2010

The Roadmap reviews and fine-tunes plans and strategies to finalize the drive to complete power sector reform and sets the nation on a steady course to produce clean and efficient electricity for her citizenry at competitive rates. The Roadmap contained two core and fundamental objectives, which are;

- To transition the Nigerian Power Sector into a private sector led market by implementing the EPSRA 2005 transition ("The Reform Objective") and
- To support and improve service delivery levels during this transition to the Nigerian public ("The Service Delivery Objective").

2.2.13 Nigerian Gender Related Policies

2.2.13.1 The Gender Policy Framework in Nigeria

The 1999 Constitution OF the Federal Republic of Nigeria prohibits discrimination based on places of origin, sex, religion, status, ethnic or linguistic association. Successive governments have always demonstrated commitment to upholding this and to promote gender equality and women's empowerment in varying degrees. To facilitate gender equality and women's empowerment, the FGN created favorable national legal and policy frameworks and put in place institutional mechanisms in this regard. Moreover, Nigeria, as a member of the United Nations, signed and ratified the various relevant international instruments, treaties and conventions without reservation. These instruments have always emphasized that member nations put in place the necessary mechanisms needed to eliminate gender discriminations, ensure equality and human dignity to all men and women.

The government of Nigeria in 2000 adopted a National Policy on Women, in 2006; it was reviewed and upgraded to become the National Gender Policy. Other key government policies with gender equality and empowerment of women frameworks include the National Economic Empowerment and Development Strategies (NEEDS) in May 2004; and the Transformation Agenda of the immediate past administration who in developing the Vision 2020, had a 'Special Interest Group on Women' to oversee –the development of policy statements that engender 'sustainable human and national development built on equitable contribution of the Nigerian women, men and children'.

2.2.13.2 National Gender Policy, 2006

The overall goal of the National Gender Policy of Nigeria is to promote the welfare and rights of Nigerian women and children in all aspects of life: political, social and economic. The policy seeks to plan, coordinate, implement, monitor and evaluate the development of women in the county. In concrete terms, the National Gender Policy in Nigeria focuses on:

- Contribution towards women's empowerment and the eradication of unequal gender power relations in the workplace and economy, in trade unions and in broader society;
- Encouragement of the participation, support and co-operation of men in taking shared responsibility for the elimination of sexism and redefining of oppressive gender roles;
- Increase the participation of women in leadership and decision-making;
- Ensure that through labour legislation and collective bargaining, the particular circumstances of women are considered and that measures are promoted to eliminate discrimination on the basis of gender;
- Ensure that there is a gender perspective in all sectors of development

2.2.14 Nigerian Institutional Provisions and Arrangement

2.2.14.1 Federal Ministry of Environment

The Federal Ministry of Environment (FMEnv.) which was formerly known as the Federal Environmental Protection Agency (FEPA) was established in 1999 through Decree No. 58 of 1988 as amended by Decree No. 59 of 1992. The Ministry is the statutory government institution mandated to coordinate environmental protection and natural resources conservation for sustainable development in Nigeria.

2.2.14.2 Federal Ministry of Power Works and Housing

The Federal Ministry of Power Works and Housing (FMPWH) has the overall responsibility for the provision of power in the country by supervising the implementation of generation, transmission and distribution projects in the sector and facilitating the emergence of a private sector led competitive and efficient electric power industry. The Ministry is guided by the provisions of the National Electric Power Policy (NEPP) of 2001, the Electric Power Sector Reform (EPSR) Act of 2005, and the Roadmap for Power Sector Reform of August 2010. The Ministry has six (6) parastatal relevant to the implementation of sub-projects:

- Transmission Company of Nigeria (TCN)
- Nigerian Electricity Regulatory Commission (NERC),
- The Rural Electrification Agency (REA), and
- Nigerian Bulk Electricity Trading Plc (NBET)
- Nigerian Electricity Liability Management Company (NELMCO)
- Nigerian Electricity Management Services Agency (NEMSA)

2.2.14.2.1 Transmission Company of Nigeria (TCN)

TCN was incorporated in November 2005, emerging from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors on April 1, 2004. Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), the company was issued a transmission license on 1st July 2006. TCN licensed activities include electricity transmission, system operation and electricity trading which is ring fenced.

2.2.14.2.2 Nigerian Bulk Electricity Trading Plc. (NBET)

The Nigerian Bulk Electricity Trading Plc., (NBET) (otherwise known as the Bulk Trader) was incorporated on July 29, 2010 as the Special Purpose Vehicle (SPV) to carry out the bulk purchase and resale of electric power and ancillary services from Independent Power Producers (IPP) and from the successor generation companies" to distribution companies. NBET purchases electricity from the generating companies through Power Purchase Agreements (PPAs) and sells to the distribution companies (DisCos) and eligible customers through Vesting Contracts. The role of NBET is more of transactional agreements between generation and distribution companies while TCN transmit the power from Generator to Distributors and eligible Customers.

2.2.14.2.3 Nigerian Electricity Regulatory Commission (NERC)

NERC is an independent regulatory body, established by the EPSR of 2005 to undertake technical and economic regulation of the Nigerian electricity supply industry. Essentially, NERC is set up to, license operators, determine operating codes and standards, establish customer rights and obligations and set cost reflective industry tariffs. NERC is responsible for the review of electricity tariffs, subsidy policies, promotion of efficient and environmentally friendly electricity generation and enforcing standards for electricity creation and use in Nigeria. NERC is largely responsible for regulating tariffs of power generating companies. NERC also issues eligible customers license to which TCN can supply directly.

2.2.14.2.4 Nigerian Electricity Liability Management Company (NELMCO)

NELMCO was incorporated under the Companies and Allied Matters Act 2004 as an SPV under the directive of the National Council on Privatization (NCP) as part of the transaction structure and strategy for the privatization of the power sector to provide investors' confidence that investment in PHCN Successor Companies (SCs) will be free of encumbrances from possible future litigations arising from the huge legacy debts, Staff Pensions, Suppliers and third party liabilities. The core objective of the organization is to assume and administer the stranded debts and non-core assets of PHCN pursuant to the provisions of EPSR Act 2005, assume and manage pension liabilities of employees of PHCN, hold the non-core assets of PHCN, sell or dispose of or deal in any manner for the purpose of financing the payment of debts or other related matters, take over the settlement of PHCN's Power Purchase Agreement (PPA) debts obligations, legacy debts and any other liabilities as may be determined by the National Council on Privatization within NESI from time to time and sell, let, mortgage, dispose of, deal in any of the property or non-core assets of the company as may be expedient with a view to promoting its objects.

2.2.14.2.5 Nigerian Electricity Management Services Agency (NEMSA)

The Nigerian Electricity Management Services Agency (NEMSA) Formerly the Electricity Management Services Limited (EMSL), is one of the successor companies established by the Federal Government in line with the provision of part 1Section 8 of the Electric Power Sector Reform (EPSR) 2005, the Supplementary Regulation number 46/47 (B499 452) of the Federal Government Official Gazette No. 374 0f 2010 and the NEMSA Act No.6 of 2015. The main function of the agency according to the provisions of the NEMSA Act 2015 and Statutory Regulations is inspect, test and certify all Electrical Installations in Power Plants / Stations, Transmission Networks / Systems, Distribution Networks/Systems, and other Allied Industries and Workplaces where Electricity is used. All electrical Installations in NTEP1 program will have to go through the testing and certification of NEMSA before they can be declared fit for use.

2.3 Affected States Environmental Laws

Table 2.3 outlines applicable environmental laws in the affected states.

Table 2.3: Applicable Environmental laws in the Affected States

States	Laws	Description
Abia State	**Basic Environmental Law No. 1of 2004 amended in 2013**	This law establishes the basic environmental sanitation practice (regulation and enforcement) in Abia State. The law spells out the Abia State Environmental Protection Agency (ASEPA) as a parastatal under the Office of the Governor, Government House Abia state. The individuals who shall by appointment (by the Governor) see to its management, the agency as an authorization, permission, registration and approval granting body as regards sitting of base stations and any other associated operations as well as penalties for any who contravenes the provisions of the same law which upholds basic environmental sanitation practice in Abia State.
	Policy on Environment (2010)	This policy emphasizes state government efforts to sustainable management of the Abia environment with regards to Erosion control.
	Flood and Erosion Control and Soil Conservation (2010)	This policy is to promote sustainable land use management by minimizing soil erosion and flooding hazards; achieving this through reducing soil exposure to rainstorms; reduction of surface run-offs and paved surfaces and restoration of degraded land mass.
	Flood Control and Water Conservation (2010)	This policy is to forecast, prevent, monitor and manage flooding. Optimal utilization of floodwater for agricultural and other purposes as well as management of flood plains. Abia Riverine Area Management Policy (2010) This policy is to minimize riverine erosion and other forms of riverine degradation such as riverbank failures, landslides and alluvial deposits.

	Watershed Management Policy (2010)	This policy enables the commencement of co-ordinated/holistic/integrated management of natural resources: Land, water, vegetation, etc. on a watershed basis to ensure resource conservation through the minimization of land and soil degradation and maintenance of water quality and yield for environmental sustainability.
	Flood and Erosion Control Management Support System (2010)	This policy aims at supporting a reliable up-to-date database and integrated management system as tools to support all erosion and control programs.
	Basic Environmental Law No. 1 of 2004 amended in 2013	This law focuses on the regulation and enforcement of Environmental Sanitation Practice in the state. It also spells out ASEPA as a parastatal under the office of the governor.
Imo State	Imo State Environmental Protection Agency Law	This Law was provided by the state with the main objective of abating environmental pollution across the state. All residents, factories, industries and parastatal are subject to this Law.
	Imo State Bureau for Sanitation & Transport Law	This law focuses on the regulation and enforcement of Environmental Sanitation Practice in the state.
Anambra State	Environmental Protection Agency Act	This Act was provided by the state with the main objective of abating environmental pollution across the state. All residents, factories, industries and parastatal are subject to this Act.
	Waste Management Agency Act	This Acts provides for the effective development and maintenance of sanitation in all areas of the State. The law further provides for proper disposition of excavated silt or earth and other construction materials after any construction project or repair works. Open burning of wastes is prohibited with stipulated penalties.

2.4 Abia, Anambra and Imo States Affected LGAs Bye Laws on Environment

The project would trigger all the environmental and waste management bye laws of all the listed affected LGAs.

2.5 International Conventions and Agreements applicable to the sector

Apart from the National Laws, Acts and Regulations, Nigeria is a signatory or party to many International Environmental Conventions and Treaties that are relevant to the energy sector. A list of some of the relevant International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria are presented in Table 2.4.

Table 2.4: Selected international agreements and conventions to which Nigeria is a signatory

S/N	Regulations	Year Adopted
1	United Nations Framework Convention on Climate Change (UNFCCC)	1992
2	Basel Convention on the Control of Tran boundary Movements ofHazardous Wastes and their Disposal	1989
3	Montreal Protocol on Substance that Deplete the Ozone Layer	1987
4	Vienna Convention on the Ozone Layer	1985
5	Convention on Conservation of Migratory Species of Wild Animals	1979
6	Convention on the Protection of the World Cultural and Natural Heritage (world Heritage Convention), Paris	1975
7	Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES)	1973
8	ILO c155 and R164 2001; Management of workplace Health and Safety and Cntrolling Workplace hazards	
8	Convention on the Conservation of Migratory Species of WildAnimals (CMS or Bonn Convention) (Signatory only)	1988
9	African Convention on the Conservation of Nature and Nature Resource	1968
10	Paris Agreement	2015

The WHO and FMEnv regulatory standards used to benchmark results obtained for several physico-chemical parameters analysed for the baseline are presented in Table 2.5.

Table 2.5: WHO and FMEnv regulatory standards

PHYSIO-CHEMICAL PARAMETERS	WHO /FMEnv Limit			
	SOIL	SURFACE WATER	SEDIMENT	GROUNDWATER
Colour		20		
Temp (°C)	<40			
pH (H_2O) @ 24.8°C	6-9		6.5-9	6.5 – 8.5
Elect. Cond. (mS/cm)	1000	1,000	35	1,000
Turbidity (NTU)		5		5
BOD (mg/L)		2.0		
Total hardness (mg/l)		150		200
THC (mg/kg)	30			
Total Dissolved Solids (mg/l)		500		
Total Nitrogen (mg/kg)	2- 6			
Chloride (mg/kg)	250	250		
Extractable Nitrate (mg/kg)	10	50		50
Nitrite (mg/l)		0.2		
Ext. Sulphate (mg/kg)	500	100		250
Magnesium (mg/kg)	50	0.20		
Calcium (mg/kg)	150			
Total Chromium (mg/kg)	0.1	0.05		
Total Iron (mg/kg)	1.5		37.7	0.3
Copper (mg/kg)	0.1	1	0.3	2.0
Lead (mg/kg)	1.0	0.01	35-170	0.01
Nickel (mg/kg)	<1			

Arsenic (mg/kg)	29	0.01		
Zinc (mg/kg)	6	3		0.005
Barium (mg/l)		0.7		0.7
Cadmium (mg/kg)	0.01	0.003	45	
Aluminum (mg/l)		0.2		
Mercury (mg/kg)	0.03			
Manganese (mg/kg)	0.2	0.2		
Zinc (mg/kg)	5,000			

FMEnv 1991, WHO 2000

Table 2.6 presents WHO Guidelines for community noise.

Table 2.6: WHO Guidelines for Community Noise

Specific Environment	**Critical Health Effect(s)**	**LAeq(dB)**	**Time base (hours)**	**LAmax, fast (dB)**
Outdoor living area	Serious annoyance, daytime and evening. Moderate annoyance, daytime and evening.	55 50	16 16	- -
Dwelling, indoors Inside bedrooms	Speech intelligibility and moderate annoyance at daytime and evening. Sleep disturbance at night.	35 30	16 8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values).	45	8	60

School classroms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication.	35	During class	-
Pre-schools bedrooms, indoors	Sleep disturbance	30	Sleeping time	45
School, playground outdoors	Annoyance (external source)	55	During play	-
Hospitals, wardrooms, indoors	Sleep disturbance at nighttime Sleep disturbance at daytime and evenings.	30 30	8 16	40
Hospitals, treatment rooms, indoors.	Interference with rest and recovery.	#1	-	-
Industrial, commercial shopping and traffic areas, indoors and outdoors.	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events.	Hearing impairment (patrons:<5 times/year)	100	4	110
Public address, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/earphones	Hearing impairment (free-field value)	85#4	1	110
Impulse sounds from toys, fireworks and firearms.	Hearing impairment (adults) Hearing impairment (children)	-	-	140#2 120#2
Outdoors in parkland and conservation areas	Disruption of tranquility	#3		

#1: As low as possible; #2: Peak sound pressure (not LAmax, fast), measured 100mm from the ear; #3: Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background so should be kept low; and #4: Under headphones, adapted to free-field values.

Source: WHO Guidelines for Community Noise, 1999

2.6 The African Development Bank (AfDB)

The E&S safeguards of the AfDB are a cornerstone of the Bank's support for inclusive economic growth and environmental sustainability in Africa. The Bank's IntegratedSafeguard Systems (ISS) is designed to promote the sustainability of project outcomes by protecting the environment, social conditions and people from the potentially adverse impacts of projects.

The ISS consists of four interrelated components as summarized in Figure 2.1

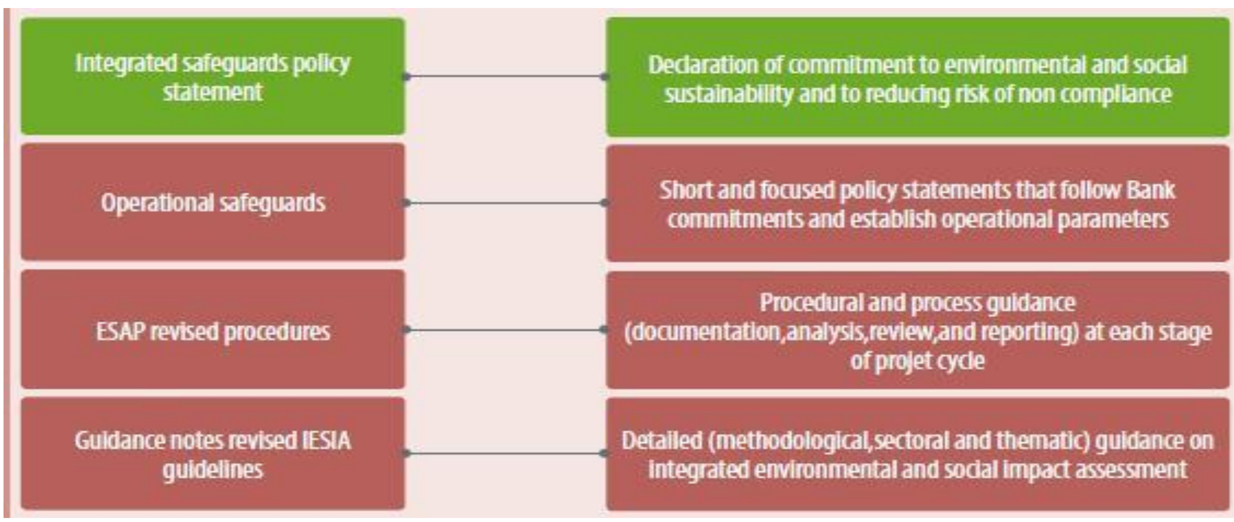

Figure 2.1: Structure of the AfDB ISS

2.6.1 The Integrated Safeguards Policy Statement

This describes common objectives of the Bank's safeguards and lays out policy principles. It is designed to be applied to current and future lending modalities and it considers the various capacities and needs of regional member countries in both the public and private sectors. The Bank's Integrated Safeguards Policy Statement sets out the Bank's own commitments to and responsibilities for delivering the ISS: to ensure the systematic assessment of E&S impacts and risks.

2.6.2 Operational Safeguards (OSs)

These are a set of five safeguard requirements that Bank clients are expected to meet when addressing social and environmental impacts and risks. Bank staff use due diligence, review, and supervision to ensure that, clients comply with these requirements during project preparation and implementation. Over time the Bank may adopt additional safeguard requirements or update existing requirements to enhance effectiveness, respond to changing needs, and reflect evolving best practices. The five OSs are presented in Table 2.7. The OSs are intended to:

- Better integrate considerations of E&S impacts into Bank operations to promote sustainability and long-term development in Africa;
- Prevent projects from adversely affecting the environment and local communities or, where prevention is not possible, minimize, mitigate and/or compensate for adverse effects and maximize development benefits;
- Systematically consider the impact of climate change on the sustainability of investment projects and the contribution of projects to global greenhouse gas emissions;
- Delineate the roles and responsibilities of the Bank and its borrowers or clients in implementing projects, achieving sustainable outcomes, and promoting local participation; and
- Assist regional member countries and borrowers/clients in strengthening their own safeguards systems and their capacity to manage E&S risks.

Table 2.7: AfDB Operational Safeguards OS1-5

Operational Safeguards	**Description**	**Triggered/Not Triggered**
OS. 1: Environmentaland social assessment	This overarching safeguard governs the process of determining aproject's environmental and social category and the resulting	Triggered
OS. 2: InvoluntaryResettlement: Land Acquisition, Population Displacement and compensation	This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement and incorporates a few refinements designed to improve the operational effectiveness of those requirements	Triggered

OS. 3: Biodiversity and Ecosystem Services	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitmentsin the Bank's policy on integrated water resources management into operational requirements.	Triggered
OS. 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials, Resource Efficiency	This safeguard covers the range of key impacts of pollution, wasteand hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.	Triggered
OS. 5: Labour Conditions; Health and Safety	This safeguard establishes the Bank's requirements for its borrower's orclients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks	Triggered

2.6.3 Environmental and Social Assessment Procedures (ESAPs)

The Bank's ESAPs details the specific procedures that the Bank and its borrowers or clients should follow to ensure that Bank operations meet the requirements of the operational safeguards (OSs) at each stage of the Bank's project cycle. Its adoption and implementation enhance the E&S performance of the Bank's operations and improve project outcomes. The ESAPs will help to improve decision-making and project results by ensuring that Bank-financed operations conform to the requirements laid out in the operational safeguards (OS) and are thus sustainable.

2.6.4 E&S Assessment of Nigerian Policies and Legislations and AfDB Safeguard Systems

The Nigerian E&S Safeguards system addresses most of the key elements of E&S Safeguards for projects involving multiple subprojects, and the required differentiated treatment of vulnerable groups which are adequately addressed by the AfDB safeguard systems. Apart from the gaps highlighted above, the main challenge facing E&S safeguarding in Nigeria is the overlapping functions of different agencies in relation to enforcement of these policies, guidelines, regulations and legislative provisions.

To ensure E&S safeguard during project implementation, both the Nigerian and AfDB E&S safeguard systems will be implemented. However, in the event of divergence and gaps between the two regulations the AfDB safeguard system with the more stringent requirement will take precedence (See Table 2.8).

Table 2.8: Benchmarking of Nigerian Legal Provisions and AfDB ISS specifications

Key Element	Nigerian Provisions	AfDBIntegrated Safeguard System	Provision to be adopted by NTEP 1 Program
ESMF for Projects Involving multiple Sub-projects.	Not a national Requirement	OS1: Environmental and social assessment	OS 1: Environmental and social assessment
Screening	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: Environmental and social assessment
Scoping	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	EIA Act Cap E12 LFN 2004
Environmental and Social Impact Assessment Guidelines	EIA Procedural Guidelines, 1995 EIA Sectoral Guidelines for Power Sector, 2013	IESIA Guidance Notes ESAP	IEIA Sectoral Guidelines for Power Sector, 2013 and ESIA Guidance Notes ESAP
Environmental Categorization	EIA Procedural Guidelines, 1995 Categories I, II & III	OS 1 – Categories 1, 2, 3, and FI for operations Involving lending to Financial intermediaries.	OS 1 – Categories 1, 2, 3, and FI for operations Involving lending to Financial intermediaries.
Environmental and Social Assessment	EIA Act Cap E12 LFN 004	OS1: Environmental and social assessment	OS1: Environmental and social assessment
Environmental and Social Management Plan	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: Environmental and social assessment

Consultation and Participation	EIA Act Cap E12 LFN 2004	OS1 (include provision of IESIA Guidance Notes on consultation)	OS 1 (include provision of IESIA Guidance Notes on consultation)
Involuntary Resettlement	-Land Use Act CAP L5 LFN 2004-Acquisition of Land Access Rights for Electricity Projects Regulations, 2012	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation
Compensation	Cash compensation Is generally made based Upon Market value. Whilst in principle there is allowance for in-kind Compensation or Replacement of assets, Cash compensation is common practice	OS 2: Affected Persons are compensated for all their losses at full replacement cost. They can be offereda range of different compensation packages, resettlement assistance & livelihood improvement options.	OS 2: Affected Persons are compensated for all their losses at full replacement cost. They can be offered arange of different compensation packages, resettlement assistance & livelihood improvement options.
Pollution Prevention And Control	National Environmental Protection (Pollution Abatement in Industries And Facilities Generating Wastes) Regulations,1991; And National Environmental (Surface & Groundwater Quality Control) Regulations 2011	Operational safeguard 4–Pollution prevention And control of, hazardous Materials and resource efficiency	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency

Greenhouse Gases	National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991	Operational safeguard 4–Pollution Prevention and control, hazardous Materials and resource Efficiency (Special screening for GHGs is also considered under OS 1)	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency (Special screening for GHGs is also considered under OS 1)
Waste and Hazardous Materials	- National Environmental Protection (Management Of Solidand Hazardous Wastes) Regulations, 1991 -Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004	Operational safeguard 4 –Pollution prevention and control, hazardous materials and resource efficiency	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency
Resources and Conservation	Natural Resources Conservation Act CAP 349 LFN 1990	Operational safeguard 3: Biodiversity and Ecosystem Services	Operational safeguard 3: Biodiversity and Ecosystem Services
Labour Conditions	Employee Compensation Act,2010 Labour Act, 1990	Operational safeguard 5 – Labour conditions, health and safety	Employee Compensation Act,2010 Labour Act, 1990
Health and Safety	Factories Act (CAP F1), 2004	Operational safeguard 5– Labour conditions, healthand safety	Operational safeguard 5 – Labour conditions, health and safety

Natural Habitat and Biodiversity	Forestry Law CAP 51 LFN 1994 Endangered Species (Control of International Trade and Traffic) Act.No. 11 of 1985. Natural Resources Conservation Act CAP 349 LFN 1990	Operational safeguard 3: Biodiversity and Ecosystem Services	Operational safeguard 3: Biodiversity and Ecosystem Services
Gender	National Gender Policy 2010	Special consideration is given to the needs and rights of women. In the context of Gender vulnerability, The client must consider the social and political constraints and barriers that women may face.	There is the need forthe project consider the implications of the AfDB Gender Marker System and how to design and implement an appropriate Gender Action Plan for the sub projects
Vulnerable Groups	Some Nigerian policies address the needs of vulnerable people, such as the Gender Policy, Child Actor NEEDs framework. However, there are no specific provisions related to E&S Assessment	OS 1: Environmental and social assessment. Special attention is given to vulnerable groups.	OS 1: Environmental and social assessment. Special attention is given to vulnerable groups.
Differentiated Measures for Vulnerable Group	No provisions	Provision for differentiated measures for inclusion	(Provision for differentiated measures for inclusion)
Environmental	EIA Act Cap E12 LFN	ESAP	ESAP

Monitoring	2004		
Disclosure and Access to Information	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	OS1: Environmental and social assessment

2.7 TCN's HSEQ Policy

TCN has a comprehensive Health, Safety and Environment policy prepared and used by PMU (World bank project) the past 12 years which are usually given to TCN EPC Contractors and all parties involved in construction activities /works of 33/132/33kV sub-stations and 330kV and 132kV transmission lines. The EPC contractor shall be required to submit his HSE Policy alongside his bidding document and the TCN HSE Policy shall be handed also over to the EPC along with the project ESMP a Month after the kick off meeting at the project sites.All parties that will be involved in this project must comply with the HSEQ Policy of TCN. The SHE&S Philosophy is anchored on:

- Safety First
- Management of workplace health and Safety and Management of workplace Hazards (ILO C155 and R164)
- Nobody Gets Hurt during project planning and execution.
- Safety and security are the project's highest priorities.
- Any work performed at a facility must be done in the safest manner possible.
- Safety is an integrated part of SHE&S policies, procedures and requirements and those are required to safely operate and maintain operating facilities.
- Safety is everybody's concern and responsibility.

The Construction SHE&S Management System is to be established prior to construction based on the above philosophy and the requirements of following at minimum:

- OHSAS18001:2018 Occupational Health and Safety Management Systems Requirements;
- ISO9004:2018 Quality management systems: Requirements
- ISO14001:2015 Environmental management systems: Requirements with guidance for use;
- Local Norms, Rules and Regulations for Health, Safety and Environmental Protection;
- Workmen's Compensation Decree/1987;

- Electrical Regulations1988.

2.8 Institutional and Administrative Framework

TCN AfDB PIU shall be responsible for implementation of ESMP of this ESIA in liaison with other relavant stakeholders which shall be directed by the Financier (AfDB) through TCN. These include the following:

2.8.1 The Federal Government of Nigeria

Section 20 of the constitution of Nigeria makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively, can also be linked to the need for a healthy and safe environment to give these rights effect. The executive council of the federation approves all national policies including the National Policy on Environment.

2.8.2 Federal Ministry of Environment

The Federal Ministry of Environment is responsible for implementation of the overall environmental policy of the Country. It has the responsibility for verification of the project sites during this study. The Ministry will be responsible for review and disclosure of this ESIA report and its implementation through panel review with experts, issuance of approval to next phase of project implementation, Monitoring the Impact mitigation processes during ESMP implementation by the EPC Contractor and finally certification at the end of the project cycle. The Ministry will also be responsible for Environmental Audit monitoring review and compliance enforcement, along with waste management in the operation phase and in the decommissioning phase. They will enforce waste Management in line with all the laid down Regulations and guidelines of Conventions to which each identified waste shall belong, e.g. Basel, Stockolm, and Montreal protocols, climate change, etc, as it relates to transmission lines and their associated sub stations.

2.8.3 Transmission Company of Nigeria

Transmission Company of Nigeria (TCN) manages the electricity transmission network in the country.

TCN's licensed activities include electricity transmission, system operation and electricity trading. It is responsible for evacuating electric power generated by the electricity generating companies (GenCos) and wheeling it to distribution companies (DisCos). It provides the vital transmission infrastructure between the GenCos and the DisCos' Feeder Substations.

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2.8.4 Project Implementation Unit

This is a unit established by TCN with responsibility for the end to end delivery of all AfDB funded projects, including planning, ESIA/ESMP, feasibility and RAP, engineering, procurement of EPC contractor, supervision of the construction by (EPC). PIU is headed by a substantive Project Manager. Furthermore, the PIU shall ensure:

- The ESIA and RAP studies are conducted in line with legal requirements as well as requirements of the lender;
- Proper implementation of the ESMP;
- Supervise the EPC contractor during the implementation of ESMP in the construction stage conjunction with the Owner Engineers in Project Department to ensure implementation of management measures;
- Provision of information on activities and consultations with the PAPs;
- Maintain an inventory of the assets to be resettled and a detailed valuation of the compensations;
- Ensure proper information and participation of PAPs and affected communities;
- Management of compensation payments;
- Monitoring the resettlement work;
- Implementation of community-approved projects financed through the EPC contractors; and
- Production of monitoring reports on ESMP and Health and Safety implementationscompliance all through the project cycle either Monthly or quarterly or as often as the reports are required from either the Bank or Regulators.

2.8.5 Electricity Distribution Companies (Port Harcourt)

There are two electricity distribution companies in this project area which are part of 18 distribution companies unbundled from defunct PHCN during electricity reform in 2005. They are responsible for distributing electricity to homes and other consumers within the Alaoji - Onitsha distribution zones. This role makes them the direct customers of TCN and a major stakeholder in ensuring improved electricity supply to consumers and realizing other objectives of this project.

2.8.6 Imo State Ministry of Petroleum and Environment (ISMPEnv.)

The Imo State ministry of petroleum and environment is charged with the obligation of developing and implementing environmental policies, formulating, enforcing programs and legislation, environmental protection and control, environmental technology including efficient implementation of research and development.

2.8.7 Abia State Ministry of Physical Planning and Urban Development (renewal) (AbSMPPUD)

The Bureau's core mandate is to strengthen land administration, acquire, prepare, allocate and register all land transactions as well as the physical planning of non-urban centres in the state. The Bureau Abia state Ministry of Physical Planning and Urban Development (renewal) (AbSMPPUD) has is an agency under the ministry's supervision.

The functions of the Agency include

- Land acquisition
- Compensation
- Land allocation
- Processing of Certificates of Occupancy for production and collection
- Registration of land transaction
- Change of land use purpose
- Merger of land titles
- Renewal of land ownership (Re-grant)
- Conversion of land titles
- Non-urban services (planning recommendation, building plan approval)
- Geographical information services
- Project management of metropolitan and other Urban Roads

2.8.8 Anambra State Environmental Protection Agency (AnSEPA)/ Imo State Environmental Protection Agency (ISEPA)/ Abia State Environmental Protection Agency (ASEPA)

The agencies are responsible for preparing and updating periodic master plans for the development of environmental science and technology and advise the government of the financial and material requirement for the implementation of such plans; to establish a mechanism to predict ecological disasters; identify the problems of drainage and sewage systems and carry out measures to improve, protect and remedy their ecosystems .Also protection and development of the environment, and also ensuring a healthy environment.

2.8.9 Abia State Ministry of Transport (ASMT)/ Anambra State Ministry of Transport (AnSMT)

The major roles of the ministry are;

- To formulate and implement effective policies in respect to road transportation to ensure that adequate road safety measures are put in place across the state.
- To co-ordinate the creation of motor parks, identification and development of railways and river transportation.
- To ensure effective and efficient movement of goods and services that will enhance socio-economic growth throughout the states.

2.8.10 Abia State Ministry of Environment (ASMEnv)

Abia State Ministry of Environment is charged with the obligation of developing and implementing environmental policies, programs and legislation, environmental protection and control, environmental technology including efficient implementation of research and development. In this project what is their functions. We are working with FMEnv. not soley the state. The FMEnv brings in people from the state in the area of waste management and pollution control.

2.8.11 Anambra State Ministry of Environment (AnSMEnv)

Anambra state ministry of environment is charged with the responsibility of formulating, enforcing, coordinating policies, statutory rules and regulation on solid waste collection, disposal, general environmental protection and flood control in the state. To also ensure the attainment if a clean, beautiful and sustainable environment across the state through the application of the best practices in the management of the environment, to initiate, implement and monitor all issues relating to climate change in order to mitigate the negative impact of climate.

2.8.12 Abia State Ministry of Women Affairs (ASMWA)/ Imo State Ministry of Health, Women Affairs and Social Development (ISMHWASD)

The responsibilities of the Ministries in both states are majorly to facilitate efforts in providing micro credits to the indigent women from donor agencies (UNICEF, UNFPA) strengthen the capacity of caregivers, OVC, NCOS, and CSO sensitize Abia women on the issues of child rights, HIV/AIDS, harmful traditional practices initiate programs that promote the economic empowerment of women provide decent health care delivery, in reducing maternal mortality and morbidity by collaborating with the ministry of health and also strengthen the child's parliament through seminars exchange programmes, debates, radio/TV shows.

2.8.13 Anambra state Ministry of Lands, Survey and Town planning (AnSMLST)/ Imo State Ministry of Land Survey Housing and Urban Planning (ISMLSHUP)

The Ministry of these states is vested with the authority of land administration. They are also charged with the survey of state lands, determination of land use and control, compensations, housing policies and urban development. The ministry is also responsible for issuance of the gazzetted right of way (ROW) of the proposed transmission Quad line.

The respective states Environmental Protection agencies are responsible for ensuring the safeguarding the environmental resources of the respective states for achieved sustainability. They liaise with the country's supervisory ministry on issues concerning environmental protection. This should be so stated to justify the inclusion of the state ministries and agencies under the regulatory framework of the report

2.8.14 Local Government Areas (LGAs)

The project will pass through sixteen LGAs, four in Abia State – Osisioma, Aba North, Aba South, Ugwunagbobo, four in Anambra state- Ekwusigo, Idemili south, Ihiala, Ogbaru and eight in Imo state- Owerri municipal, Mbatoli, Ngor–Okpala, Owerri-north, Owerri-west, Oru-east, Oru- west, Njaba. These LGAs are involved in the ESIA approval process. According to the EIA act, the LGAs will have representatives in the panel that will review the report and advise the Minister to make decisions on the project. The LGAs also have roles in the administration of lands in rural areas and hence, will be involved in the resettlement process.

2.8.15 The Customary District Councils

The line route will pass through the Chiefdoms as several villages under them. The Igwe's (traditional head of chiefdom) have important role to play in the project with respect to mobilization of the community members to support the project, grievance redress, peace and security of personnel, equipment and facilities to be installed. Close contact and regular consultation shall be maintained with customary chiefs throughout the life of the project.

2.9 ESIA Terms of Reference

In line with the Nigeria's EIA procedural guidelines (FEPA, 1995), a Terms of Reference (ToR) for the ESIA of the proposed project was developed, for the FMEnv's approval, at the early stages of the study based on an initial assessment of the environmental issues relating to the proposed project. The ToR was approved by FMEnv and a one season waver for field data gathering exercise was issued for the project. The specific objectives of the ToR were to:

- Define the relevant framework of legal and administrative requirements for EIA of the proposed project;
- Outline the general scope of the ESIA study including the overall data requirements on the proposed project and affected environment; and
- Define the procedures and protocols for identification and assessment of associated and potential impacts and for selecting appropriate prevention, reduction, and control as well as enhancement measures for such impacts; and eventually developing an effective Environmental and Social Management Plan (ESMP) for the project. The ToR has been approved by the FMEnv.

CHAPTER THREE
PROJECT JUSTIFICATION AND ALTERNATIVES

3.0 Introduction

This chapter discusses the justification for the project and as well as description of all alternatives considered to ensure that the least environmentally and socially damaging alternative was selected.

3.1 Project Justification

Need for the Project

Although the **transmission capacity** in Nigeria is amounting to 10,000MW, transmission lines have reached their maximum capacity, the grid is therefore constrained in several areas, and power is not availed to consumers at all time. The suppressed demand is extremely large (estimated to over 10,000 MW). Consequently, the average annual electricity consumption per capita of Nigeria (144.5kWh) is one of the lowest on the continent (480.3kWh for Sub-Sahara Africa and 2,059.1kWh for middle-income countries).
The absence of reliable supply of electricity negatively affects Nigeria's economy. Due to significant shortage of power supply capacity compared to demand, load allocation has been implemented nationwide in Nigeria. Businesses experience an average of 239 hours of power outages per month while more than 60% of the population does not have access to electricity. As a result, a very large number of residential consumers, businesses and industries rely on expensive diesel and petrol generators. Self-generation of electricity is estimated at a minimum of 6,000 MW, almost equivalent of the available generation capacity on the grid. The use of diesel and petrol generators contributes significantly to air and noise pollution, which negatively impacts the quality of life of the people of Nigeria – especially those of women and young girls. Energy poverty disproportionately affects women because they are primarily responsible for energy generation and use in homes (cooking, heating and lighting).

Nigeria's transmission system managed to evacuate a record. Nigeria's transmission system, which is operating well below international reliability and security standards, only managed to evaluate a record 5,074 MW on February 2, 2016. Fichtner's (2017) Transmission Expansion Plan for Nigeria puts the net balance between power generation and transmission at 5,900MW as at December 2015. Planned power generation investments by gas, hydro, photovoltaic and wind fired powered stations would further provide more available energy requiring transmission.

There is therefore an urgent need to increase transmission capacity to sustain economic development in the country because there is a strong correlation between improved power availability and economic development.

3.2 Benefits of the Project

Energy is the raw material needed to fuel any country's economy growth. The benefits of this project for the people of Abia, Anambra and Imo Statesin particular, and the economy of Nigeria in general are numerous. The following few are worth mentioning;

- Improved and more reliable electric power supply.
- Improvement of the wheeling capacity and stabilized the grid connection
- Enhances productivity and efficiency in both public and private organizations
- It helps to develop and promote small, medium, and large-scale enterprises thereby creating direct and indirect employment opportunities.
- It helps to improve the security of lives and properties.
- General contribution to climate change through overall reduction of the used of personal power generating sets. Reduction in green house gases from generating sets that eventually impact negatively on the climate and the consequent climate changes
- General improvement of the standard of living for the populace.
- Improve the revenue base of the country by increasing the economic activities that have access to electricity

3.3 Envisaged sustainability

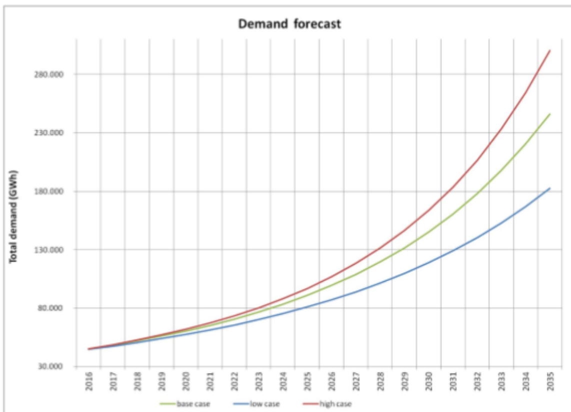
The general sustainability principles (technical, economic, environmental and social) that guided the design of the project are set out below.

3.3.1 Technical Sustainability

The proposed project is technically feasiblebecause, it is professionally designed, and the technology employed is readily available. The proposed route selection has also considered the accessibility for maintenance works after commissioning. Demand for power to drive industrial, and residential concerns has also been established in the Fichtner (2017) Transmission Expansion Plan.

3.3.2 Economic Sustainability

There is a huge power demand in Nigeria as exemplified in Figure 3.1 below which shows an exponential growth in demand.



Source: Fitchner (2017)

Figure 3.1: National Demand Forecast of Nigeria

In the short term, the project will be funded by debt from development finance institutions. However, in the medium to long term after operation, the return on investment would be guaranteed assuring loan repayment promptly. The availability of skilled and unskilled labor force in the project area, functional TCN organizational structure, presence of up takers and deployment of good industrial best practices in construction technology is expected to make the project economical sustainable.

3.3.3 Environmental Sustainability

The line routes and the substation sites have been carefully selected by considering sensitive ecosystems and to avoid built-up areas as much as possible. In addition, practical mitigation measures have been proffered for the identified environmental impacts of the Existing Alaoji – Onitsha Transmission line project and TCN is fully committed to comply with the relevant applicable national environmental laws, applicable international conventions and AfDB environmental and social safeguard requirements. Furthermore, TCN is also committed to implementing the ESMP developed to further guarantee the environmental sustainability. TCN has full department that handles environmental matters. The HSE department is headed by an Assistant General Manager who reports directly to the Managing Director. Significant number of ESIAs and environmental audits studies has been conducted in the past by TCN. Hence, they have the technical skills needed to manage the mitigations that are determined for the identified impacts of this project.

The implenetation of the findings and recommendations of the ESIA in the project design such as redesigning to accommodatethe identified impacts on the ROW among others shall ensure the environmental sustainability of the project. The application of standard industrial practice during construction and implementation of the project shall also ensure the environmental sustainability of the project. The implementation of the stand alone ESMP shallensure continuous safeguarding of the Environmental and Social components for ensured sustainability in line with the Bank's policy.

3.3.4 Social Sustainability

The project has secured the buy-in of the people due to their quest for electricity availability for socioeconomic activities. One of the benefitsof this project isto enhance the socioeconomic activities of these peopland also to create job opportunities for unemployed indigenes. Therebyand this would enhance the socio-economic activities of the communities thereby supporting the sustainability. In addition, TCN is committed to effective and continuous stakeholders' engagements and consultations and effective implementation of the Resettlement Action Plan (RAP).

TCN is committed to comply with applicable national social laws, relevant international conventions and AfDB safeguard requirements. While AfDB is also committed to training and re training of the PIU team members on environmental and social management risks.

The continuous implementation of the Bank's Environmental and Social safeguards policies throughout the various phases of th project shall also ensure the social sustainability of the project.

3.4 Project Alternatives

This project alternative supposed to be a chapter on it own. Please remove it from justification.

3.4.1 'Do-Nothing' Option

The first project option considered was the 'do-nothing' option. This option would result in the continuation of the shortage of electricity supply, which has also been inefficient, inadequate, and unreliable. The use of domestic and industrial generators to power homes, offices and industries will escalate. And this will result in increased gaseous emissions with its associated health effects as well as increased greenhouse gas effects. Furthermore, economic growth will be stifled. Therefore, this option was **rejected**.

3.4.2 Delayed Project Option

This would arise if a situation of civil unrest or public opinion is against the development, or the socio-economic and cultural impacts of the project are not favorable, given available mitigation options. This would mean that all planning and development activities would be stalled until conditions are more favorable.

This option would therefore delay access to more reliable electricity and slow down investments in generation plants, since power evacuation is delayed. The use of domestic and industrial generators to power homes, offices and industries will also be prolonged. This will result in increased gaseous emissions resulting in the increase in green house gas which enhances global warming effect that leads to Climate change effects; therefore, this option was **rejected**.

3.4.3 Project Implementation Option

The third option considered was the execution of the proposed project as planned. This option was accepted because it will de-bottleneck the grid around the largest demand center of Abia, Anambra and Imo States, provide a more secure and reliable energy supply with all the benefits listed under Section 3.2.

3.5 Analysis of Alternatives

3.5.1 Design/ Technology Alternatives

Several design alternatives were considered including:

- Overhead versus Underground Transmission
- Conductor type
- Tower type

3.5.1.1 Overhead versus Underground Transmission Line Cables

Electrical power is transmitted through either overhead power lines or underground cables. Each of the two types of cables has its benefits as well as pitfalls as well as places where it is commonly used. The choice of which method to use is influenced by voltage, cost, safety, type of application, and other factors. Table 3.1 presents a comparative evaluation of both system types.

Table 3.1: Overhead Versus Underground Transmission Line Cables

Design Consideration	Alternatives Considered	Preferred Alternative	Justification
Transmission line design	Overhead	Overhead	Overhead transmission lines possess the following comparative advantages over underground • Increased life expectancy, • Enables fault detection and repair, • Higher voltage carrying capacity, • Accommodate large size of conductors, • heat dissipation, • Easier and less expensive to install and construct in installation and construction,
	Underground		This TL design type is associated with issues related to public safety; effect of lightening discharge, interference, voltage drop, environmental impact, high installation cost, and land use can be effectively mitigated. Underground TL has lesser comparative qualities to overhead lines in following areas; • Lower life expectancy, • Doesn't fault detection and repair, • Lower voltage carrying capacity, • Lesser conductor sizes, • Lower heat dissipation, • Ease in installation and construction,
	Tubular		• Has a diagonal shape • Very convenience • A bit costlier than the lattice • Varies in height between 10m-100m

			• The choice of towers type is dependent on the electrical clearance and SAGs

3.5.2 Foundation Alternative

The various alternatives considered for the Foundation are outlined in Table 3.2.

Table 3.2: Foundation Alternatives

Design Consideration	Alternatives Considered	Preferred Alternative	Justification
Foundation Type	Concrete spread footing	Concrete spread footing	• It is durable, less expensive, accommodates variety of soils, accommodates both light and heavy towers,
	Raft Foundation		• It is durable, less expensive than the other two options, accommodates only poor soils and light towers
	Pile Foundation		• It is durable, less expensive, best for only swampy soils, accommodates both light and heavy towers

3.5.3 Conductors Alternatives

Conductor type and number of circuits alternatives considered for this project are presented in Table 3.3.

Table 3.3: Conductor Type Alternatives

Design Consideration	Alternatives Considered	Preferred Alternative	Justification
Conductor type	Gap-type ZT-aluminum conductor steel reinforced (GZTACSR)	Gap-type ZT-aluminum conductor steel reinforced (GZTACSR)	• Long life span, corrosion resistant, very high current capacity and conductivity, low sagging at high temperature, High thermal resisting properties
	Aluminum Conductor Steel Reinforced (ACSR)		• Long life span, poor corrosion resistant, high current capacity and conductivity, low sagging at high temperature, High thermal resisting properties
	All Aluminum Conductor (AAC)		• Short life span, corrosion resistant, high current capacity and conductivity, High sagging at high temperature, low thermal

			resisting properties

3.5.4 Number of Circuits Alternatives

Table 3.4 presents the alternatives of using the single-, double-, or multi-circuit transmission lines for the proposed project.

Table 3.4: Number of Circuits Alternatives

Design Consideration	Alternatives Considered	Preferred Alternative	Justification
Number of conductors	Single circuit conductors	Double circuit conductors	• higher E & S footprint and • low voltage carrying capacity and • Low construction and maintenance cost • Absence of EMF coupling effect
	Multi-Circuit conductors		• high capital outlay for construction and maintenance cost • High voltage carrying capacity • Presence of EMF coupling effect • Reduced E&S footprint,
	Double circuit conductors		• High voltage carrying capacity • Moderate construction and maintenance cost • Reduced E&S footprint, • Presence of EMF coupling effect

3.5.5 Towers Types (Tubular / Lattice) Alternatives

Two basic tower types were consideredthe tubular and the lattice steel tower. The choice of tower type was based on considerations of Design, Detailing, Tower cost, transportation and erection as shown in Table 3.5.

Table 3.5: Tower Type Alternatives

Design Consideration	Alternatives Considered	Preferred Alternative	Justification
Tower type	Lattice	Lattice and Tubular tower	• Can be easily adjusted to accommodate several electric circuits and various conductor types • Less expensive and easy to fabricate • Can be easily bundled and transported • Extremely flexible on site
	Tubular		• Can be used in areas with reduced RoW due to encroachment • Can be adopted in areas with huge social concerns like Aba and Onitsha • It is more difficult to transport • It is more expensive than the lattice. ($1,160-$1,500/Ton as at September, 2019 source: online -Google) • It has height ranges fro 10m-100m • It is mostly used when there is contention with the electrical clearance and SAG

CHAPTER FOUR

PROJECT DESCRIPTION

4.1 Introduction

The proposed Alaoji - Onitsha Transmission Project is aimed at strengthening the national grid around the country for a more reliable electricity supply. The project involves the reconstruction of the existing line and upgrading it to a double circuit Quad Conductor of 330kV type with a total length of about 138 km, between the existing TCN substation at Alaoji (in Abia State), Ihiala (in Anambra State) and Onitsha (in Anambra State).

4.2 Project Locations

The States where the project traverses are presented in the Figure 4.1.

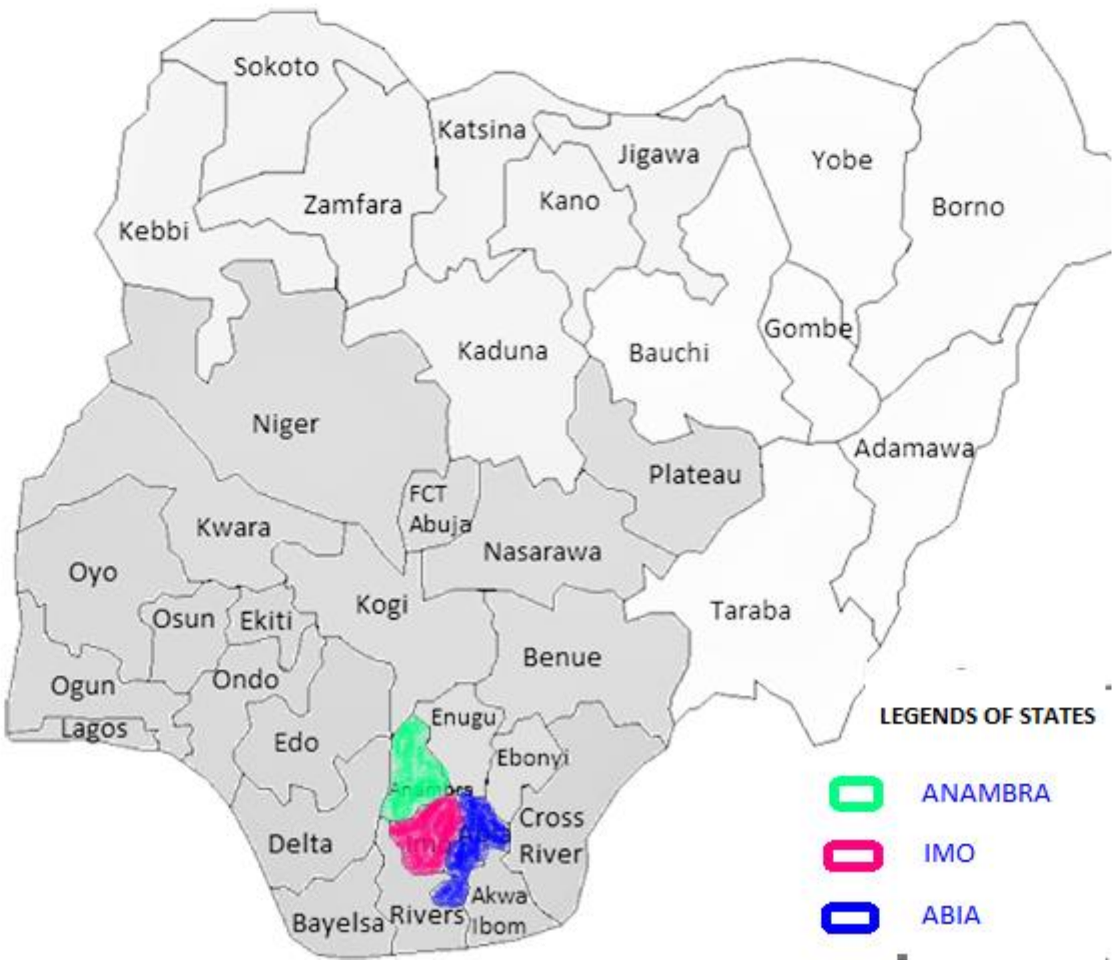


Figure 4.1: Project Location Map

Table 4.1 lists the State and Local Government Areas traversed by the transmission line, while Figure 4.1 outlines the administrative locations of the component parts of the project.

Table 4.1: Administrative units traversed by the Alaoji - Onitsha TL

State	Local Government	Communities
Abia	Osisioma Ngwa	Umuode, Umuocham, Abayi, Umuozuo, Osia Umu Mgbede, Ama Okpu, Umu Ojima Ogbu, Umuobo, Umumba, Umu Akpara, Umuabai, Okpuala, Mbuntu, Mboko Umuete, Ihie, Ama Apu Ife, Aga
	Aba South	Umu Mba, Ohabiam, Asia Nnentu, Ariaria, Aba
	Ugwunagbobo	Asia Umu Nka, Asia Amanhie, Umuodo, Umugo, Ala Oji
	Ukwa West	UmuIku Uko and Obokwea
Anambra	Idemili South	Obosi, Umuoja, Obosi, Oba Aboji, Oba
	Ogbaru	River Idemili, Eruna Lagbe, Atani, Eze,
	Ihiala	Uli, Ihiala, Azira, Awgbu
	Ekwusigo	Ozubulu, Orifite, Ihembosi, UruoboOkija, Omai, Isieke
Imo	Owerri Municipal	Owerri, Nwaorie, Owerri Division,
	Mbatoli	Umunoha, Orodo, Ohoba, Nkwesi, Mbieri, Awo, Akabo, Obaku,
	Ngor-Okpala	Umu Echem, Amala, Upe, Umuowa, Umuonhie, UmuNeke, Umukabia, UmuEwere, Obokwe, Obeki, Nguru, Ngor, Eziama, Egbelu, Amaibo, Alulu, UmuOye, UmuOgii, Ochicha, Elelem, Amafor
	Njaba	Umuaka, Amiri,
	Owerri west	Orogwe, Ubomiri, Irete, AwoIdemiri, Umu Oma, Okuku, Obokwe, Obinze, Nekede, Ihiagwa, Eziobo,
	Oru East	Awomama
	Owerri North	Umunahu, Owelu, Orji, Oratta, Olakwo, Naze, Ihite, Emii, Emekukwu, Emekeobibi, Egbu, Awaka, Akalovo, Abala, Obeke, Amorie
	Oru West	Nempe, Oteru, MbidiIbi,

4.3 Design objectives

The proposed transmission line to theirassociated terminal substations at both ends are ultimately intended to cater for the surrounding industrial and residential growth within the Project Areas. Design objectives include:

- accommodating for expansion due to future load growth and planned distribution additions,
- providing a safe, efficient and reliable supply of electricity in an economically, socially and environmentally sound manner.
- maintaining a safe operating environment
- keeping any disturbance footprint to the minimum size required
- strategically placing the proposed transmission line footprints and future ROWs within previously disturbed and relatively level areas as much as practical to reduce vegetation clearing, soil and site hydrology disturbance
- providing options for vegetation offsets and re-vegetation works
- adopting environmentally sensitive design features to reduce the clearing of canopy trees within RoWs, where practical
- adopting alternative clearing profiles (e.g. scalloped) when crossing sensitive vegetated areas
- providing a service life of 50+ years that can be extended by refurbishment programs so long as the need for the facilities continues

4.4 Project Scope

The reconstruction of the approximately 138km 330kV SCAlaoji –Onitsha transmission line will involve:

- Decommissioning phase. This phase includes widening of access roads, unstringing of the existing lines, dismantling of existing towers and tower foundation
- Planning and design phase. This phase includes preparation of relevant planning documentation, technical and design documentation and analysis of the environment aspects. The planning documentation will be prepared in accordance with the requirements of the current Nigerian and international legislation for this type of facilities
- Construction of overhead transmission line towers, their foundations and line stringing. The type and size of a tower foundation is determined by soil details obtained from geotechnical investigations and prior experience. Provision for horizontal shear forces at the ground line shall be factored into all

foundation designs. All typical OHL consists of tower body, earth wire peaks and crossarms as components. They served to bear the conductor forces and outward loads. The transmission line is going to be a 330 kV two to four circuit TL. Each pair of circuits comprises of composite conductors.

4.5 General Layout of the TL

The transmission line as well as the all the communities/LGA it cuts across are shown in Figure 4.2.

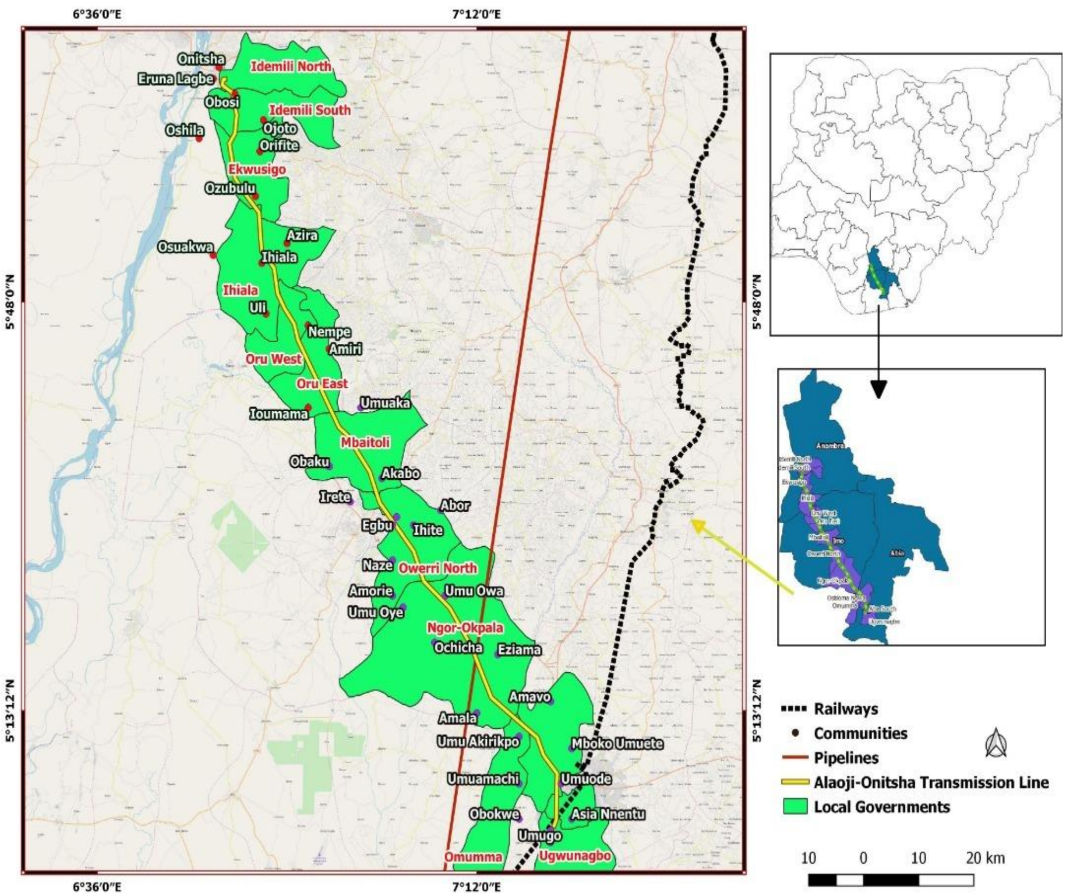


Figure 4.2: Map of Project Area Showing Affected Communities and LGAs

4.6 Land Take

The Transmission Line Right of Wayfor the project is approximately 138km in length and 50m wide, thereby giving a total area of about 1,083,990 m^2.

4.7 Safety Criteria

The design of the TL system (routes and layouts) have been carried out taking into consideration corporate safety rules to assure safety, prevent accidents and reduce risks level to as low as practicable. Further safety and operability studies would be carried out on final transmission route, tower foundations and general technical drawings to verify safety systems and integrity of installations to possible changes in environmental conditions.

4.8 Design Conditions

The Environmental, as well as the actual design conditions, considered for the proposed transmission line, substations and ancillary facilities are presented in Table 4.2.

Table 4.2: Environmental Design Conditions

Environmental Conditions	
Altitude	
Climate	Mangroove forest and swamp forest zones environment
Maximum Ambient Temperature	28^{0}C
Minimum Ambient Temperature	25^{0}C
Mean Annual Rainfall	161 mm
Relative Humidity (Maximum)	75%
Relative Humidity (Average)	72%
Maximum Hourly Wind Speed	8%
Maximum 3 Seconds Gust Wind Speed	52 m/sec (115 mph)

The design life and reliability requirements as detailed in the feasibility report prepared by Oskajo (2019) are presented in Table 4.3.

Table 4.3: Summary of the design life and reliability requirements

Component	Description
standard design working life	TCN adopts the Industry standard design working life of 50 years for TL and its components
Reliability Level	A reliable level of 3 shall be built into the design to offset uncertainties in environmental loads and structural resistance with a wind return period of 200 years
Applicable Codes andStandards	TCN aligns itself with national and international electrical, civil and mechanical codes governing transmission lines. See Appendix 3.2 for details
Tower Type& Design	Self-supporting suspension, tension, transposition and special tower types with vertical / barrel configuration shall be used
Tower span and Weight	Average span is 0.425km, Number of towers=350, weight per tower = 4.5tons.
Material selection for the towers	Towers shall be of steel material using hot rolled angle (90º) sections and plates. In general, the following grades of steel shall be applicable: • Mild steel shall be Grade 250 (for plates) and Grade 300 (for angles) • The recommended high tensile steel shall be Grade 350L0.
Foundation Design	The foundation design is based on safety, reliability, economy and reasonability criteria. Three foundation types (mass concrete, pad and pile foundations) shall be used in the proposed project. The mass concrete, and pad foundation types shall be used for foundations with small and large loads respectively while the pile foundation shall be used in areas where the mass concrete and padfoundations are considered unsuitable. The upper surface of the foundation body will be at least 500 mm above the level of the surrounding terrain. Special Foundations would be required in areas of low soil bearing capacity, special foundations will be required.

4.9 Grounding

In the context of safety and protection at work (reducing the effects from electric shock, etc.) a special accent will be given to the grounding of towers. The grounding resistance on each tower must be lower than 17.5 ohms, while for the first five towers before the Strip, it should be at the most 10 ohms.

4.10 Conductor Type

The conductor types selected for the proposed TL line are GZTACSR Goose (for 330kV Lines) and the GZTACSR Lynx (for 132kV Lines). Table 4.4 outlines the design criteria meant to achieve non- sagging and minimize heat capacity.

Table 4.4: Conductor Types

Conductor			**Goose**
Size		mm^2	310
Stranding	(Z) TAl	No/mm	16/3.9 10/TZ(3.94)
	Est		7/2.8
Rated Tensile Strength		kN	113.8
Diameter	GZTACSR	Mm	24.4
	Steel core		8.4
Cross sectional area	Aluminum	nm^2	313.1
	Steel core		43.11
	Total		356.2
Weight	Aluminum	kg/km	1227
DC. Resistance at 20^{o}C		Ω/km	0.0941
Current carrying capacity	GZTACSR (210°C)	A	1,255
Modulus of elasticity	Steel core	GPa	206.9
Coefficient of Linear Expansion	Steel core	10-6/°C	11.5

4.10.1 Protective Wires

One of the protective wires will be ordinary alum weld wire 19/9. The other one will be made of optic fibers – OPGW 120/70, with similar mechanical and electric characteristics as the ordinary protective wire. Due to temperature variations, a maximum allowable strain of 1.6 и

2.5x0.18√ddaN/m2 has been selected in compliance with the phase conductor. The selection of the above value is based on the following criteria:

- Those safety coefficients of protective wires should be higher than the coefficients of phase conductors.
- That slope of the protective wire should be 10-15% smaller than the slope of the phase conductor.
- That protective wire must efficiently protect the phase conductors from atmospheric discharges in a protective angle of 300 degrees

4.10.2 Line Insulation and Fittings

4.10.2.1 Insulators Type

Composite insulators shall be used for the TL. Insulation between the conductors in the span is provided by the spacing in air. Modification to horizontal vee insulators and re tensioning will aid in resolving conductor clearance infringement. To protect the insulators from power arcs with temperatures ranging up to 12,000 K, the insulator strings shall be equipped at both ends with protective arcing fittings. Protective cradles shall be used for multiple insulator sets to avoid clashing of individual strings. To maximize load bearing capacity of the conductor, a tension insulator sets shall be used while an arching device to avoid electric discharge along the insulator skirt shall be used also.

4.10.3 Protection and Earthing System Design

4.10.3.1 Lighting protection and Earthing System

To protect the line and towers against lightning, an earth wire conductor made of copper and galvanized steel at a shield angle of0° shall be used. The mid span clearance between upper conductor and ground wire for the lines shall be 6.5m respectively.

The earthing devices shall be buried in ditches with depth of over 750mm dug in a straight line and backfilled.

Earthing rods will be installed in the soil to conduct failure and induction currents as well as currents from lightning strikes into the earth.

The earthing of both Dead-End Towers will be connected with the earthing system at the substations. The ground-wire will be connected to the gantry and the foundation earthing of the Dead-End Towers will be connected to the foundation earthing of the substation.

4.10.4 The Right of Way (ROW) and Access Corridor Conditions and Operation

The operation of the TL is in accordance to the following conditions:

The Nigerian Electricity Supply and Installation Standards Regulations 2015 (see Legal section) requires that 330KV high voltage lines should have a RoW with 50m width. All structures along this corridor shall be evacuated. In accordance with standard industry practice, TCN has generally adopted a 50 m wide ROW for its 330-kV high voltage power lines.

A ROW is a registered overlaying interest in a parcel of land for which TCN will pay compensation to the landowner for authority to build and operate the power Line. Restrictions are placed on activities permitted on a RoW, such as buildings or excavations, to ensure that the safety of the public is maintained, and the line can operate reliably.

Compensation payments are assessed by professional values and take into account the effect of the RoW on the property.Prior to the decommissioning works, selective clearing will ensure that only trees, vegetation, debris, roots, and other material interfering with the construction process are cleared from the site. Vegetation shall be cleared only along RoW and areas marked for construction of access roads.

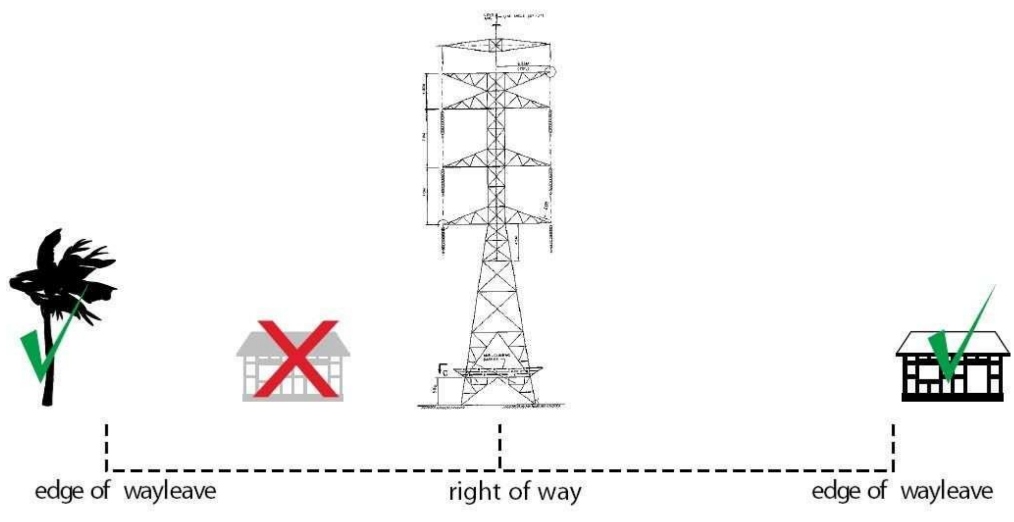


Figure 4.3: ROW Clearance along the Transmission Line

Trees shall be cut off at max 30cm above ground level and the stumps left in place for erosion control.

Any debris shall be collected and disposed of through the use of an approved waste disposal contractor. Topsoil shall only be stripped in the areas of tower foundations, associated access roads, and marshaling yards. Care shall be taken to avoid mixing topsoil and subsoil.

4.10.5 Access Tracks

Access to the power Line is required for initial decommissioning, construction and route maintenance. For the Power Line Project, access to the power Line and poles for construction and maintenance will be via the existing Owerri – Onitsha express Way Aba –Porthacort express. Usually access is only required to the structure sites and there is no particular need for access to be along the ROW (other than vegetation management) between structures if existing, alternative access roads are readily available. During the service life of the proposed power Line, access track maintenance is only conducted at lengthy intervals or as required for repairs. Natural rehabilitation of access tracks is carried out as a matter of course as maintenance traffic usually consists of light four-wheel drive vehicles which can traverse rough terrain, sometimes without the need for tracks.

4.11 Decommissioning of the Existing Line

Decommissioning of the proposed transmission line is estimated to take six months to complete and will involve the following operations.

4.11.1 Dismantling of Tower and Tower Foundation

Prior to the decommissioning, all power from the substation and transmission lines will be de-energized. The steel lattice towers will be removed entirely from the way leave. All materials arising from demolition will be disposed of in accordance with relevant Imo, Anambra and Abia states waste management regulations. The excavated areas will be backfilled, covered in topsoil and seeded with an appropriate local mix prior to construction.

4.11.2 Unstringing of Conductors

The conductors will be de-energized, cut, ends removed and reeled and sold to licensed steel recycling vendors. The insulators will be removed and disposed off in accordance with relevant state waste management regulations and international waste management guidelines.It is envisaged that there will be minimal by-products generated through the decommissioning of the transmission line (Detailed waste streams is provided in later part of this Chapter). During the decommissioning phase, the primary waste will be the scrap metal from the steel lattice towers, insulators and cables. Several trucks will be required to transport wastes generated through the decommissioning phase to appropriate waste disposal sites. These vehicles will consume diesel and produce air emissions as a waste. Secondly, through servicing of these trucks, used oils will be generated which are hazardous wastes. Potentially there may be tires that will be replaced and old tires that come out of the trucks during the decommissioning of the transmission line may also be wastes.

4.12 Construction of Power Line

4.12.1 Site Surveys

This generally involve collecting data on ground elevation, cross-fall drainage on the study site, location of gullies, depressions, existing vegetation heights, roads as well as geotechnical and other information that could affect the final layout of the sub-transmission realignment.

4.12.2 Lay-Down Area and Utilities

Throughout the construction period, bottled drinking water will be imported to the job site by means of a tractor trailer truck for use by construction labour. Non-potable water for construction purposes will be obtained from the onsite constructed boreholes. Temporary portable sanitation units will be employed for construction labour. The Project will be responsible for pump-out and disposal of all sanitary waste.

The management and disposal of all construction generated waste streams will be conducted in accordance with all applicable Nigerian waste management regulations including project waste management and disposal standards. To ensure compliance with this commitment, the Project will contractually require its EPC contractor to develop and implement a waste management plan (WMP) consistent with its waste management standards and practices. The EPC contractor's WMP and any subsequent revisions will require approval from the Project. To further ensure compliance, the Project will conduct periodic assessments of the EPC contractor's waste management activities. The EPC Contractor will be required to promptly resolve any findings from these assessments to the Project's satisfaction.

Construction lighting will be accomplished by relying on mobile light towers, mainly required to illuminate the site each night for security. Temporary diesel electric generators will be used to provide office lighting and service other light loads. It is expected that temporary construction power will be provided by the EPC contractor using tow behind diesel generators for the construction period.

4.12.3 Temporary Site Facilities

Temporary offices facilities essentially construction trailers will be established. Connex boxes will be used to store, dispense and secure consumables, small tools and small equipment.

Some of the materials supplied will be used directly after delivery and as such no piling up is expected. Other materials like aggregates and sand will be stored at the layout area (To be determined by EPC contractors) ready for use. Cement and reinforcement bars will be stored in special storage rooms. Fuel/oils will be stored in drums which shall be stored in bunds (well paved areas which do not allow fluids to come into contact with the soil).

The Transmission Line lay down area will be determined by the EPC contractor. This area will be used during all the stages of the Project. It will aid in keeping materials dry and to provide a surface suitable for vehicle traffic. Later during the construction phase, construction materials and equipment like foundation reinforcement steel or steel tower metal bars will be stored in the area.

Security at the lay-down area is expected to consist of a combination of expatriate security managers and local national guards some of whom will be recruited from the host communities. Perimeter security, entry control points as well as roving security patrols will likely be used.

4.12.4 Towers

A large area shall be rented to store the delivered materials towers. The tower material is not arriving tower by tower or tower- section by tower-section. For each type of tower, the bill of materials and the workshop drawings shall be studied and all parts for a specific tower type have to be picked and separately stored and marked per tower type.

After all material for tower types is sorted out, the specific tower of specific type has to be sorted out. If body extensions or leg extensions are needed the material has to be picked and stored the same way. The completed material of one tower shall be taken off the store not before the tower erection gang has been established on the specific tower site identity. During picking and sorting, tower related materials shall be stored on wood supports in yard and on site. Bolts and nuts delivered per tower shall be unpacked and prepared so that bolt, washer, snap-ring and nut are screwed together and packed again to be carried with tower No X to site.

4.12.5 Bulk Earthworks and Site Levelling

Typically, around 300 to 500 mm of imported road base fill material will be distributed across project footprint to obtain the required surface levels along the swampy parts of the TL.

4.12.6 Foundation construction for Towers

Construction of steel-bar towers and installation of electric and protective equipment, including the conductors, insulators, protective wires, earthing, etc., will mainly be of prefabricated type. The design and manufacturing of elements of the steel-bar towers will be in compliance with the requirements incorporated in the Regulation on the technical principles for construction of overhead power lines with nominal voltage of 330kV. It also includes undertaking engineering and designing measures for corrosion protection. In case the power line passes above facilities or entities in nature, i.e. in case when the power line approaches to facilities or entities in nature, the requirements incorporated in the Regulation on technical principles for construction of overhead power lines with nominal voltage of 330 kV will be followed. This refers to the prescribed safety heights and distances. Therefore, special attention is required while conducting the power line above buildings, inhabited places, forests and trees, roads, railway and bridge constructions, antenna installations, gas pipelines, and sections with other overhead power lines. The safety heights and distances for certain entities are presented in the following Table 4.5.

Table 4.5: Safety heights and distances for power lines

Entity / terrain condition	Safety height [m]	Safety distance [m]
Inaccessible places	6	5
Places accessible for vehicles	8	7
forests and trees		5
Inhabited places	9	
Roads (local, State, Federal highways)		12/20/40
Bridge constructions		7
Gas and oil pipelines	Minimum of 10m away	Minimum of 10 m away

Table 4.6: Types, Quantity and sources of project requirements during the Decommissioning, Pre-construction, Construction, Operation and Decommissioning phases

Requirements	Type	Source	Estimated Quantity/Number decommissioning and Preconstruction phase		Estimated Quantity/Number construction phase		Estimated Quantity/Number Operation phase		Estimated Quantity/Number Decommissioning phase	
Energy	Electricity	Public utility and generators	Nil		110V		Nil		Nil	
	Fuel	Local Vending Stations	As the need arises		As the need arises		As the need arises		As the need arises	
Manpower	Skilled	Contractor	Men	Women	Men	Women	Men	Women	Men	Women
			80	20	100	30	100	50	70	30
	Laborers	Locals in the project area	300	50	1,500	700			1,300	300
	Un skilled	Locals in the project area	300	50	1000	150			150	50
Raw Materials	Coarse aggregates	From the nearby existing	302, 400m^3		22,350m^3		Nil		Nil	

		commercial quarries				
	Hard core	Same as coarse aggregates	75,000m^3	16,000m^3	Nil	Nil
	Fine aggregates	From commercial sources	Nil	3,600m^3	Nil	Nil
	Sand	From commercial sources	191,400m^3	Nil	Nil	Nil
	Water	Municipal water supply and commercial purchases	31,000,000 litres	10,000,000 litres	Nil	Nil
	Cement	Local cement depot	173,141m^3	27,133m^3	Nil	Nil
	Reinforcement bar	reinforcements are readily available in local iron and steel stores	194,452m^3	17,342m^3	Nil	Nil
	Boulders	Contractors	As the need arises	Nil	Nil	Nil
	Rough sawn timber	Contractor	As the need arises	Nil	Nil	Nil

	Oil (transformer oil)	Contractor	5drums/year	Nil	Nil	Nil
Equipment/ Machines	Dump trucks	Contractor		10	Nil	Nil
	Graders	Contractor	2	5	Nil	6
	Motor Grader	Contractor	Nil	Nil	Nil	7
	Bull Dozers	Contractor	2	12	Nil	5
	Water Boozers	Contractor	Nil	5	Nil	Nil
	Vibrators	Contractor	Nil	7	Nil	Nil
	Excavators	Contractor	3	13	Nil	10
	Water Truck	Contractor	1	Nil	Nil	Nil
	Tractor /Trailer	Contractor	1	Nil	Nil	Nil
	Elevatedwork platform	Contractor	5	Nil	Nil	Nil
	Diesel light trucks duty trucks	Contractor	6	Nil	Nil	Nil
	Concrete Batching Plant	Contractor	3	Nil	Nil	Nil
	Generator	Contractor	1	Nil	Nil	Nil
	track or 4WD mounted drill rig	Contractor	1	Nil	Nil	Nil
	Macadam roller	Contractor	1	Nil	Nil	Nil
	Diesel Heavy Dump Truck	Contractor	5	Nil	Nil	Nil

	Diesel Heavy Mixer Truck	Contractor	1	Nil	Nil	Nil
	Workers Buses	Contractor	5	Nil	Nil	Nil
	Light Vehicle	Contractor	Nil	Nil	5	4

***Estimated quantity of materials and equipment are as supplied by TCN**

Source: GNL, 2017

4.13 Transportation

Figure 4.4 shows a map of road network for the transmission line. Men and equipment will be transported to the transmission site via:

- Aba – Port Harcort Express Way
- Umuikaa – Owerrri Road
- Owerri – Onitsha Express Way

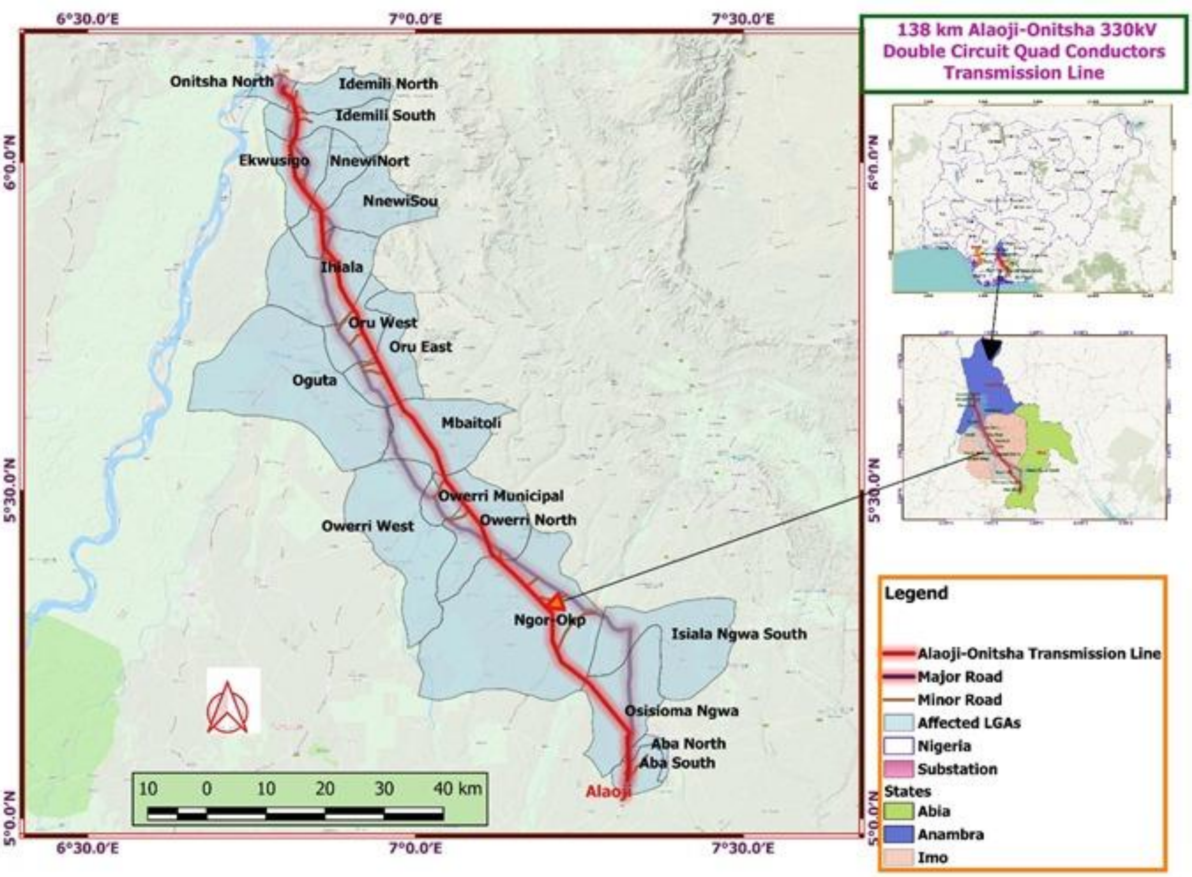


Figure 4.4: Map of Road Network for the TL

A Traffic Management Plan (TMP) outlined in Chapter 8 shall be updated by the construction Contractor, as a part of the ESMP. TMP is to focus on the preconstruction and construction phase of the project and in addition, must also include (but not be limited to):

- The management of movement of children, adults, cars, cows, etc
- Security of the equipment delivered
- Time schedule of work timing i. e. from what priod to what period per day
- off loading of the equipment

- Access to and from structure sites;
- Work methodologies for restringing across roadways;
- Arrangements for temporary road closures;
- Parking; and
- Any security access arrangements.

4.14 Emission Estimation

The amount of dust (from pre-construction and construction activities), noise (emission from bull dozer, diesel tanker, excavator, wheel loader, ambulance, dump truck, grader and generator) and noxious gases (from diesel tanker, excavator, wheel loader, dump truck, generator and grader), expected to be produced from each activity and equipment were quantified as shown in the succeeding sections.

4.14. 1 Dust Emission Estimation

Three species of particulate matter (TPM, $PM_{(10)}$, $PM_{(2.5)}$) were quantified for some activities and equipment that could potentially generate dust. The dust emission was estimated as follows:

4.14.2 Pre-construction and Construction phases

Particulate matter could be potentially generated during construction and developmental stage of the proposed transmission project activities.

The quantity of dust estimated during these phases is 1×10^6 m tones. The expected emission rate of particulate matter is obtained using the formula:

Where

S = silt content

M = moisture content

$$TPM = \frac{2.6\,(s)^{1.2}}{(M)^{1.3}}$$

$$PM_{(10)} = \frac{0.45(s^{1.5})}{(m^{1.4}) \times 0.15}$$

$$PM_{(2.5)} = \frac{2.6\,(s)^{1.2}}{(m^{1.3}) \times 0.105}$$

The projected particulate emission using the formula above for the proposed Alaoji - Onitsha project site in South East Nigeria is shown as:

TPM = 0.08E +01

$PM_{(10)} = 0.114E + 01$

$PM_{(2.5)} = 0.613E + 01$

4.14.3 Green House Gases (GHG) Emissions

Total emissions of GHGs from project equipment and vehicles were determined using the SCEG tool version 5.1 created by the US Environmental Protection Agency. Mobile sources, like owned or leased cars and heavy-duty vehicles generate emissions by burning fuel. Mileage or fuel use was estimated based on vehicle fuel economy from www.fueleconomy.gov, since other data sources are not readily available as at present.

Fuel usage and mileage is reported the same for hybrid vehicles as for conventional vehicles such as Pickups and Vans are classified as "**Light Trucks**", Trucks (Diesel heavy dump truck, water truck, Diesel heavy mixer truck) weighing more than 8,500 lb are classified as "**Heavy- Duty Trucks**", while Non-highway vehicles (dozers, tractors, excavators, concrete batching plants) used in construction are classified as "Construction Equipment".Table 4.7 presents the details of equipment and vehicles required for the construction of the TL, substation and access roads.

Table 4.7: Details of Estimated quantity and types of Equipment/vehicle Required for the Project

Type of Equipment/Vehicle	Transmission line decommissioning and preconstruction	Transmission line construction
Water truck	2	4
Dozer	4	-
Diesel heavy duty dump truck	5	7
Crane	3	5
Track mounted drilling rig	3	3
Diesel heavy mixer truck	-	5
Tractor	1	1
Diesel light duty truck/vehicles	5	5
Excavator	4	2
Concrete batching plant	-	2
Passenger busses	2	5

4.14.4 Emission Estimation during Decommissioning Phase

The initial decommission phase is expected to last for a period of six months, after which construction shall commence. The total estimated GHG emissions expected to result from decommissioning activities is presented in Table 4.8.

Table 4.8: Details of estimated GHG to be emitted during TL decommissioning

	Transmission line decommissioning						
Equipment Category	**Number**	**Average fuel economy (mileage/g)**	**Fuel usage (gal)**	**Mileage**	**CH_4 (kg)**	**N_20 (kg)**	**CO_2 (kg)**
Diesel Construction Equip.	19	17.3	1,699	29,399	968.6	441.8	31,643
Diesel Light-Duty Trucks	5	7.3	755	5,658	5.7	8.5	
Diesel Medium- and Heavy-Duty Vehicles	5	7.3	310	2,263	11.5	10.9	
Diesel Passenger Cars	2	23.9	315	7524	3.8	7.5	
Total	31		3,079	44,844	989.6	468.7	31,643

In all, a total of 31,643kg of $CO_2$is estimated to be emitted in as a result of decommissioning the existing TL. This also includes 989.6kg of methane and 468.7 kg of nitrous oxide. This is approximately 196.0 metric tons of CO_2equivalence. Diesel construction equipment shall be the major sources of these criteria pollutants as established in the result.

4.14.5 Emission Estimation during Construction Phase

The total estimated GHG emissions expected to result from construction activities is presented in Table 4.9.

Table 4.9: Details of estimated GHG to be emitted during TL construction

	Transmission line construction						
Equipment Category	**Number**	**Average fuel economy (mileage/g)**	**Fuel usage (gal)**	**Mileage**	**CH_4 (kg)**	**N_20 (kg)**	**CO_2 (kg)**
Diesel Construction Equip.	15	17.3	343	5,940	195.7	89.3	24,913.5
Diesel Light-Duty Trucks	7	7.3	775	5,658	5.7	8.5	
Diesel Medium- and Heavy-Duty Vehicles	5	7.3	1,085	7,921	40.4	38	
Diesel Passenger Cars	5	23.9	237	5,658	2.8	5.7	
Total	32		2,440	25,177	244.6	141.5	24,913.5

A total of 24,913.5kg, 244.6 kg and 141.5 kg of CO_2, CH_4 and N_20 respectively are estimated to be emitted during the TL construction. This is approximately 73.2 metric tons CO_2 equivalence. Diesel Medium- and Heavy-Duty Vehicles shall be the major sources of these criteria pollutants as presented in the result.

4.15 Energy Consumption (Demand Component) Among PAPS in Alaoji – Onitsha TL

The average energy consumption data for households, artisanal operations, government offices, banks, schools (tertiary and pre tertiary), hospitals and industries revealed information presented in Table 4.10. The data took into cognizance all activities requiring energy consumption in the area. Data were obtained from ground trotting activities during field survey and from the Nigerian Bureau of Statistic, Annual Report of Statistics 2012. The data base is a living document that would be updated as events becomes actions. The EPA Household GHG emission and reduction tool was used in estimating the amount of CO_2 emitted yearly by different activities in the project area. Using this tool, it is assumed the average monthly consumption of 5,500 cubic feet of gas, or average annual consumption of 66 thousand cubic feet per household, if the average household size is 3.8 (http://www.eia.gov/consumption/residential/data/2009/index.cfm?view=consumption). On obtaining the figure, extrapolations were made using an average household composition of the three project States.

Table 4.10: Energy consumption rates, activities and consequence annual CO_2 emiited in the affected LGAs in both States

Activity		Unit	Average Litre of Fuel per day	Average Litre of Diesel per day	Average fuel and diesel consumption Per month (litre)	Estimated CO_2 emitted per year (kg)	Estimated CH_4 emitted per year (kg)	Estimated N_2O emitted per year (kg)
Household lightening	Abia	670	2	0.5	41,205	947,963,755.9	29,646,523	14,041,355.5
	Anambra	690			42,435	976,261,221.3	30,531,495.3	14,460,501
	Imo	1300			79,950	1,839,332,711.2	57,523,106.3	27,244,421.9
Artisanal operations and non-governmental offices	Abia	211	5	2	44,310	1,019,397,541.9	31,880,536	15,099,441.5
	Anambra	141			29,610	681,208,788.3	21,304,055	10,090,148.2
	Imo	224			47,040	1,082,203,998.6	33,844,739	16,029,738.5
Government offices	Abia	13	-	10	3,900	89,723,546.9	2,806,005.2	1,328,996.2
	Anambra	12			3,600	82,821,735.4	2,590,158.6	1,226,765.7
	Imo	21			6,300	144,938,037.2	4,532,777.6	2,146,840
Banks	Abia	9	-	20	5,400	124,232.56	3,885.24	1,840.15
	Anambra	6			3,600	82,821.858	2,590.2	1,226.77
	Imo	7			4,200	96,625.274	3,021.85	1,431.23
Schools (Pre-tertiary	Abia	463	5	3	111,120	2,556,430.9	79,949.6	37,866.2
	Anambra	501			120,240	2,766,246.1	86,511.3	40,974
	Imo	728			174,720	4,019,614.8	125,709	59,539

and tertiary)								
Hospitals	Abia	21		10	10,710	246,394,663.4	7,705,722	3,649,628
	Anambra	28			14,280	328,526,217.6	10,274,295.9	4,866,170.7
	Imo	37			18,870	434,123,930.8	13,576,748.2	6,430,297
Industries	Abia	73	5	10	32,850	755,748.4	23,635.2	11,194.2
	Anambra	52			23,400	538,341.4	16,836	7,973.98
	Imo	84			37,800	869,628.4	27,196.7	12,881
Total for 2.57 household						7,884,705,838.19	246,585,497.19	116,789,230.73
Total for 3.8 (combined average household size for Abia, Anambra and Imo)						**11,658,319,916.4**	**364,601,124.2**	**172,684,465.7**

The estimated annual emissions of CO_2, CH_4 and N_2O emitted as a result of energy consumption within the project's area of influence is about 11,658,319,916.4kg, 364,601,124.2 kg and 172,684,465.7 kg respectively. This is approximately 75,940,746.9 of CO_2 equivalence in metric tons.

4.15.1 Emission Estimation from Fuel Wood Consumption in the Project Area

The total amount emitted in the project area from household fuel wood consumption for cooking is presented in Table 4.11. Data for the assessment was obtained from Nigerian National Bureau of Statistics, Annual Abstract of Statistics Report of 2011. Assumptions for the estimation of the total CO_2 emitted were based on Arno Frühwald, University of Hamburg report on ***Wood and Climate Change*,** 2018. It was assumed that wood is composed of up to 50 per cent carbon. One cubic metre of wood weighs 500 kilograms on average, which means it contains about 250 kilograms of carbon. When carbon is transformed into carbon dioxide (oxidised), 1 kg of carbon creates about 3.67 kg of CO_2. Therefore 250 kg of carbon creates 917 kg of CO_2, which is about 1 tonne of CO_2 per cubic metre of wood (Table 4.11).

Table 4.11: Details on CO_2 Emissions in the project area from household fuel wood consumption for cooking

State	Number of Affected LGAs	Number of Households in LGAs	Percentage number of households that consume fuel wood, 2010	Number of households that consume fuel wood	Per Household fuel wood consumption (kg/year)	Total amount of fuel wood (kg/year)	Total amount of CO_2 (kg/year)	Total of CO_2amount in MT/yr
Abia	4	224,256	72.6	162,809.9	624	101,592,816	186,321,224.5	18,6321.22
Anambra	4	173,425	54	93,649.5	598	56,002,401	102,708,403.4	102,708.40
Imo	8	398,058	84	334,368.72	566.8	189,520,190.5	347,580,029.4	347,580.03
Total	16	795,739		590,828.12	1,788	157,784,927.5	636,609,657.3	636,609.66

As could be seen in Tables 4.11 and 4.12, an estimated annual total of 636,609,657.3kg and 636,609.66 MTof CO_2 is emitted on an annual basis in the project area.

Table 4.13 outlines gross total of carbon footprint resulting from the proposed project and that generated by activities and persons in the project area. The total is expressed in terms of MT CO_2 equivalence.

Table 4.12: Total MTCO$_2$ Equivalence

GHG supply Component		**GHG Demand Component**	
Project Phases	**MTCO$_2$ Equivalence**	**Activities by PAPs**	**MTCO$_2$ Equivalence**
Initial Decommissioning	196.06	Energy consumption rate	636,609.66
Construction	73.20	Fuel wood for cooking	75,940,746.9

	269.25		76,577,356.56
Total **GHG Footprint**	**76,577,625.81**		
Project predicted to reduce GHG emisions by 7.5 % in the project area	7.5 x 76,577,625.81/100		5,743,321.94
Net **MTCO$_2$ Equivalence**	**70,834,303.87**		

When the project is completed and power being distributed to the various household, businesses and organizations in the project area, the energy consumption rate is expected to drop by 7.5% resulting in GHG foot print reduction of about **5,743,321.93** MTCO$_2$e for the project life cycle resulting in a negative net GHG emission of 70,834,303.87 MTCO$_2$e. The project would add an estimated 269.2516 metric Tonnes of CO$_2$ and its equivalence (N$_2$0 and CH$_4$) to the environment reduce **5,743,321.93** MTCO$_2$e while a total of 70,834,303.87573 MTCO$_2$e shall still be emitted yearly in the project area.

4.15.2 Treatment and Waste Disposal Methods

4.15.2.1 Solid Waste (Degradable)

The minimal biodegradable wastes and cut down shrubs can be left at safe locations along the ROW for use as fuel woods by locals.

4.15.2.2 Solid Waste (Non-Degradable)

Scrap metals and drums will be sold to recyclers; topsoils will be sold to quarries as backfilling materials while tins, glasses and plastics and other non biodegradable wastes shall be safely collected and taken to the government authorized dumpsites within the city.

4.15.2.3 Faecal Waste

A soak away system shall be installed in all the substations and when full, faecal waste shall be disposed of properly by relevant waste disposal agents. Line route workers shall be intimated on safe disposal of faecal waste during work. Adequate toilets that will be evacuated by approved disposal vendors shall be provided at worksites.

4.15.2.4 Liquid Wastes

Liquid wastes such as sewage and other effluents shall be pre-treated in septic tanks. Also, adhered spent oils from transformers are drained out before delivery to authorized dump sites.

4.16 Project Schedule

The different stages of the project implementation are contained in the work schedule attached hereunder Table 4.14.

Table 4.13: Project Schedule for the Alaoji - Onitsha Transmission Line

S/N	Description	Duration (months)	1st Qtr. 2019	2nd Qtr. 2019	3rd Qtr. 2019	1stQtr 2020	2ndQtr 2020	3rdQtr 2020	1st Qtr. 2021	2ndQtr 2021	3rdQtr 2021	1s Qtr. 2022	2ndQtr 2022	3rdQtr 2022
1	Feasibilitystudies	12												
2	Line route studies	4												
3	EIA studies	9												
4	RAP studies	9												
5	Front End Engineering Design	12												
6	EPC ContractawardProcess	6												
7	Mobilization	2												
8	Check survey of EPC Contractors	1												
9	Transmission Line detailed design	2												
10	Material production (tower, conductors, insulators, line hard wares)	7												
11	Materialtesting	4												
12	Materialshipment	2												

13	Clearing and grub site along transmission line corridor	1												
14	Access road widening and Decommissioning (removal of existing towers and TL)	1												
15	Foundations for tower installation	4												
16	Tower erection	8												
17	Conductorstringing	6												
18	Commissioning and testing	1												
19	Reinstallation and clean up	1												
20	Demobilization from site	0.5												
21	Commissioning	1 day												

4.17 Decommissioning

The project has a life span of 50 years. Decommissioning activities will be implemented in compliance with applicable regulations. The activities that would be involved during the decommissioning include the following:

- Decommissioning and site-clean – up
- Disposal of waste generated
- Site review and reclamation.

Decommissioning generally entails resolving all grievances issues that will have arisen among workers, communities, etc. during the course of the project implementation, and returning the environment (reclamation) to near its original status as much as possible. *The aim of proper decommissioning is to, among other things, ensure continuation with subsequent developments and reduce hinderances to future and subsequent developments as much as possible.*

CHAPTER FIVE
PROJECT AREA OF INFLUENCE

5.1 General Considerations

Project Area of Influence (AoI) is the geographic area likely to be affected by the project as well as unplanned developments induced by the project. Determining the AoI therefore requires informed but subjective judgment, based on available information and the knowledge of previous and similar project impacts, combined with practical findings.

The ESIA Regulations require the definition of an Area of Direct Influence (ADI) and an Area of Indirect Influence (AII).

5.2 Area of Direct Influence (ADI)

The Project's ADI is made up of two components:

- The footprint area, i.e., the area occupied by the Project's infrastructure; and
- The area where direct impacts from the construction and operational activities will be felt.

The footprint includes the area occupied by the transmission tower, the substations and the RoW. In the construction phase, the footprint also includes ancillary infrastructure such as temporary access roads and construction camp sites. It is expected that these ancillary infrastructures will be located in the immediate vicinity of the Project site. Within the footprint area, several activities will be implemented such as soil stripping, vegetation clearing, earth movements, etc., but they will be contained to their footprint.

The Project's direct impacts outside of the footprint area include the biophysical and socioeconomic impacts. Therefore, the Project's ADI is delineated as follows:

- **Biophysical environment**: it is expected that all direct biophysical impacts resulting from Project construction and operation will be limited within a corridor centered in the TL alignment, with maximum width of 1 km (500metres on either side of the TL RoW). It is 1.5km^2 base radius for each sub stations. These widths account for a wider construction corridor, which will likely be required to establish temporary accesses, machinery movement, etc.
- **Socioeconomic environment**: Direct socioeconomic impacts are expected to be felt mostly by the villages and communities crossed, or near, the alignment. The socioeconomic ADI is illustrated using a 2km wide corridor cantered on the line's route and epicentre of the substation.

Direct impacts are also to be expected in the areas where the auxiliary construction and reconstruction facilities will be located (construction camps, temporary accesses, burrow pits).

5.3 Area of Indirect Influence (AII)

The Project's AII is the geographic area where indirect impacts are likely to be felt, or in other words, where secondary impacts resulting from direct ones are felt.

In terms of the biophysical environment, few or no indirect impacts are expected outside of the ADI. Other socioeconomic indirect impacts will likely be felt, namely associated with creation of job opportunities, mobilization of workforce, development of informal commercial activities, etc. These indirect impacts are likely to be experienced mostly in the areas closer to the TL alignment

As such, the Project's AII is defined as follows:

- **Biophysical environment**: a 1 km wide corridor, centered RoW;
- **Socioeconomic environment**: the boundaries of the districts crossed by the TL, as benefits and impacts from Project-induced changes in the ADI are likely to extend to other communities within these territories.

Figure 5.1 is a map showing the project Area of Influence within the biophysical and socio-economic components of the Transmission line.

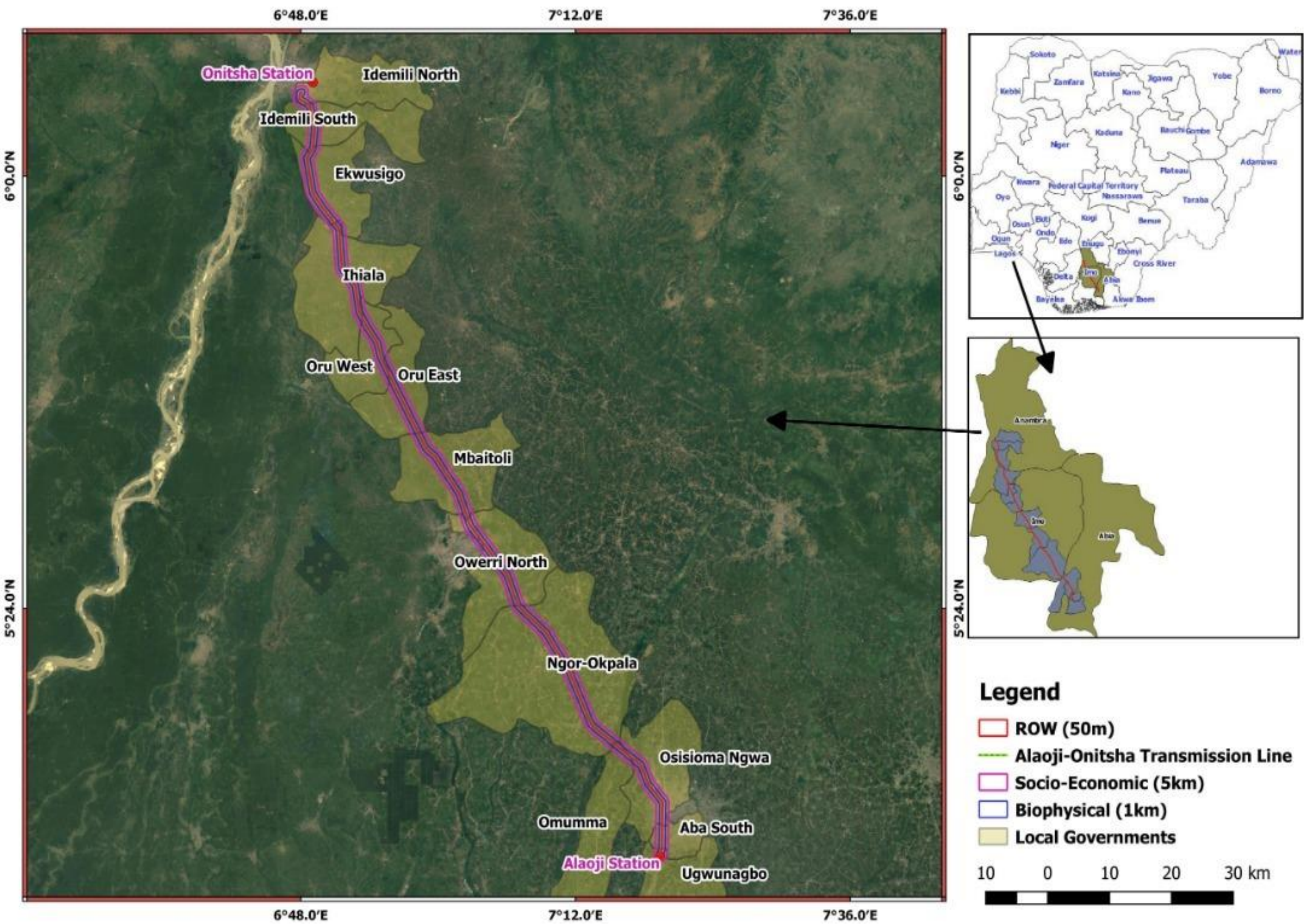


Figure 5.1: Map of the Project Area Showing the Area of Influence

CHAPTER SIX

DESCRIPTION OF THE ENVIRONMENT AND SOCIAL BASELINE

6.1 Identification of the Study Area

The project areas are located in the southernregion of Nigeria which generally falls in the tropical rainforest climate. It cut across Abia, Anambra and Imo states respectively. The project is anticipated to expand and link the already existing substation in Alaoji with that of Onitsha. In order to fully characterize the baseline conditions, the line route and the substation needed be studied. This is so because the environmental and social impacts of the line route differ from that of the substation. A spatial boundary of 50 metres on both sides of the proposed line route and 1km base radius for the substation was established. This is in consonant with the regulatory requirements for linear project in Nigeria. Figure 6.1 is a map showing the location of the line route.

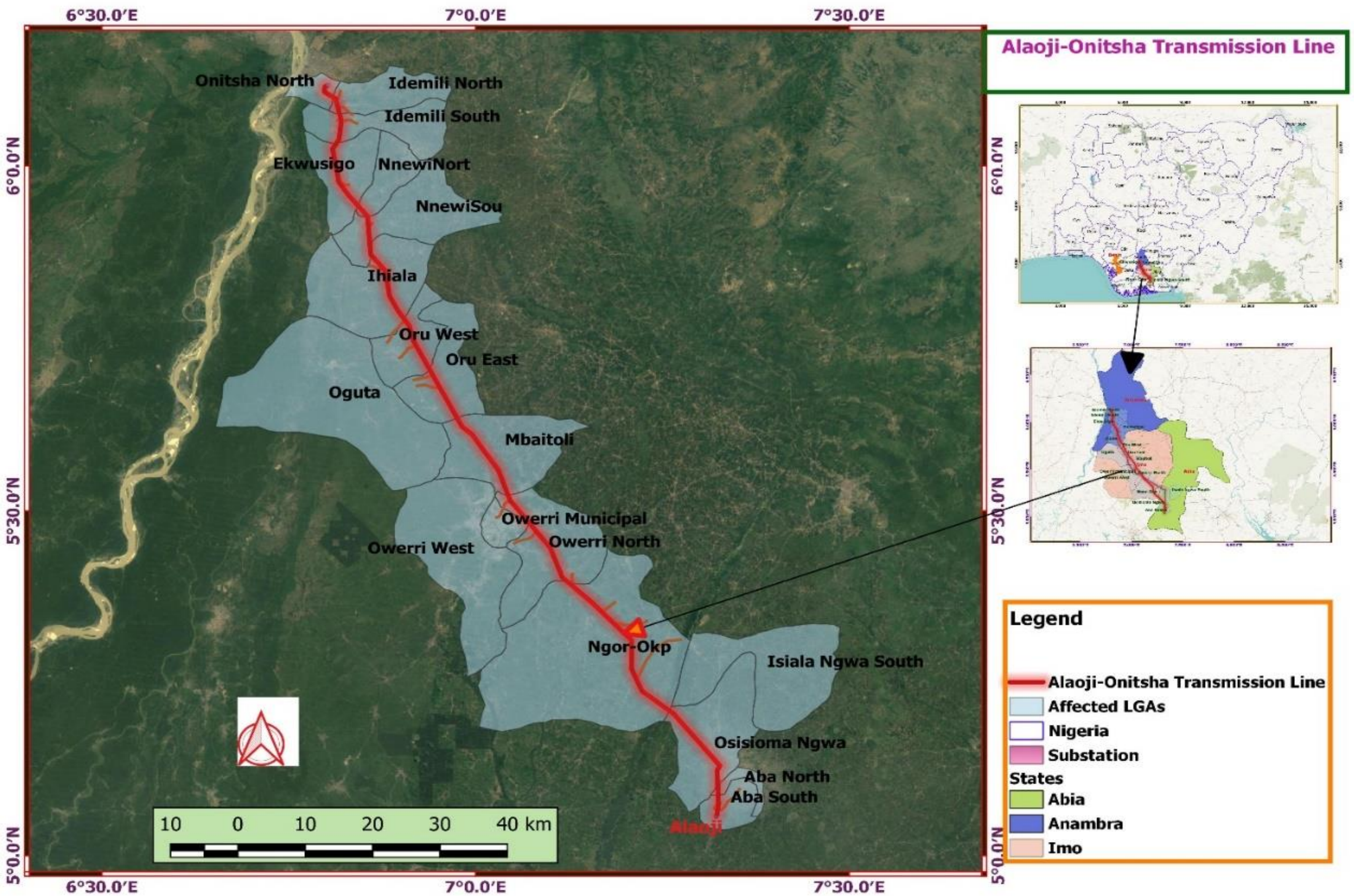


Figure 6.1: Location of the Proposed Line Route

6.1.1 Overall Data Collection Methodology

The summary of baseline conditions is based on the one season data collected from field, supplemented by the secondary data from approved ESIA Report on the Ukanafun – Oma Power Plant Fas Pipeline Project 2016 (dry season data) of Abia and Akwa Ibom States, including literatures. The data acquired will be used in further environmental management decisions and future monitoring of changes, if any, in the environmental and social components.

A combination of data from existing literature and field sampling campaign was used to inform the preparation of the baseline chapters for various environmental and social components. In accordance with the approved TOR by the FMEnv and EMSF document for this project. The data was collected as follows:

Baseline data for the dry season was collected from existing literature, notably the approved ESIA of Ukanafun – Oma Power Plant Gas Pipeline Project 2016. Wet season baseline data for this project was collected between 26th August and 2nd September 2019. A summary of the available data for the wet and dry season used in the preparation of the baseline chapter of this ESIA is presented in Table 6.1.

Table 6.1: Summary of Data Collected for the ESIA of Ukanafun

	Ukanafun – Oma Power Plant Gas Pipeline Project 2016	Wet Season (based on data collected between 26th August and 2nd September 2019)		
Environmental/Social Component		Samples requested by FMEnv	Actual No collected	Comments
Climate and meteorology	10	20	20	Only twenty of the forty samples collected were analyzed as specified by the FMEnv.
Air quality and noise levels	10	20	20	Air and noise quality samples points were same as for soil and meteorology

Soil	15	40	20	Topsoil and subsoil samples were collected at each point
Groundwater	4	6	3	Three samples were collected at each sub station
Surface water	11	10	10	Samples were collected at 10 points, including a control point

Field studies and data collection for characterization of the baseline conditions of the proposed project environment, in line with the approved TOR by the FMEnvcovered:

- Climate and meteorology
- Air quality and Ambient noise levels
- Geology/hydrogeology
- Surface and groundwater
- Soil
- Sediment
- Vegetation & fauna wildlife
- Hydrobiology, fisheries and
- Socio economics/health impact, demography and community characteristics.

The acquisition of data involved field data gathering, measurements and the collection of representative samples used to establish the environmental conditions of the study area. This exercise involved a multi-disciplinary approach and was executed within the framework of a QHSE management system approach. This approach assured that the required data and samples were collected in accordance with agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel. Elements of this approach include:

- review of existing reports that contain environmental information on the study area;
- designing and development of field sampling strategies to meet work scope and regulatory requirements;

- pre-mobilization activities (assembling of field team, sampling equipment/materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);

mobilization to field; fieldwork implementation –representative samples collection (including positioning and field observations), handling, documentation and storage protocols and procedures; anddemobilization from field; transfer of sample custody to the laboratory for analyses.

Quality Assurance/Control

The following are the Quality Assurance and Quality Control undertaken to guarantee the intergrity of the data and analytical results

- Only adequately trained personnel were used for the laboratory analysis.
- The personnel were briefed on the scope of work.
- Complete adherence to written analytical work instructions available to staff involved in project execution were maintained and verified.
- Routine auditing and checking of results at every stage of analysis were implemented. Quality control solutions and mid-point standards were also introduced in every batch of samples or every set of ten samples. Analyses for which deviation of these quality control / mid-point standards which were outside 90 to 110% of expected concentration ranges were repeated.
- Equipment were adequately calibrated prior to use and checked by the supervising officer.
- Sediments were not dried before extraction takes place.
- Solvent used were those of the lowest possible boiling points. When evaporations were necessary, solvents were reduced or removed with great care at temperatures no higher than 30°C.
- Analysis schedule indicating analysts assigned to carry out various tests were drawn up. During benthic analysis, internal standards shall be added before extraction takes place.
- Analytical errors were controlled by duplicate analysis at pre-determined intervals, sample spiking, etc.

Materials that were consulted included approved reports on previous environmental surveys in the area, publications, textbooks, articles, maps, etc. on the area and similar environments. The list of materials consulted is specified in relevant sections.

6.2 Physical Environment

6.2.1 Climate

The region has a tropical climate with humidity and rainfall decreasing from the coast inland and characterized by uniformly high temperature and a seasonal distribution of bimodal rainfall (Anyadike, 2002). The mean minimum and maximum temperatures ranged from 21-30°C in the coast and 29-33°C in the interior or inlands (Chukwu, 2007). Table 6.2 shows the summary of climatic data for the project area between 1988 and 2018.

Table 6.2: Climatic data of Abia, Anambra and Imo States

Months	Abia State					Anambra State					Imo State				
	Temp (^{O}C)	Rainfall (mm)	Relative Humidity (%)	Wind speed (km/h)	Sunshine (hr)	Temp. (^{O}C)	Rainfall (mm)	Relative Humidity (%)	Wind speed (km/h)	Sunshine (hr)	Temp. (^{O}C)	Rainfall (mm)	Relative Humidity (%)	Wind speed (km/h)	Sunshine (hr)
Jan	27.1	25	44	5.9	308.5	25.7	8	32	5.9	310	26.7	17	60	5.2	290.5
Feb	28	47	61	6.3	221.5	27.2	17	57	8.2	249	27.5	37	54	7.9	275.2
Mar	28.4	114	68	6.6	230	28.1	53	67	9.4	220.2m	27.9	98	69	8.7	278.5
Apr	28	175	73	6.3	223	28	106	71	9.1	248	27.6	166	75	8.1	262.2
May	27.4	252	77	6	222.5	26.4	175	75	7.7	234	26.8	225	79	7.4	248.0
Jun	26.6	276	86	5.8	197.5	25	182	84	7.2	208	26	363	84	6.9	205.5
Jul	25.5	328	87	5.3	168.5	24.5	181	87	6.8	179	25.1	313	86	6.8	176.5
Aug	25.4	274	85	6.8	157	24.2	175	87	7.7	186	25	339	90	7.9	141.5
Sep	25.9	325	87	5.4	166.5	24.5	276	87	6.1	184.5	25.5	322	88	6.2	179.5
Oct	26.3	276	82	5.1	160	25.1	174	79	6.2	172.5	25.9	269	85	6.4	226.5
Nov	26.9	85	73	4.7	210	26	27	67	5.5	234.5	26.7	52	75	5.9	257.0
Dec	27.1	16	52	5.3	299.5	25.6	9	35	6.1	298	26.6	18	59	5.6	289.0

Source: NIMET, 1988 - 2018

6.2.2 Meteorology (Micro-Climatic Conditions)

The prevailing micro climatic conditions (temperature, humidity and wind speed) of the study area were measured *in-situ*. Measurement was carried out with the aid of Aeroqualaerocet 531. This equipment was calibrated and held at arm-length towards the direction of the prevailing wind. The value of the climatic elements was read off screen and data documented. The sampling locations for noise and air were same for air quality. The results of the meteorological conditions of the study and proposed project area are presented in Table 6.3.

Table 6.3: Result of On-Site Meteorological Measurement

SAMPLING PARAMETER	Wind speed (m/s)	Wind Direction	TEMP. (^{0}C)	RH (%)
Alaoji-Ihiala				
Mean	5.3	North-east	26.7	65.9
Min.	3.8	North-east	24.5	64.9
Max.	5.9	North-east	28.9	66.9
Ihiala-Onitsha				
Mean	5.3	North-east	27.2	65.6
Min.	4.4	North-east	25.9	64.1
Max.	6.0	North-east	27.9	67.6
Secondary data (mean)	5.5	North-east	27.8	57.2

Source: GNL Survey, 2019

All microclimatic data obtained in the field conformed favourably with secondary data (Ukanafun – Oma Power Plant Gas Pipeline Project, 2016). Expectedly, during construction and operation phases, as ambient temperature increases, the outstretched conductor length is expected to increase, resulting in sag increase and decrease in conductor tension. This phenomenon was factored in the environmental design conditions of the proposed project and also for proffering the mitigation measures outlined in chapter seven.

The linear relationship shown between wind speed and elevated levels of tension in conductors during power transmission is a causal factor in power failure (Orawski Eurlng, 2013). However, wind, speed levels in the area is minimum and risk of power failure through this factor is low.

6.2.3 Topography

Altitudes influence electricity transmission lines due to its impact on the dielectric behavior of air-insulated systems. As a result, atmospheric and voltage correction factors must be applied in air-insulated transmission systems operating in high-altitude conditions. Figure 6.2 shows the topography of Nigeria in relation to the project area. Nigeria is characterized by four elevation regions (Adelana, et al 2008). This results from the merging of the River Niger and Benue. The lowland topographic regions found mainly in the south have elevations ranging between 0-200m. The coastal plains are found in both the southwest and the southeast, mostly covered by swamp and mangrove forests, merging into highly degraded forest inland. To the southwest of the Niger valley lays a rugged landscape defy by the Western Plains (WP) interspersed with the Western Highlands (WHL). The heavily populated Jos Plateau with its semi-temperate climate, Nigeria's largest area above 1,000-m elevation, rises prominently from the riverine plains.

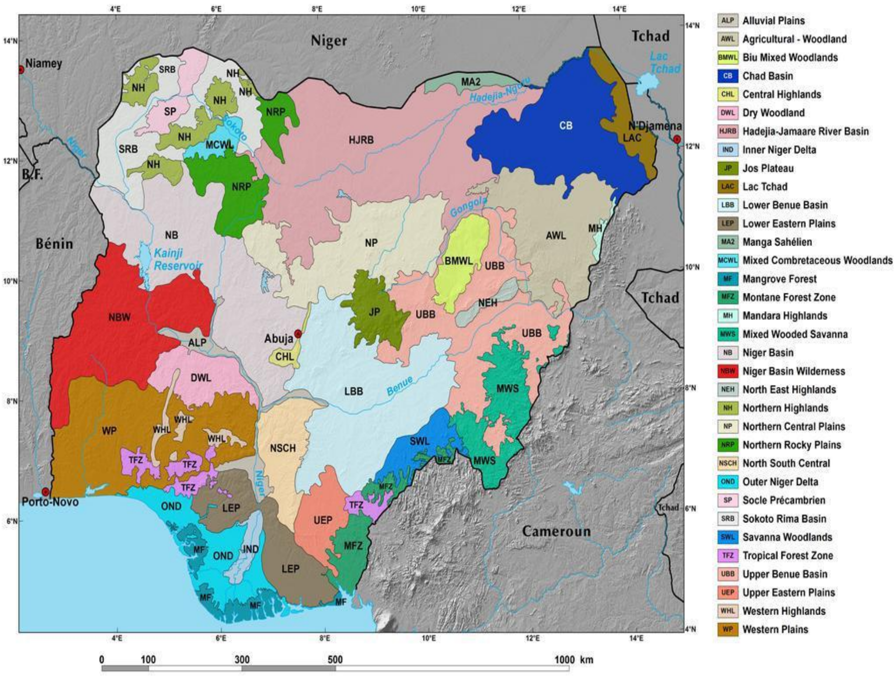


Figure 6.2: Map showing topography of Nigeria and the project area

Source: Adelana et al 2008

Topography of the project area

The elevation of the project area as provided ranged from 51.014m to 62.472 m. Figure 6.3 illustrates this information.

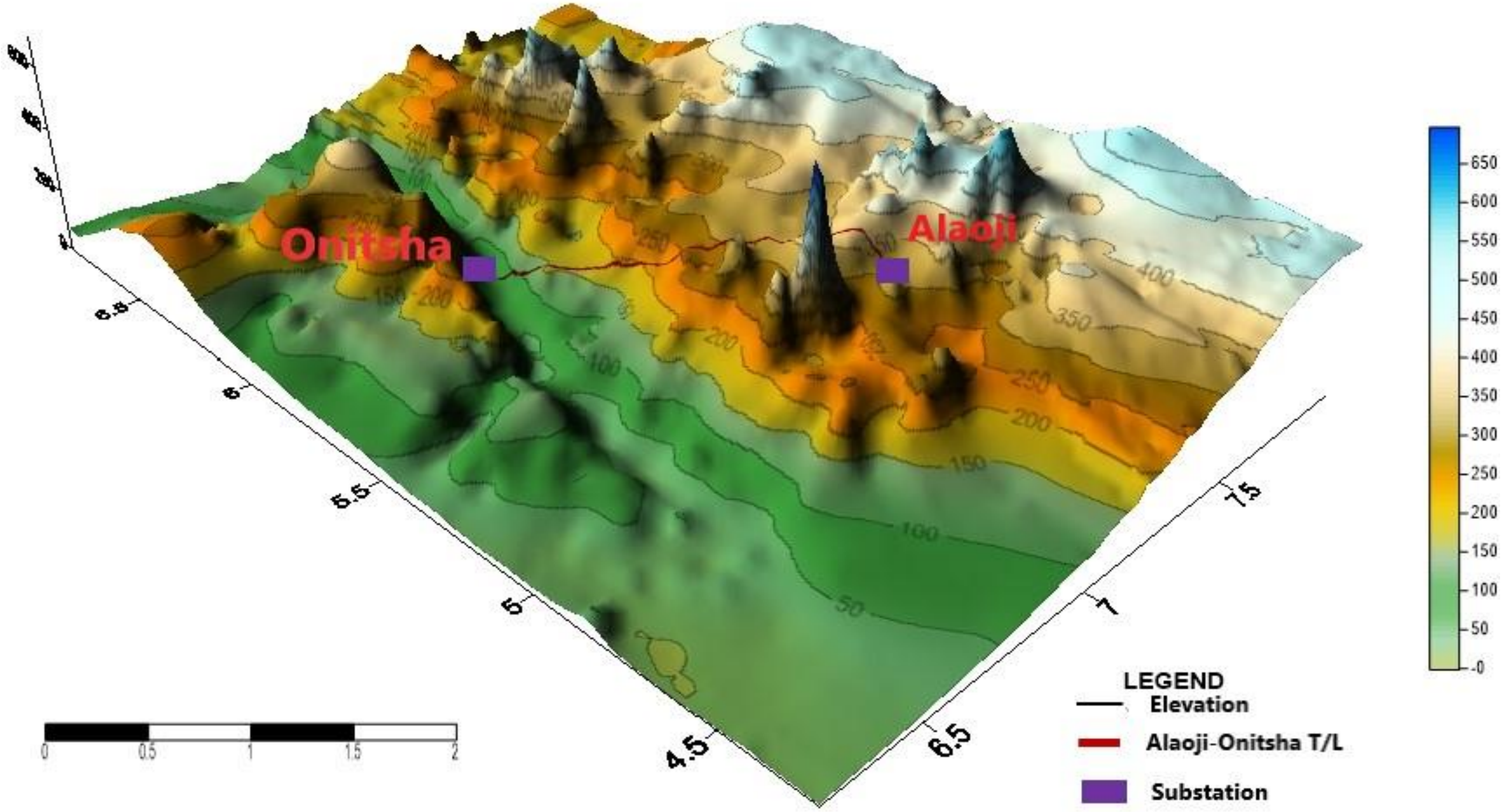


Figure 6.3: Topographic Map of the Project Area in 3D

6.2.4 Ambient Air Quality

6.2.4.1 Sources of Air Pollution

Air pollution is the presence in the atmosphere of one or more contaminants in such quantities, characteristics, duration as to make them actually or potentially injurious to human, plant, or animal life or to property, or which unreasonably interfere with the comfortable enjoyment of life and property.

The air quality in the study area can be influenced from both natural and anthropogenic sources. Possible anthropogenic activities that influence air quality in the study area majorly include:

- Fuel combustion from vehicular movements
- Household energy consumption
- Municipal and agricultural waste sites and waste incineration/burning
- Indiscriminate bush burning

6.2.4.2 Air Quality Measurement

Atmospheric gases were measured with the aid of Universal Gas Analyser MX6. This equipment was calibrated and held at arm-length towards the direction of the prevailing wind. The value of the atmospheric concentrations of each gaseous pollutant was read off directly on the equipment screen and data documented.

Measurements were conducted between 07:00 and 19:00hrs Nigerian time, for air measurements. Specific locations for measurements were selected with consideration for concentrations of human receptors such as residential areas, commercial areas, hospitals, churches schools and farmlands. The co-ordinates of the sampled locations for air quality, noise and soil quality are presented in Table 6.4 and sampling map in Figure 6.4.

Table 6.4: List of Air and Noise Quality Equipment Used in the Study

Parameter	Equipment	Detection Limit
Total Suspended Matter	Casella Cel Micro Dust Pro 880nm	0.001
Hydrogen sulphide	Gas Alert Extreme (BW Technologies) Model GAXT-H-DL	0.001
Carbon monoxide	Gas Alert Extreme (BW Technologies) Model GAXT-M-DL	0.001
Sulphur oxides	Gas Alert Extreme (BW Technologies) Model GAXT-S-DL	0.001

Ammonia	Gas Alert Extreme (BW Technologies) Model GAXT-A-DL	0.001
Nitric Oxide	Toxi RAE II PGM -1140	0.001
Nitrogen iv oxide	Gas Alert Extreme (BW Technologies) Model GAXT-N-DL	0.001
Carbon iv oxide	Alnor CF910	0.001
Total Hydrocarbon (THC)	Crowcon MultiGas indicator	0.001
Noise Level	Pulasa Sound Meter Model 14	10.0
Meteorology	Aeroqualaerocet series 531	0.1
Chlorine (Cl_2)	Cl_2 Crowcon Gasman S/N: 19812H	0.001
Hydrogen Cyanide (HCN)	HCN Crowcon Gasman S/N: 19773H	0.001

Source: GNL survey, 2019

Ambient air quality measurements were carried out on site using *in - situ* digital meters (Plate 6.1) at 20 locations (Figure 6.5).

Plate 6.1: Air quality Equipment (Casella Cel Micro Dust Pro 880nm)

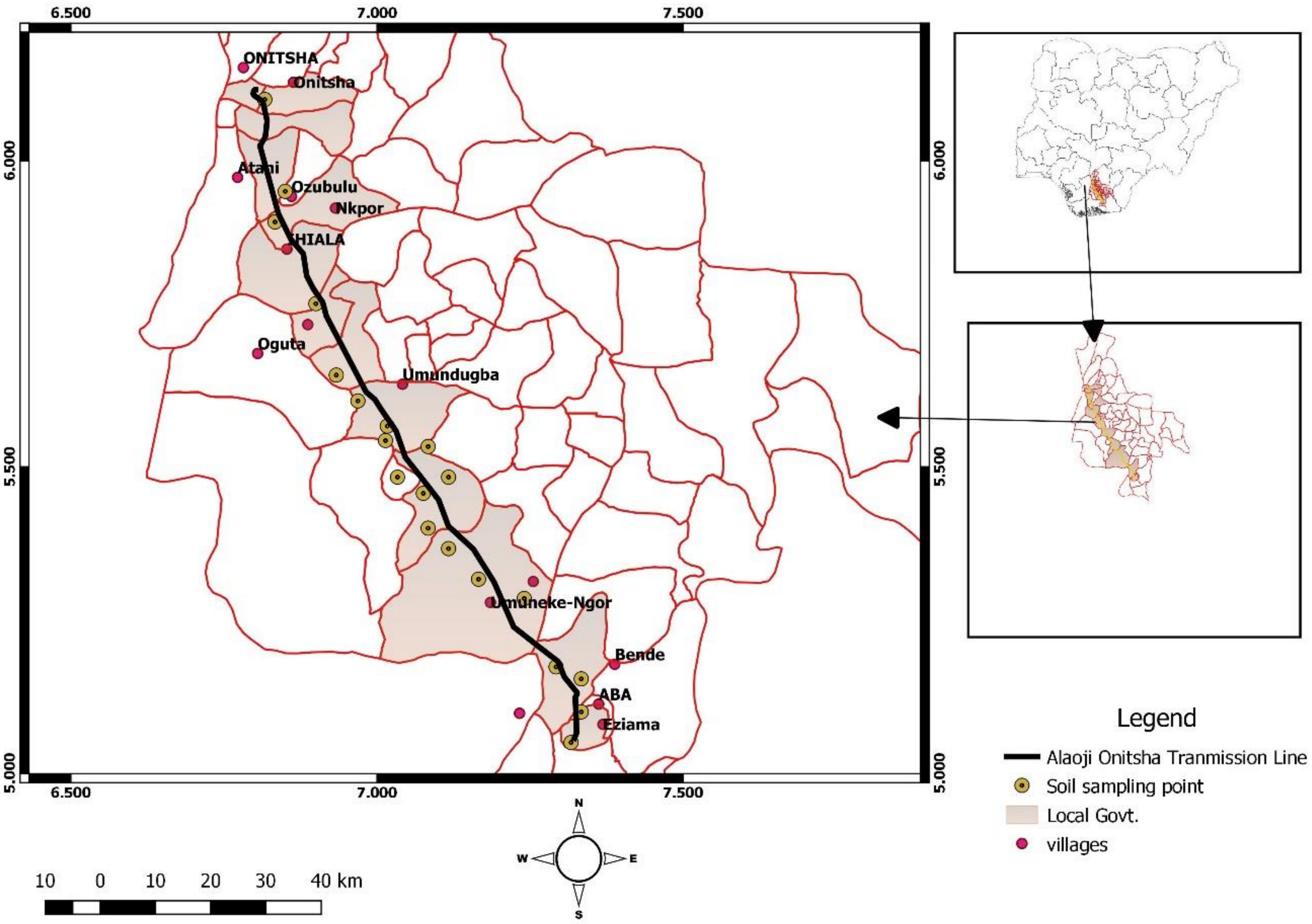


Figure 6.4: Map Showing Air Quality /Noise/Soil Sampling Locations

Measurements were conducted between 09:00 and 17:00hrs Nigerian time, for air measurements. Specific locations for measurements were selected with consideration for concentrations of human receptors such as residential areas, commercial areas, hospitals, churches schools and farmlands. Table 6.5 shows sampling locations and coordinates.

Table 6.5: Air Quality /Noise Sampling Locations

CODE	Latitude	Longitude	TIME	Description
AN1	7.333333	5.116667	15:42	Track roads and farmlands
AN2	7.333333	5.100000	17:14	sparsely built up area
AN3	7.333300	5.016667	13:37	Residential
AN4	7.316667	5.050000	11:52	residential area, partially paved road
AN5	7.316667	5.016667	12:30	Residential
AN6	6.816667	6.100000	08:09	Residential
AN7	6.850000	5.950000	10.26	Residential
AN8	6.833333	5.900000	14:53	Farmland
AN9	7.033333	5.483333	18:00	church
AN10	6.933333	5.650000	13:31	Market
AN11	7.083333	5.400000	16:56	Highly built-up area
AN12	7.083333	5.533333	10:20	Farmland
AN13	7.016667	5.566667	10:25	school
AN14	7.066667	5.433333	14:02	Market
AN15	6.900000	5.766667	18:04	church
AN16	7.116667	5.366667	09:19	Residential
AN17	7.116667	5.483333	12:30	Residential
AN18	7.000000	5.500000	09:19	Sparse vegetation
AN19	6.966667	5.566667	07:30	Church
AN20	7.083333	5.350000	11:56	School

Sampling sites were carefully selected to reflect the various ecological environments and land use patterns. Summarized result of the air quality and ambient noise level of the study area is presented as shown in Table 6.6, while Appendix 6.1 contained detailed result. Particular attention was paid to CO_2 and N_2O, being components of Greenhouse Gases (GHG).

Table 6.6: Summarized Air Quality Result

PARAMETERS	ALAOJI – IHIALA			IHIALA - ONITSHA			WHO Limits	FMEnv. Limits	Comments
	MAX.	MIN	MEAN	MAX.	MIN	MEAN			
SO_2 (ppm)	0.09	0.009	0.04	0.08	0.02	0.05	0.002	0.002	Concentrations were generally above WHO and FMEnv detection limit for sampling points within both sections
NO_2 (ppm)	ND	ND	ND	ND	ND	ND	0.04-0.06	0.05	Concentrations measured in all sampling points were below equipment detection limit
CO_2 (ppm)	460.6	391.7	432.2	482.1	414.9	438.7	350-1,000		Concentrations were within WHO threshold value
VOC (ppm)	0.6	0.02	0.3	0.337	0.008	0.276	0.1		Concentrations were generally above WHO and FMEnv detection limit in all sampling stations. Elevated concentrations of VOC in this area is presumably due to fragrance from natural and anthropogenic sources
HCl (ppm)	ND	ND	ND	ND	ND	ND			Concentrations measured in all sampling points were below equipment detection limit
CO (ppm)	11.25	0.38	5.48	10.55	0.72	5.72	10-20		All concentrations were within WHO threshold value for both sections.
H_2S	2.26	1.55	1.95	2.21	1.60	1.89	<10		Concentrations were within WHO threshold value
PM10 (ppm)	0.175	0.03	0.07	0.1	0.01	0.05	0.15-0.25	150	All concentrations were within WHO threshold value for both sections

*ND= Not Detected

6.2.5 Ambient Noise Level and Electromagnetic Fields (EMF)

6.2.5.1 Noise Quality Measurement

Noise is a periodic fluctuation of air pressure causing unwanted sound. Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (SIEP, 1995). The effects of noise on residents generally relate to the annoyance/nuisance caused by the short- and long-term high noise levels. Also, disturbance to wildlife is significant especially during breeding seasons and/or when rare species are present. The rate at which these fluctuations of air pressure occur is the frequency, expressed in hertz (cycles per second). The range of sound pressures encountered is very large and to keep numbers in manageable proportions, noise levels are measured in decibels (dB), which have a logarithmic scale. Most legislations and measurements refer to the ‘A' frequency weighting, dB(A) which covers the range audible to the human ear. A 10dB (A) typically represents a doubling of loudness.

Sound pressure or acoustic pressure is the local pressure deviation from the ambient (average, or equilibrium) atmospheric pressure caused by a sound wave. Sound pressure in air can be measured using a microphone, and in water using a hydrophone. The SI unit for sound pressure p is the Pascal (symbol: Pa). Sound pressure level (SPL) or sound level is a logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level. The commonly used "zero" reference sound pressure in air is 20µPa RMS, which is usually considered the threshold of human hearing (at 1 kHz). Noise levels are usually altered during installation and servicing of the transmission line. The regulatory limit for noise provided by the FMENV. is specific to the workplace (90dB (A). However, noise due to construction and installation of the transmission line and associated facilities are expected to rise. The IFC, WHO and FMEnv.limitsshall be used to benchmark the ambient noise levels measured in the project area. The WHO guideline for community noise is in Chapter 2.

Noise measurements were conducted in accordance with IFC 2012 standard. The document implies measurement of noise with respect to the various micro-habitats present in a given area. In this study the micro-habitats present are houses, farmlands, religious grounds and hospitals. The ambient noise level was measured in different stations (selection criteria was earlier explained) with the aid of a hand-held Pulsar Sound Level Meter about 1.9 m high during the day and night. Night measurements were imperative since trucks are also expected to move at night-time. This meter has a Liquid Crystal Detector (LCD) where readings are displayed for observation. The noise level was read off from the LCD after about 2 to 3 minutes of display. It is expected that the measured ambient noise levels and the regulatory guidelines will be the standards against which noise will be assessed during the course of constructing the transmission line.

6.2.5.2 Electromagnetic Fields (EMF)

EMF is a combination of invisible electric and magnetic fields of force. They are generated by natural phenomena like the Earth's magnetic field but also by human activities, mainly through the use of high voltage power lines. Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines.

Exposure to EMF above 0.3 μT to 0.4 μT causes acute health issues such stimulation of peripheral nerves and muscles, shocks and burns; elevated tissue temperatures and childhood leukemia (ICNIRP, 2003).

6.2.5.3 Noise Quality and EMF Result

Table 6.7 shows the summarized result of noise and EMF measurement, while Appendix 6.1 presents detailed result for both noise level and EMF respectively.

Table 6.7: Noise and EMF Measurements in the Study Area

PARAMETERS	ALAOJI – IHIALA			IHIALA- ONITSHA		
	MAX.	MIN.	MEAN	MAX.	MIN.	MEAN
NOISE	65.0	55.7	60.5	67.6	57.8	60.6
LAF (dBA)	71.3	51.8	64.3	75.5	51.0	65.9
LMIN. (dBA)	31.6	23.4	27.6	28.9	22.4	26.4
LMAX. (dBA)	73.0	42.0	61.5	61.0	42.3	54.0
EMF	0.28	0.28	0.28	0.27	0.26	0.26

WHO/FMEnv Regulatory daily limit for Noise	
General Noise Level limit	- 105 db.(A) per hour or 90dB(A) per day for prolonged exposure
School	45 (day) 35 (night)
Hospital	30 for day and Night
Residential	45 for Day and 35 for Nighttime
Farmlands	40 for Day and 45 for Night

* EMF was measured at 50Hz

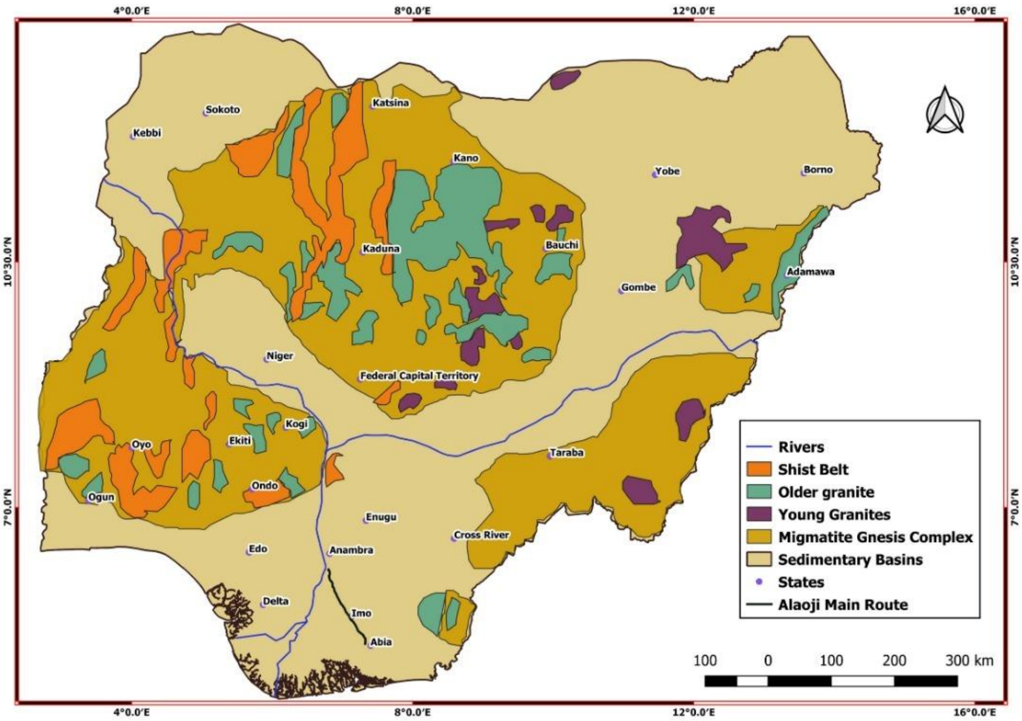
Source: GNL survey, 2019

The results as presented in Table 6.7 indicated an elevated noise level above the daytime threshold stipulated for the various environments (school, hospital, residential and farmlands) for all the sections. However, these results were within the general noise level of short exposure of 105dB (A) or that of prolonged exposure of 90dB (A) and compared favorably well with the obtained secondary data.

6.2.6 Geology and Pedology

6.2.6.1 Geology

Three main rock types form the geology of Nigeria. These are the Precambrian basement with crystalline metamorphic-igneous-volcanic rocks; Mesozoic basement with tertiary sediments, granites/volcanic and The Quaternary alluvial deposits. Figure 6.5 shows the regional geologic map of Nigeria.



Source: Ajibade (1983)

Figure 6.5: Geologic Map of Nigeria Showing the Study Area

Abia State has two principal geological formations in the state namely Bende-Ameki and the Coastal Plain Sands otherwise known as Benin Formation. The Bende-Ameki Formation of Eocene to Oligocene age consists of medium–coarse-grained white sand stones. The late Tertiary-Early Quaternary Benin Formation is the most predominant and completely overlies the Bende Ameki Formation with a southwestward dip. The Formation is about 200m thick. The lithology is unconsolidated fine-medium-coarse-grained cross-bedded sands occasionally pebbly with localized clay and shale. The two principal geological Formations have a comparative groundwater regime. They both have reliable groundwater that can sustain regional borehole production. The Bende-Ameki Formation has less groundwater when compared to the Benin Formation. The numerous lenticular sand bodies within the Bende- Ameki Formation are not extensive and constitute minor aquifer with narrow zones of sub-artesian condition. Specific capacities are in the range of 3 - 6 m^3/hr. On the other hand, the high permeability of Benin Formation, the overlying lateritic earth, and the weathered top of this Formation as well as the underlying clay shale member of Bende-Ameki series provide the hydrogeological condition favouring the aquifer formation in the area.

The Benin Formation of coastal plain sands underlies Imo State. This formation, which is of late Tertiary age, is rather deep, porous, infertile and highly leached. In some areas like Okigwe, impermeable layers of clay occur near the surface, while in other areas, the soil consists of lateritic material under a superficial layer of fine-grained sand. Rivers are few with vast interfluves that are characterized by dry valleys that carry surface drainage in periods of high rainfall. The main streams draining the state are Imo, Otamiri, Njaba and Ulasi rivers, all of which have very few tributaries. With the exception of Imo River, this runs through the area underlain by the Imo Shales, other rivers rise within the coastal plain sands. Generally, river valleys constitute the major physical features, which are often marshy. The undulating nature of the interfluves gives rise to numerous depressions especially in the northeast of the State.

Anambra State lies in the Anambra Basin and has about 6,000 m of sedimentary rocks. The sedimentary rocks comprise ancient Cretaceous deltas, somewhat similar to the Niger Delta, with the Nkporo Shale, the Mamu Formation, the Ajali sandstone and the Nsukka Formation as the main deposits. On the surface the dominant sedimentary rocks are the Imo Shale a sequence of grey shales, occasional clay ironstones and Sandstone beds.

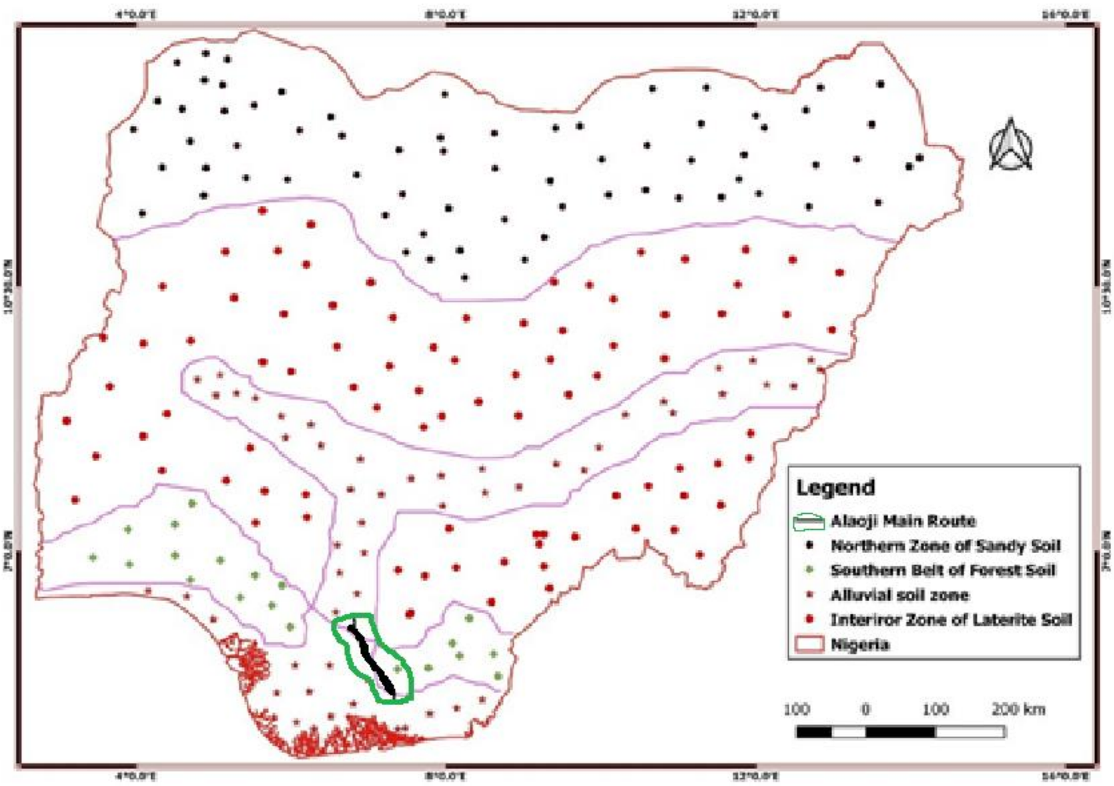
The Imo Shale underlies the eastern part of the state, particularly in Ayamelum, Awka North, and Oruma North LGAs. Next in the geological sequence, is the Ameki Formation, which includes Nanka Sands, laid down in the Eocene. Its rock types are sandstone, calcareous shale, and limestone in thin bands. Outcrops of the sandstone occur at various places on the higher cuesta, such as at Abagana and Nsugbe, where they are quarried for construction purposes. Nanka sands out crop mainly at Nanka and Oko in Orumba North LGA.

Lignite was deposited in the Oligocene to Miocene; and it alternates with gritty clays in places. Outcrops of lignite occur in Onitsha and Nnewi. The latest of the tour geological formations is the Benin Formation or the coastal plain sands deposited from Miocene to pleistocene. The Benin Formation consists of yellow and white sands. The formation underlies much of Ihiala LGA. Thick deposits of alluvium were laid down in the western parts of the state, south and north of Onitsha in the Niger and Anambra river floodplains.

6.2.6.2 Pedology

According to FAO soil taxonomy legends; there are thirteen (13) major soil types in Nigeria, which are all influenced by the climatic and vegetation zones of the country. This is expected because the degree of available moisture in the soil is an important factor in soil reactions, fertility and productivity. In general, the soils of Nigeria are divided into four main groups. These are:

- the ferruginous tropical soils on crystalline acid rocks which occupy about two-fifth of the area to the south, south-west and south-east;
- the brown soils and latosols of the northern half;
- the brown and reddish-brown soils in the north eastern corner; and
- the juvenile and hydromorphic soils which occur along the alluvial channel complexes. The soils largely reflect the influence of parent materials. Intensive use of the soils and the addition of manure and chemical fertilizers have altered their character, profile, texture, structure and chemical characteristics. Soil types in Nigeria are shown in Figure 6.6.



Source: Agriculture Nigeria, ND, 2006

Figure 6.6: Soil Zones and Types in Nigeria in Relation to the Project Location

Soil of the project area is characterized by the following features:

- Dark reddish brown to red
- Soil texture ranged from loamy sand to sandy clay loam soils
- Clay content ranged from 70 – 290gkg-1 and increased with depth
- Silt vary irregularly with depth from 50 – 90
- Fine sand also varies irregularly from 300 – 390gkg-1 and
- Coarse sand irregularly with depth from 290 – 450gkg-1 soil.
- The total sand (gkg-1) generally decreased with depth ranging from 640 – 840gkg-1.

Source: Agriculture Nigeria, ND, 2006

6.2.6.3 Assessment of Soil Quality

This soil is a very important component of the environment. Several activities of the transmission line project shall negatively impact the soil. These include; Potential erosion from vegetal clearing and creation of foundations for tower; soil pollution and contamination from accidental oil & fuel leak from construction machineries and vehicles for transport of construction materials equipment. More so, the disposal of solid wastes by camp workers and migrants may contaminate the soil.

6.2.6.4 Methodology

The soil sampling locations were distributed, marked out and geo-referenced. The choice for sampling points took into consideration the various land use systems and natural features of the area. These included forest areas, commercial farmlands, uplands, lowlands and water courses. The grid method of soil sampling stations is as recommended by the International Institute of Tropical Agriculture. A total of twenty (20) sampling stations were established in the study area (Same point as Air quality/Noise).

A stainless steel, handheld Dutch type Soil Auger was used to collect representative soil sample at each soil sampling station. At each sampling station, soil depth (0-15 cm and 15-30 cm for topsoil and sub soil levels respectively. Soil samples for physical and nutrient elements analyses were sub sampled and appropriately labeled using masking tape and indelible ink to indicate sample location and soil depth level. Soil samples for hydrocarbon contents analyses were collected into amber glass bottles and labeled appropriately also using masking tape and indelible ink. Plate 6.2 shows soil sampling activities.

Plate 6.2: Field Soil Sampling Activity

6.2.6.5 Assessment of Soil Quality

Table 6.8 is a summary of the physico chemical characteristics of the soil of the project area. Detailed results ispresented in Appendix 6.2.

All physico-chemical parameters measured in the soil samples were within WHO/FMEnv threshold valuesfor contamination except for PCB. PCB concentrations were specifically high in the Aba and Onitsha section of the project area. Possible sources of PCB in soils of these areas are spent oils and condemned refrigirators sampled at repairers' shop. Data obtained for all parameters are slightly in conformity with those reported in the secondary data (Ojanuga et al., 1981; (FDALR) 1990; Nuga and And, 2011; Chukwu, 2013 and Nuga & And, 2011; Ejikeme and Nweke, 2016).

Table 6.8: Summarized physico chemical results of Soils

0-15cm								15-30cm						WHO/FMEnv limits
		Alaoji-Ihiala			Ihiala-Onitsha			Alaoji-Ihiala			Ihiala-Onitsha			
Parameters		Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	
PH		6.59	6.78	6.69	6.65	6.87	6.76	5.44	5.52	5.49	5.47	5.52	5.50	5 – 8.0
Elect. Conductivity (µS/cm)		78.1	92.6	85.4	80.1	93.9	86.0	107.9	175.4	145.0	115.7	187.6	149.2	
Moisture Content (%)		6.5	13.5	11.0	9.1	13.0	10.9	13.0	17.0	14.8	13.6	18.2	15.7	
PSD (%)	Clay	1	1	1	1	1		1.88	3.11	2.47	2.22	3.16		
	Silt	4.3	17.5	10.5	2.3	25.1		5.9	16.3	12.2	9.0	17.8		
	Sand	83.9	93.5	88.9	88.4	94.4		78.6	102.8	88.3	79.6	97.7		
PCB		52	65	56.2	52	59	56.1	23	52	32	21	59	37	50
Ext. nitrate		3.23	4.77	4.30	3.47	5.40	4.03	4.1	6.9	5.2	4.5	6.6	5.6	500
Ext. sulphate		24.4	25.6	25.0	23.8	26.2	25.0	21.8	23.8	22.9	21.8	23.4	22.8	500.00
Ext. phosphate		0.03	3.41	1.53	0.51	2.39	1.39	1.32	3.00	2.22	0.96	3.60	2.10	
Phosphorus		6.1	20.1	13.9	8.4	17.0	14.6	6.0	21.5	13.7	10.7	17.5	14.3	

Calcium	3.93	6.89	5.47	3.69	6.59	5.30	1.66	6.05	4.28	1.95	6.89	3.75	
Magnesium	0.50	0.91	0.70	0.55	0.98	0.69	0.46	1.15	0.75	0.44	1.03	0.77	0.10-1.0
THC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30.00
Total chromium	0.74	0.98	0.86	0.51	1.09	0.87	0.87	2.07	1.48	1.13	1.88	1.48	100.00
Total iron	64.2	99.0	84.3	73.7	99.3	84.9	103.0	138.7	120.7	106.8	141.1	121.9	500-30000
Copper	5.84	8.76	7.09	6.93	10.14	7.86	4.70	9.73	7.72	4.78	8.74	7.21	36.00
Lead	0.15	0.29	0.24	0.14	0.30	0.23	0.03	0.27	0.16	0.16	0.26	0.21	85
Manganese	5.26	6.50	6.00	5.34	7.19	6.57	5.63	9.67	7.88	6.62	10.00	7.66	
Nickel	0.39	0.82	0.63	0.58	0.73	0.66	0.70	1.08	0.94	0.73	1.20	0.95	35.00
Zinc	1.05	1.31	1.19	1.18	1.25	1.21	0.71	1.97	1.21	0.32	2.11	1.20	
Arsenic	0.23	0.33	0.28	0.20	0.35	0.28	0.24	0.47	0.37	0.23	0.41	0.32	
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.30
Vanadium	0.22	0.30	0.25	0.20	0.31	0.24	0.22	0.37	0.28	0.22	0.38	0.28	
Cadmium	0.29	0.66	0.47	0.26	0.49	0.38	0.15	0.90	0.52	0.29	0.78	0.56	
Boron	0.79	1.84	1.44	1.06	1.84	1.51	0.87	2.33	1.49	1.21	2.09	1.67	

6.2.6.7 Soil Microbial Results

Soil microbial results of the study area is presented in the Appendix 6.2, summarized soil microbial waste matrix of the study area is presented in Table 6.9.

Table 6.9: Microbial – Waste Substrate Matrix

Species	Broad spectrum media nutrients	Possible Substrate in Project Area
Bacillus sp	Nitrogen, carbohydrate	Meat, Groundnut, bread
Pseudomonas sp	vitamins, carbohydrates, nitrogen, and salts	Egg, bean and meat
Micrococcus sp	vitamins, carbohydrates, nitrogen, and salts	Rice, corn and bread
Escherichia sp	Sodium, chlorine, nitrogen	Meat, Groundnut, bread
Klebsiella sp	Nitrogen, carbon and sodium, ammonium phosphate	Egg, bean and meat
Protues sp	Nitrogen, vitamins, lactose	Meat, Groundnut, bread Egg, bean and meat
Serriatia sp	Sodium, chlorine, nitrogen	Rice, corn and bread
Staphylococcus sp	vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut, bread
Enterobacter sp	Sodium, chlorine, nitrogen	Meat, Groundnut, bread Egg, bean and meat
Arthrobacter sp	Nitrogen, carbohydrate	Cassava tubers, corn
Actinomyces sp	Propionic acid, sodium salt, nitrogen	Meat, Groundnut, bread
Flavobacterium sp	Proteosepeptone, Casamino acids, Yeast extract, Dextrose, Soluble starch, Dipotassium phosphate, sulfate Sodium	Meat, fish, cheddar cheese
Chromobacterium sp	Nitrogen, glutamic acid, peptone	Meat, Groundnut, bread Egg, bean and meat
Cladosporium sp	Sodium, chlorine, glucose,	Meat, Groundnut, bread Egg, bean and meat

Mucor sp	Magnesium Sulfate, Monopotassium Phosphate, Peptone, glucose, Sodium, potassium, iron, calcium	Rice, beans and soya bean
Trichoderma sp		Yam, potatoes, Sugarcane, corn and wheat straw
Fusarium sp	Sodium, potassium, iron, calcium, glucose	Meat, Groundnut, bread Egg, bean and meat
Rhizopus sp		
Candida sp		
Aspergillus sp		
Penicillium sp		

Microbial diversity of the study area was largely uniform indicating similar substrate except for the presence of Chromobacterium sp and Cladosporium. Their presence could best be explained by the consumption of their preferred growth media as outlined in Table 6.9. All microbial species assayed in the soil samples are important in nutrient recycling. Microbial organisms in soil aid the degradation of wastes and contaminants, soil enrichment through nitrogen fixation for instance, etc. The presence of the broadspectrum micro organisms in the project/study area is the ability of the soio to self enrich and break down contaminats in the eventual incident of improper waste disposal or accidental spill among others.

6.2.7 Groundwater Quality

6.2.7.1 Sampling Methodology

Water samples were collected from three existing boreholes. Two of these boreholes were within the sampling corridor while the third was obtained outside the spatial boundary and hence acted as control. Collected water samples were analysed for their baseline physico-chemical condition. Water samples were collected for laboratory analyses using

- 2-litre plastic bottle for water samples for physicochemical analysis;
- 2-litre plastic bottle for water samples for heavy metal analysis;
- 1-litre plastic bottle for water samples for microbiological analysis; and
- 1-litre glass bottle with Teflon seal cap for water samples to be analysed for hydrocarbon content (oil and grease, etc.).
- Samples were kept in cooler loaded with ice blocks, while samples meant for metal analysis were preserved by the addition of concentrated nitric acid (5 ml to 1 L of water). Parameters like pH, temperature, electrical conductivity (EC) and depth were measured on *in-situ*. The pH, conductivity and

total dissolved solid (TDS) were measured with pH-conductivity-TDS meter (COMBO HI model 98130). Plate 6.3 shows the water sampling activity.

Plate 6.3: Groundwater Sampling Activity Near Ugheli Substation

6.2.7.2 Groundwater Sampling Stations and Coordinates

The groundwater sampling stations are presented in Figure 6.7.

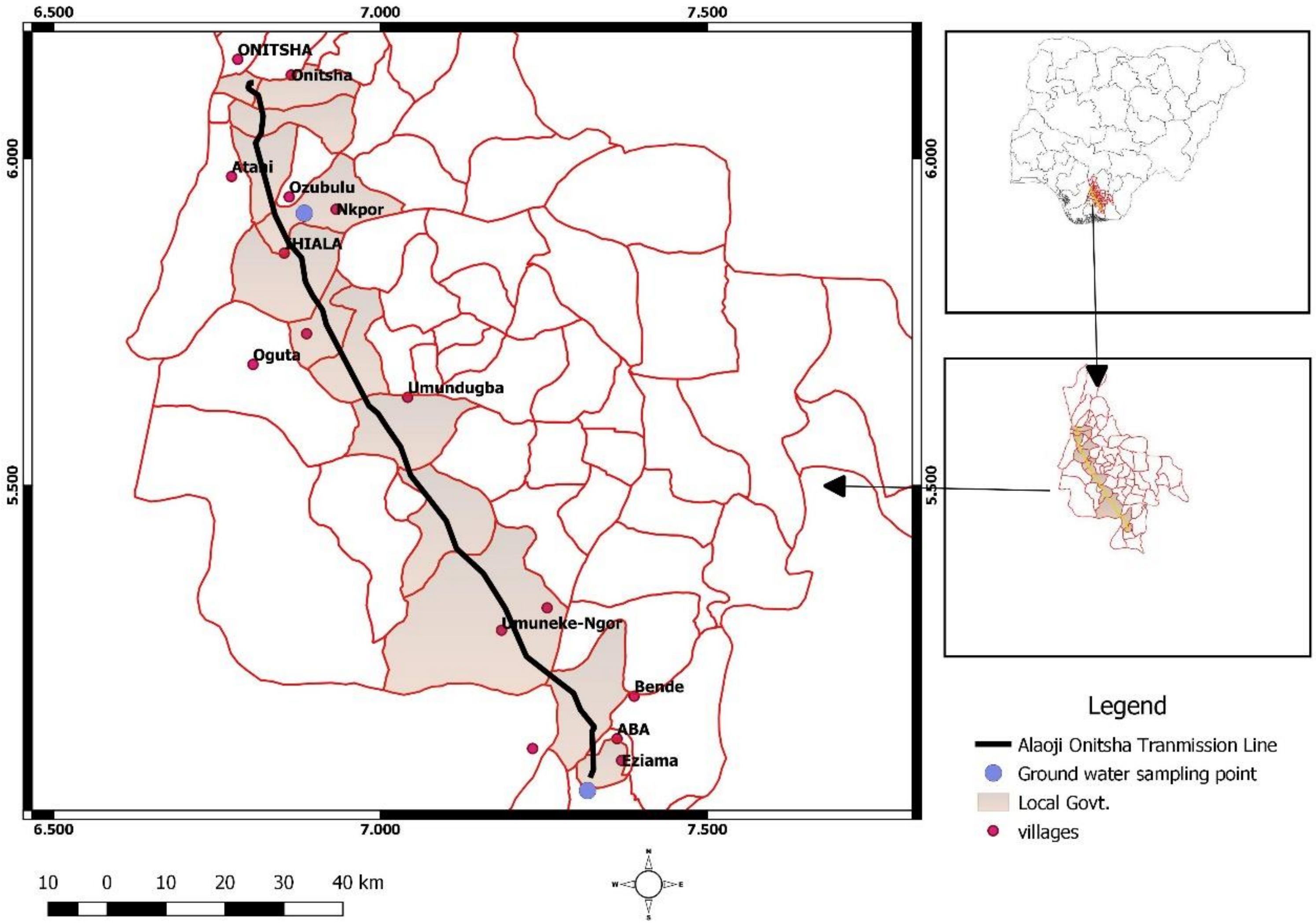


Figure 6.7: Groundwater Sampling Stations and Coordinates

6.2.7.3 Assessment of Groundwater Quality

The results recorded for each physico-chemical parameter were benchmarked with those from reviewed secondary data and from WHO/FMEnv regulatory limit, where one exists (Table 6.10).

Table: 6.10: Physico – chemical Results for Groundwater

		Ala-ojiSubstation	Onitsha Substation	Ihiala Substation	Secondary Data (Ukanafun – Oma Power Plant Gas Pipeline Project 2016)	FMEnv limits	WHO limits
Parameters		GWI	GW2	GW3			
General appearance		Clear	Clear	Clear	Clear	Clear	Clear
pH @ 21.2oC		6.31	7.41	6.92	4.7	6.5- 8.5	6.5-9.2
Temperature (0C)		26.32	25.23	28.5	31.0		40 oC
Turbidity (NTU)		1.05	1.32	1.83			5
TDS (mg/l)		39.40	11.43	31.28	10.6		
Conductivity (µS/cm)		58.21	40.25	59.12	20.0	1,000	250
Total Hardness (mg/l)		6.23	3.25	4.23		150	
THC		ND	ND	ND		0.3	0.05
PCB (ng/m3)		ND	ND	ND			0.003
Mineral Oil (mg/l)		<1.00	<1.00	<1.00			
Chloride (mg/l)		11.6	4	10			
Total Alkalinity (mg/l)		<1.00	<1.00	<1.00	2.0		
Nutrients	Nitrate (mg/l)	2.52	0.64	1.82	<1.00	50	10

	Phosphate (mg/l)	0.25	0.15	0.31			5
	Sulphate (mg/l)	0.36	0.24	0.33	0.28	100	500
Reactive Silica (mg/l)		7.4	11.3	10.5			
Cyanide (mg/l)		<0.01	<0.01	<0.01			
Ammonium (mg/l)		<0.02	<0.02	<0.02			
Aluminum (mg/l)		<0.10	<0.10	<0.10	<0.01		
Calcium (mg/l)		0.32	2.13	2.15			
Magnesium (mg/l)		1.48	0.43	0.52			
Sodium (mg/l)		2.36	8.67	4.63	4.08		
Potassium		0.41	0.39	0.7			10
Cyanide (mg/l)		<0.01	<0.01	<0.01			
Heavy Metals	Arsenic (mg/l)	<0.001	<0.001	<0.001			
	Total Mercury (mg/l)	<0.0002	<0.0002	<0.0002			
	Selenium (mg/l)	<0.001	<0.001	<0.001			
	Lead (mg/l)	<0.01	<0.01	<0.01	0.007	0.05	0.02
	Zinc (mg/l)	0.14	0.17	<0.05			
	Total Iron (mg/l)	<0.05	<0.05	0.27		1.0	0.3
	Copper (mg/l)	<0.05	<0.05	<0.05	0.16	1.0	2.0
	Manganese (mg/l)	<0.10	<0.10	<0.10			
	Cadmium (mg/l)	<0.002	<0.002	<0.002			

	Total Chromium (mg/l)	<0.01	<0.01	<0.01			
	Cobalt	0.01	0.03	0.02			
	Vanadium	ND	ND	ND			
Total Coliform (cfu/100ml)		0	2	6.8x107			
Faecal Coliform (cfu/100ml)		0	0	5.3x105			
E-coli (cfu/100ml)		0	0	0			
Faecal Streptococci (cfu/100ml)		0	0	0			
Total Plate Count (cfu/ml)		3.19x102	7.20x103	2.19x102			

Source: GNL. ND = Not Detected; NA= Not Available

As shown in Table 6.10 all physico chemical parameters analyzed in the groundwater samples were within threshold values.

6.2.8: Hydrology and Drainage

6.2.8.1 General

Nigeria has two major Rivers, the Niger, after which the country is named, and the Benue. They meet at the Lokoja confluence and enter the Gulf of Guinea through a network of creeks and distributaries which form the Niger Delta. There are, however, a few other tributary rivers which drain into the Niger-Benue trough and Lake Chad. These include the Sokoto-Rima, Kaduna, Anambra, Gongola, Hadejia, Jama'are and Yobe rivers. The basins of these major rivers and their tributaries constitute the drainage pattern of the entire country. Other major rivers e.g. Cross, Imo, Ogun, Osun, Benin, Qua Iboe etc. empty directly into the Atlantic Ocean. The majority of small rivers are seasonal (Figure 6.8).

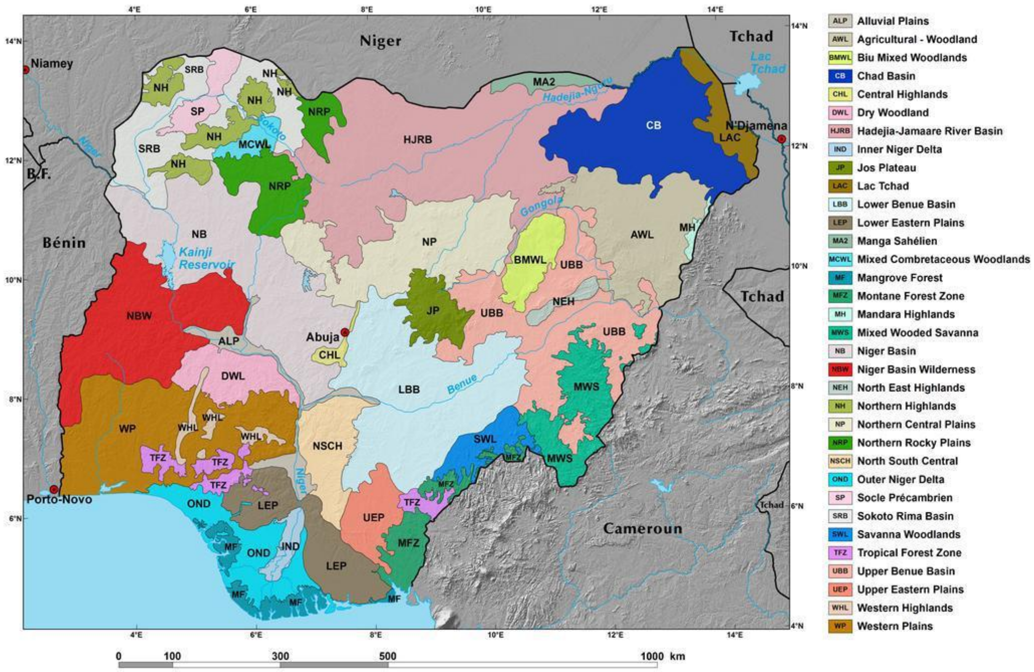


Figure 6.8: Nigeria Drainage System

The Principal rivers are the Njaba and Imo rivers. They cut through the two states and are more prominent in the southern part of Abia and the Eastern part of Imo. The Imo River flows from Imo through Abia and empties into the Atlantic Ocean through the Niger delta Estuary.

Hydrogeology

The Benin Formation (Coastal Plain Sands) is the major aquiferous layer in the project area. Lithologically, it is made up of coarse- to medium-grained loose sands and gravels. Thin clay hori- zons and lenses occur in places disturbing the vertical and horizontal disposition of the aquifer, giving rise to a multiaquifer system. The aquifer may reach about 300 m in thickness. This aquifer is underlain by thick shale (aquiclude) in the northern sector. A lower sand aquifer underlies the aquiclude. The Alluvial Deposit aquifer overlies the Benin Formation in the southern parts of the area. The thickness of these aquiferous layers varies from place to place. Presently, only the Coastal Plain Sand aquifer is being tapped. Some hydrogeological data for this unit are as follows: total depth of boreholes, 42-172 m; saturated thickness of aquifer, 39-100 m; static water level, 1-55 m; Yield, 216-5,304 m^3/d; transmissivity, 200-8,300 m^2/d; hydraulic conductivity, 2-28 m/d; drawdown, 1.2-42.5 m; and storage coefficient, 0.10-0.25 (Edet, 1993).

6.2.9 Surface Water Quality

6.2.9.1 Sampling Methods

Surface Water

Surface water was collected as appropriate using non isokinectic water sampler. Figure 6.9 shows the sampling locations for surface water, sediments and hydrobiology. Surface water sampling involved immersion of the laboratory cleaned sample bottle below the surface of the water body. The exercise also involved *in situ* measurement of salinity, temperature, turbidity, pH, dissolved oxygen and conductivity. These were stored and preserved as appropriate for each analysis. Water samples were collected for laboratory analyses using

2-litre plastic bottle for water samples for physicochemical analysis;

2-litre plastic bottle for water samples for heavy metal analysis;

1-litre plastic bottle for water samples for microbiological analysis; and

1-litre glass bottle with Teflon seal cap for water samples to be analysed for hydrocarbon content (oil and grease, etc.).

All water samples were preserved in ice blocked loaded boxes in the field and refrigerators at the camp site prior to transmission on ice loaded coolers to Mifor Consult Nigeria Limited (MCNL) Laboratory in Calabar. Samples meant for metal analysis were preserved by the addition of concentrated nitric acid (5 ml to 1 L of water). Parameters like pH, temperature, electrical conductivity (EC) and depth were measured on *in-situ*. The pH, conductivity and total dissolved solid (TDS) were measured with pH-conductivity-TDS meter (COMBO HI model 98130).

Sediment

The Eckman grab was deployed in the collection of sediment samples. The grab is made up of stainless steel that consists of two jaws that automatically closes when it is lowered into the river. On reaching the bottom of the water body, sediment is trapped in the jaws and is gradually pulled back to the surface. A single grab bite was collected per station. The surface of sediment (1 - 2cm) were collected in a stainless-steel basin and homogenized for the analysis of physico-chemical parameters and Total Hydrocarbon Content (THC). The residual sediment was washed for benthos and collected in a plastic container, while any residual sediment was thrown back into the river.

Samples for physico-chemical analyses were collected in polythene bags and stored for analysis. In-situ measurements such as pH, and temperature were carried out on sediment samples. The sediment samples for microbial analyses were collected in sterile plastic containers and stored in coolers containing ice block. After each sampling, the grab samples were washed thoroughly to remove any adhering particles from previous sampling.

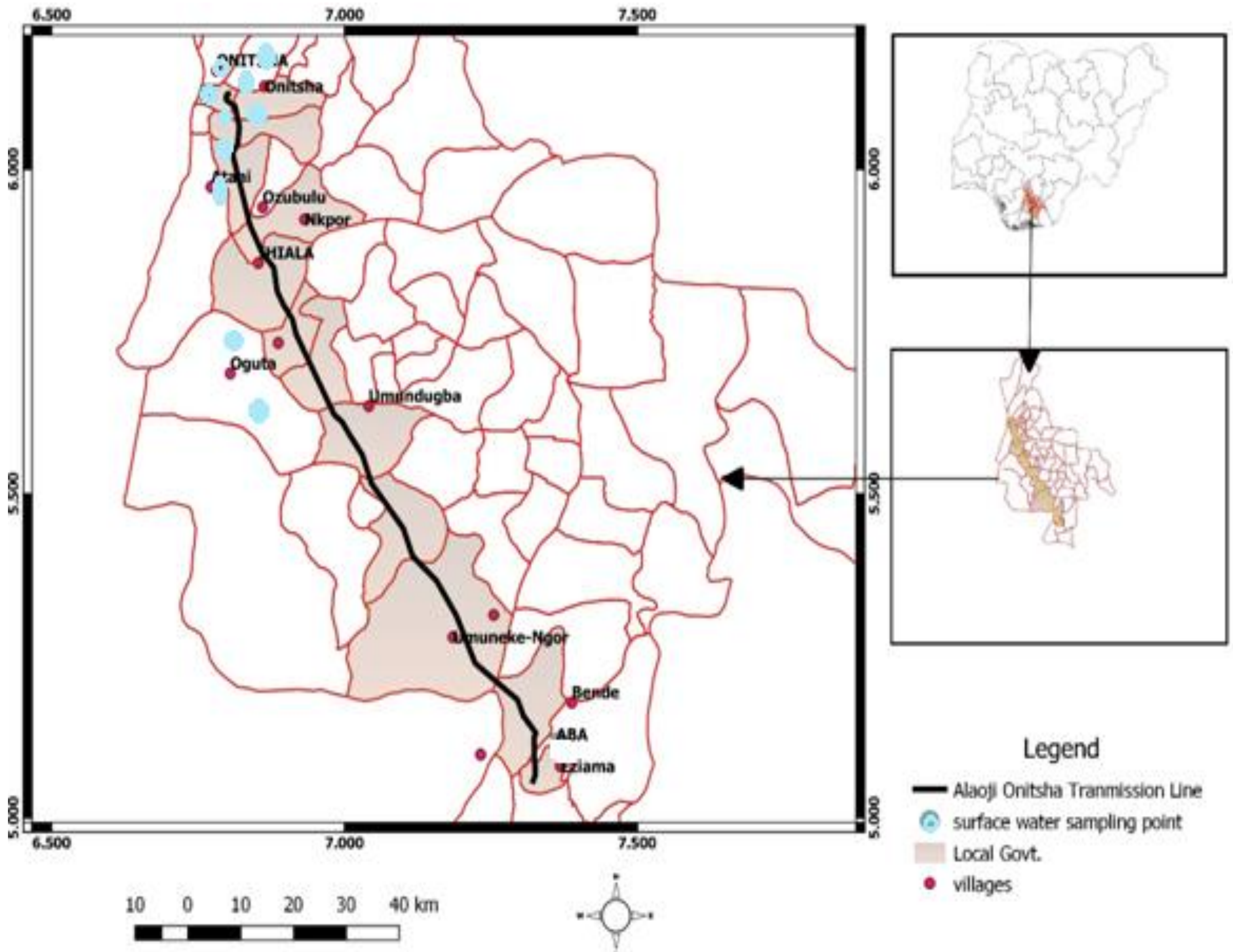


Figure 6.9: Surface Water, Sediment and Hydrobiology Sampling Points

6.2.10 Hydrobiology

6.2.10.1 Benthic Macro Fauna Sampling

Benthos were obtained by washing residual sediment samples through a 0.5 mm-mesh sieve using water obtained from the river at the site. This was carried in a manner so as not to destroy the integrity of the benthic organisms. The benthos samples obtained were placed in a plastic container and preserved in 20% buffered formal saline solution and stored in the ice coolers. After each sampling, the Eckman Grab was washed thoroughly with water from the river to remove remaining particles from previous sampling.

6.2.10.2 Plankton Sampling

Zooplankton

As part of the procedures taken to determine the type and nature of small living organisms surviving on the surface of the water, a zooplankton sampling exercise was conducted. Zooplankton samples were collected by pulling plankton net of mesh size of 0.063mm vertically on the surface of the river. A weight (iron rod) was attached to the cord holding the net, lowered into the water and then pulled back to the surface for collection of samples. After each tow, zooplankton were collected using labeled wide mouth plastic containers and preserved with 10% buffered formalin, the net was thoroughly washed so that particles adhering to the net was washed into the collecting bottle for analysis.

Phytoplankton

Phytoplankton sample collection was done by lowering the plankton net just below the water surface and dragged (horizontally) on the waterway. The phytoplankton samples were collected in clearly labeled containers and preserved in Lugol's iodine solution.

6.2.10.3 Fishery Methodology

Data for fishery studies were collect from professional observation in the water bodies, nearby markets and desktop studies. This was so because neither fishing camp nor fishermen were found in the project area. Fish observed and identified were photographed as part of the primary data source, while secondary data source involves literature review of past fish studies conducted within the area.

Data on fish and fisheries resources, daily landings and sales were generated by discussing with observed fisherfolks in the area.

6.2.10.4 Result of Hydrobiology

Two of the sampling stations (SW9 and SW10) were devoid of plankton or benthic organisms. A total of eighty-nine (89) species were observed in the study from SW 1-8. The breakdown includes; thirty-two (32) phytoplankton, thirty-six (36) zooplankton and twenty (20) macro benthos. Details are provided in Tables 6.11 – 6.13.

Table 6.11: Phytoplankton Assemblage across All Sampling Stations

S/N	Species	**Group/Class**	**Family**	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
1	*Melosira* sp	Diatom	Melosiraceae	13							
2	*Melosira nummuloides*	Diatom	Melosiraceae		12		15	8		8	4
3	*Navicula* sp.	Diatom	Naviculaceae	22				2			
4	*Surirella nobilis*	Diatom	Bacillariophyceae		10	14		6	17	9	
5	*Nitzschia obtustata*	Diatom	Bacillariophyceae		13			5	8		4
6	*Nitzschia linearis*	Diatom	Bacillariophyceae		12		14	6		7	8
7	*Coscinodiscus eccentricus*	Diatom	Coscinodiscaceae		21	22		4	23		8
8	*Micrasterias denticulate*	Green algae	Chlorophyceae		24	19	15			12	
9	*Closterium lunula*	Green algae	Chlorophyceae		10		12	6		17	7
10	*Cosmarium* sp.	Green algae	Chlorophyceae					4			

11	*Ankistrodesmus falcatus*	Green algae	Chlorophyceae	4			16	4	6	11	
12	*Scenedesmus* sp.	Green algae	Chlorophyceae	21	25	17		7			8
13	*Eudorina* sp.	Green algae	Chlorophyceae	30		21	29		21	9	
14	*Volvox* sp.	Green algae	Chlorophyceae		8			4	13		8
15	*Ulothrix* sp.	Green algae	Chlorophyceae	22				8			6
16	*Trachelomonas lacustris*	Green algae	Euglenophyceae	24	22		21	7		9	9
17	*Phacus caudatus*	Green algae	Euglenophyceae			18	12	4	17	15	5
18	*Tetraspora*	Green algae	Chlorophyceae	24			15	7		9	
19	*Microcystis aeruginosa*	Blue-green algae	Chroococcaceae		9			9	7		9
20	*Oscillatoria limnetica*	Blue-green algae	Oscillatoriaceae	10	2	10		2	7	18	
21	*Anabaena*	Blue-green algae	Nostocaceae			12			8		
22	*Centritractus dubius*	Dinoflagellate	Xanthophyceae				10	4		8	8

23	*Peridinium cinctum*	Dinoflagellate	Dinophyceae	9	2			2			
24	*Phacus caudatus*	Green algae	Euglenophyceae	10		14			14	2	
25	*Pleurosigma elongatum*	Diatom	Naviculaceae		33			6			5
26	*Scenedesmus sp.*	Green algae	Chlorophyceae					4	18		12
27	*Surirella nobilis*	Diatom	Bacillariophyceae				17	6		7	
28	*Surirella splendid*	Diatom	Bacillariophyceae				17		7		
28	*Tetraspora sp*	Green algae	Chlorophyceae	12		16		4	9	6	2
30	*Trachelomonas lacustris*	Green algae	Euglenophyceae	18		10	9		32	4	
31	*Ulothrix* sp.	Green algae	Euglenophyceae	10		16		9	19		12
32	*Volvox sp.*	Algae	Green algae		20				7		
	Total abundance			229	223	189	202	128	81	81	233
	Total number of species			14	15	12	13	24	19	17	17
	Shannon index			2.53	2.53	2.46	2.52	3.10	2.71	2.67	2.70
	Evenness_e^H/S			0.9	0.8347	0.9712	0.9547	0.9268	0.8797	0.9033	0.9288

Table 6.12: Zooplankton Assemblage across All Sampling Stations

S/N	**Species**	**Phylum/ Division**	**Group/Class**	**Family**	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
1	*Euchlanis sp.*	Rotifer	Monogononta	Euchlanidae	9				5			
2	*Brachionus falcutus*	Rotifer	Monogononta	Brachionidae	4		15		8	4		
3	*Lepadella ovalis*	Rotifer	Monogononta	Collurellidae	7		6		6			
4	*Moina micrura*	Arthropoda	Cladocera	Moinidae	12				12		2	
5	*Kurzia longirostris*	Arthropoda	Cladocera	-----	5				7			
6	*Ilyocryptus verrucose*	Arthropoda	Cladocera	Macrothricidae	3							
7	*Nauplius larvae*	Arthropoda	Copepoda	-----	16	9			4	14	12	8
8	*Meta-nauplius larvae*	Arthropoda	Copepoda	-----		8			6	7		5
9	*Metacyclops minutes*	Arthropoda	Copepoda	-----		12			5			
10	*Microcyclops varicans*	Arthropoda	Copepoda	-----		5		11	11			
11	*Bryocamptus birsteini*	Arthropoda	Copepoda	-----		8	7	12				
12	Gastropod larvae	Mollusca	Gastropoda			2						
3	Fish larvae	Chordata	Pisces			1					3	

14	*Diaphanosoma excisum*	Rotifer	Monogononta	Sididae			6		3			
15	*Lecane leontina*	***Rotifer***	Monogononta	Lecanidae			7		8			
16	*Labidocera acutifrons*	Arthropoda	Copepoda	-----			3			10		
17	*Oithona setigera*	Arthropoda	Copepoda	Oithonidae			5					2
18	*Eucyclops macrurus*	Arthropoda	Copepoda	-----				10				
19	*Keratella quadrata*	Rotifer	Monogononta	Brachionidae					3			2
20	*Ilyocryptus verrucose*	Arthropoda	Cladocera	Macrothricidae					9			
21	*Evadne spinifera*	Arthropoda	Cladocera	Polyphemidae						6		
22	*Platyias quadricornis*	Rotifer	Monogononta	Brachionidae								
23	*Paracalanus parvus*	Arthropoda	Copepoda	Paracalanidae								
24	*Brachionus calyciflorus*	Rotifer	Monogononta	Brachionidae							4	6
25	*Lepadella patella*	Rotifer	Monogononta	Collurellidae								
26	*Eurytemora* sp	Arthropoda	Copepoda	Temoridae								
27	Polychaete larvae	Annelida	Polychaeta	-------							8	
28	*Euterpina acutifrons*	Arthropoda	Copepoda	--------						2		

29	*Lecane bulla*	Rotifer	Monogononta	Lecanidae						5		
30	Gastropod larvae	Mollusca	Gastropoda	--------						4		
31	*Microsetella norvegica*	Arthropoda	Copepoda	Ectinosomidae						4		
32	*Temora longicornis*	Arthropoda	Copepoda	Temoridae						2	2	
33	*Euchaeta norvegica*	Arthropoda	Copepoda	Euchaetidae							8	
34	*Eucyclops serrutalus*	Arthropoda	Copepoda	Cyclopidae							2	
35	*Oithona plumifera*	Arthropoda	Copepoda	Oithonidae								3
36	*Eucalanus elongatus*	Arthropoda	Copepoda	Eucalanidae								3
	Total number of individuals				56	47	49	45	87	46	31	58
	Total number of species				7	8	7	4	13	7	6	10
	Shannon index				1.803	1.756	1.837	1.096	2.482	2.133	1.858	1.823
	Evenness_e^H/S				0.8666	0.8267	0.8964	0.9972	0.9204	0.8439	0.8011	0.8839

Table 6.13: Benthos Assemblages across All Sampling Stations

S/N	Species	Group/Class/Order	Family	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
1	*Bulinus truncates*	Gastropoda	Planorbidae	4							
2	*Bulinus globosus*	Gastropoda	Planorbidae	4	4						
3	*Nais communis*	Oligochaeta	Naididae	*3*	4			1		1	
4	*Caridina Africana*	Decapoda	Atyidae	2				1		1	
5	*Macrobrachium sp.*	Decapoda	Palaemonidae	2			3	1		2	
6	*Chironomus sp.*	Diptera	Chironomidae	2		2		2		1	
7	*Lymnaea natalensis*	Gastropoda	Lymnaeidae		4						
8	*Dero digitate*	Oligochaeta	Naididae		4						
9	*Nais communis*	Oligochaeta	Naididae		2				1		
10	*Philaccolus sp.*	Coleoptera	Dystiscidae		2						
11	*Canthyporus sp.*	Coleoptera	Dystiscidae		2						
12	*Dero digitata*	Oligochaeta	Naididae		2	4			1		
13	*Tanypus sp.*	Diptera	Chironomidae			2					
14	*Cryptochironomus sp*	Diptera	Chironomidae				5				
15	*Melanoides tuberculates*	Gastropoda	Thiaridae					1			
16	*Zyxomma sp.*	Odonata	Libellulidae					1			
17	*Pseudocloeon glaucum*	Ephemeroptera	Baetidae					1			

18	*Nereis* sp	Polychaeta	Nereidae						1		
19	*Biomphalaria pfeifera*	Gastropoda	Planorbidae							1	
20	*Bulinus globosus*	Gastropoda	Planorbidae							1	
	Total number of individuals			17	24	8	8	8	3	7	17
	Total number of species			6	8	3	2	7	3	6	6
	Shannon index			1.742	2.023	1.04	0.6616	1.906	1.099	1.748	1.742
	Evenness_e^H/S			0.9518	0.9449	0.9428	0.9689	0.961	1	0.9571	0.9518

Note: Samples from SW9 and SW10 were both barren

Source: GNL survey, 2019

6.2.10.5 Phytoplankton Study

Phytoplankton species were only observed in sampling points 1-8. A total of thirty-two (32) species were recorded across all sampling points. The increased number of species and counts could be due to favourable environmental factors including warm water temperature, nutrients from agricultural runoff and cleaning fluids (Hoppenrath and Saldarriaga, 2012). The abundance of phytoplankton usually influenced availability of nutrient and light. *Trachelomonas lacustris Trachelomonas lacustris Scenedesmus* sp. *Micrasterias denticulate Coscinodiscus eccentricus Eudorina* spwere the dominant species in the samples. The presence of diatoms in water is indicative of possible pollution from anthropogenic sources such as fertilizers and nutrients runoff, leading to eutrophication (Blinn and Bailey, 2001) (Table 6.13).

6.2.10.6 Zooplankton Result

A total of thirty-seven (37) were observed in the samples. Copepoda was the dominant taxa in the samples. The presence of these zooplanktons in a high proportion is indicative of water body experiencing environmental stress and anthropogenic impacts.

6.2.10.7 Benthic Study

A total of twenty (20) species were observed in the samples. A pollutant tolerant species *Nereis sp*. was censored in sediments samples obtained in (SD7). Its occurrence suggests water bodies polluted by sewage, agricultural run-off and wastes. All other samples were devoid of pollution indicator species.

6.2.10.8 Surface Water Physico-Chemical Result

The physico-chemical characteristics of the surface water bodies within the proposed project areas are summarized in Table 6.14. The project area is served by the Imo, and Njaba Rivers.All physico chemical parameters analyzed in the water samples were within threshold values, except for Turbidity which had concentrations above FMEnv/WHO threshold limits for sustenance of aquatic lives in al sampling points and DO which had values below threshold limits in al sampling points except SW4 and SW9. Also, PCB values were found to be above the regulatory limit in surface water within Onitsha market. Possible cause of increase in PCB levels in the water bodies is runoff from PCB polluted soils around Onitsha and Aba markets since baseline soil PCB levels were also above FMEnv and WHO regulatory limits at these sites.

Table 6.14: Summarized Surface Water Physico-chemical Characteristics

	Alaoji-Ihiala						Ihiala-Onitsha				**Secondary Data** Ukanafun – Oma Power Plant Gas Pipeline Project 2016	**FMENV/WHO (2011) Limits for sustenance of Aquatic Lives**
PARAMETERS	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10		
PH	3.62	4.47	8.64	6.17	4.77	5.41	5.20	4.86	4.92	3.33	6.8	4.8-9.2
Temperature (oC)	30.5	26.6	26.7	28.6	31.8	26.8	26.8	31.0	29.9	27.0	29.0	40
Conductivity (µS/cm)	0.32	0.33	0.40	0.47	0.67	0.27	0.28	0.09	0.36	0.39	50.0	
Salinity (g/l)	0.92	1.36	0.93	1.29	1.77	1.88	1.41	2.14	0.60	1.46	8.0	
DO (mg/l)	3.85	1.75	3.58	4.19	3.57	3.70	3.82	3.59	4.66	2.34	5.42	4 - 9
Turbidity (NTU)	27.61	27.07	26.99	28.17	27.09	26.99	27.37	26.90	26.55	27.01		$\leq$25
Total Dissolved Solids (mg/l)	273.9	222.4	120.1	158.4	251.3	292.3	268.2	354.6	377.8	326.1	26.6	
Oil & Grease (mgl)	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00		
PCB (ppb)	0.4	0.3	0.2	0.4	0.3	0.3	1.1	1.0	0.8	1.2		0.5
BOD (mg/l)	5.64	5.01	4.85	5.33	5.18	3.13	4.36	5.43	4.27	4.88	5.31	$\leq$10
COD (mg/l)	4.77	5.78	5.33	5.01	3.38	4.92	2.03	5.26	3.73	3.86	6.0	40
Chloride (mg/l)	74.9	74.0	74.3	73.4	74.6	74.0	74.2	73.7	75.1	73.9		
Nitrate (mg/l)	0.28	0.31	0.40	0.34	0.41	0.37	0.36	0.41	0.39	0.34		50

Phosphate (mg/l)	5.28	6.13	6.43	6.41	4.85	3.69	4.71	6.61	5.25	4.94		500
Sulphate (mg/l)	0.8	3.0	1.2	1.4	1.7	2.1	1.1	2.3	4.8	2.2		500
Phenol (µg/l)	0.025	0.028	0.030	0.031	0.019	0.033	0.031	0.038	0.028	0.023		
Magnesium (mg/l)	14.5	15.8	19.0	18.7	6.5	9.0	10.2	7.7	13.6	10.0	4.07	200
Potassium (mg/l)	4.02	2.36	6.42	2.86	0.81	4.81	5.68	3.57	3.24	4.16	0.51	10
Sodium (mg/l)	1.4	10.5	7.9	5.5	2.0	12.7	9.4	5.4	10.6	8.8	4.95	200
Calcium (mg/l)	6.89	4.35	2.37	5.23	4.23	6.36	9.78	1.03	6.02	5.95	80.11	200
Chromium (mg/l)	0.280	0.269	0.268	0.268	0.275	0.264	0.272	0.271	0.277	0.266	<0.01	50
Manganese (mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.01	100
Lead (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.01	25
Zinc (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	1.30	5000
Copper (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	2.36	1500
Total Iron (mg/l)	1.06	1.40	1.47	0.53	1.17	1.23	1.25	1.24	1.99	1.59		300
Nickel (mg/l)	0.92	1.44	1.23	1.05	1.21	1.25	1.06	0.51	1.08	1.02		88
Silver (mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10		
Cobalt (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Cadmium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	0.03

*ND= Not Detected

Source: GNL Survey, 2019

6.2.10.9 Surface Water Microbiology

The densities and taxa of microorganisms in the water bodies within the project environment are presented in Table 6.15 while the substrate matrix for surface water microbial species is presented in Table 6.16. Surface water microbiology studies was conducted to further reveal the quality of the water bodies in the project area with regards to ecological sustainability. The presence of pollution indicator species and their abundance could reveal the pollution state of a water body. The presence of various microbial organisms and the microbial load of the surface water is also an indication of capability of the water body to breakdown contaminants,Possible sources of contamination in surface water bodies include domestic waste materials such as meat, strawberries, cereal grain and nuts mold in vegetables and peanuts as reported by Sridhara et al (1990).

Table 6.15: Surface Water Microbiology Result

	Total Heterotrophic Bacteria (THB)	Count (cfu/ml)	Hydrocarbon utilizing Bacteria (HUB)	Count (cfu/ml)	Total Heterotrophic Fungi (THF)	Count (cfu/ml)	Hydrocarbon Utilizing Fungi (HUF)	Count (cfu/ml)
SW 1	*Alcaligenes sp* *Proteus sp* *Escherichia sp* *Actinomyces sp*	2.54×10^3	*Escherichia sp* *Actinomyces sp*	1.44×10^1	*Alcaligenes sp* *Proteus sp*	1.67×10^2	*Proteus sp*	1.1×10^2
SW 2	*Bacillus sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	3.8×10^4	*Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	2.33×10^2	*Bacillus sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	3.47×10^3	*Bacillus sp* *Micrococcus sp*	2.03×10^1
SW 3	*Escherichia sp* *Arthrobacter sp* *Micrococcus sp* *Pseudomonas sp*	4.15×10^4	*Micrococcus sp*	1.66×10^2	*Arthrobacter sp* *Micrococcus sp* *Pseudomonas sp*	3.47×10^3	*Arthrobacter sp* *Micrococcus sp*	2.20×10^2
SW 4	*Streptococcus sp* *Flavobacterium sp Alcaligenes sp Proteus sp*	5.3×10^3	*Escherichia sp* *Arthrobacter sp*	2.85×10^1	*Flavobacterium sp* *Alcaligenes sp* *Proteus sp*	3.8×10^4	*Flavobacterium sp*	1.27×10^3

	E. sp Arthrobacter sp							
SW 5	*Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp* *Proteus sp* *Escherichia sp*	2.84×10^4	*Flarobacterium sp* *Alcaligenes sp*	1.04×10^1	*Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp* *Proteus sp*	2.32×10^2	*Streptococcus sp* *Flavobacterium sp* *Proteus sp*	2.06×10^1
SW 6	*Staphylococcus sp* *Micrococcus sp* *Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp* *Escherichia sp*	3.69×10^5	*Micrococcus sp* *Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp*	3.12×10^3	*Staphylococcus sp* *Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp*	2.78×10^4	*Staphylococcus sp* *Streptococcus sp* *Flavobacterium sp*	2.42×10^2
SW 7	*Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp* *Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp* *Proteus sp*	4.81×10^5	*Pseudomonas sp* *Staphylococcus sp* *Streptococcus sp*	2.77×10^3	*Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp* *Streptococcus sp* *Flavobacterium sp*	3.65×10^4	*Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	2.31×10^2

SW 8	*Bacillus sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp* *Micrococcus sp* *Streptococcus sp*	3.64×10^5	*Pseudomonas sp* *Staphylococcus sp* *Micrococcus sp*	1.36×10^2	*Bacillus sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	2.76×10^3	*Micrococcus sp* *Pseudomonas sp*	1.43×10^2
SW 9	*Micrococcus sp Streptococcus sp* *Flavobacterium sp* *Alcaligenes sp Proteus sp* *Escherichia sp*	5.03×10^6	*Flavobacteriumsp* *Alcaligenes sp* *Proteus sp* *Escherichia sp*	3.74×10^4	*Micrococcus sp* *Streptococcus sp* *Flavobacteriumsp*	3.56×10^2	*Streptococcus sp*	1.71×10^1
SW 10	*Flavobacterium sp* *Alcaligenes sp Proteus sp* *Escherichia sp Actinomyces sp*	4.01×10^2	*Proteus sp* *Escherichia sp*	2.62×10^1	*Alcaligenes sp* *Proteus sp* *Escherichia sp* *Actinomyces sp*	3.42×10^3	*Escherichia sp* *Actinomyces sp*	2.12×10^2

Table 6.16: Substrate matrix for Surface water microbial species

Species	Broad spectrum of growth media	Examples of local foods as possible growth medium
Bacillus sp	nitrogenous substance	Meat, Groundnut, bread
Pseudomonas sp	vitamins, carbohydrates, nitrogen, and salts	Egg, bean and meat
Micrococcus sp	Nutrient agar plate and broth	Rice, corn and bread
Proteus sp	Nitrogen, vitamins, lactose	Meat, Egg, Groundnut, bread
Arthrobacter sp	Nitrogen, carbon	Cassava tubers, corn
Flavobacterium sp	Proteosepeptone, acids, Yeast, Dextrose, Soluble starch, phosphate, Magnesium Sodium,	Meat, fish, Bread, Egg, Yam
Staphylococcus sp	vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut and Bread
Streptococcus sp	vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut and Bread
Escherichia sp	vitamins, carbohydrates, nitrogen, and salts	Meat, fish, Egg cheese
Actinomyces sp	vitamins, carbohydrates, nitrogen, and salts	Meat, fish, Beans, cheese
Alcaligenes sp	vitamins, carbohydrates, nitrogen, and salts	Meat, fish, Beans, Egg, Yam

The presence of faecal contamination indicator species (*Escherichia sp*) is suggestive of water unsafe for drinking and it entails open defecation practice in the area. Interestingly, the samples were devoid of water-borne pathogens such as *Giardia lamblia* and *Vibrio cholera.* However, details of the composition, abundance and broad-spectrum media nutrients of the microbial species assayed in the various samples is suggestive of contamination by food waste and runoff from fertilizer laden agricultural lands (Nitrogen source). All microbial species assayed in this study had been reported as playing key ecological roles in various water systems especially nutrient recycling.

6.2.10.10 Sediment Study

Sediment Physico-Chemical Analyses

Sediment (bottom of river, stream, lake etc) serve as sink for contaminants from the overlying surface water. The physico-chemical characteristics of the sediment thus provide indication to what the trend of the pollution or otherwise status of the surface water has been.

Several physico-chemical parameters for recovered sediment samples from water bodies in the study area were conducted. Some of the parameters include pH, Total Hydrocarbon (THC), Nitrates, Phosphates, Sulphates, Magnesium, Sodium, Potassium, Calcium and about nine (9) heavy metals.

Table 6.17 shows the various parameters and their concentrations across spatial and temporal gradients. Similarly, the regulatory limits and ranges of some of the parameters (where they exist) were used as the benchmark for determining existing status. Also, the results of the baseline study were compared with those observed and reported for contiguous areas. The sampling points were same as that of the surface water.

Table 6.17: Result for Sediment Physico-chemical Results

	Alaoji-Ihiala						Ihiala-Onitsha				FMEnv Limits **Aquatic lives**	Interim Sediment Quality Guidelines (ISQGLimits **Aquatic lives**
PARAMETERS	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8	SD9	SD10		
pH	7.35	7.93	7.55	8.30	6.05	8.13	7.75	8.13	8.35	7.50		6.0
Oil & Grease (mgl)	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00		
THC (mg/kg)	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00		
Chloride (mg/l)	76.4	75.8	74.2	77.0	75.6	73.0	73.9	74.5	75.1	78.7		
Ext.Nitrate(mg/kg)	0.16	0.16	0.17	0.15	0.13	0.16	0.14	0.15	0.16	0.13		
Ext.Phosphate(mg/kg)	1.43	2.25	1.94	1.67	1.72	3.68	1.22	1.55	3.06	2.78		
Ext.Sulphate(mg/kg)	4.68	4.81	4.89	5.20	7.36	5.41	4.29	3.81	3.86	3.93		
Chromium (mg/kg)	0.27	0.26	0.26	0.28	0.26	0.26	0.27	0.27	0.28	0.30	50	
Lead (mg/kg)	0.09	0.06	0.09	0.07	0.11	0.06	0.08	0.06	0.08	0.07		
Zinc (mg/kg)	1.17	1.51	1.25	1.26	1.46	1.35	1.48	1.41	1.49	1.37	5000	120-540
Copper (mg/kg)	3.74	3.15	3.76	3.40	3.93	3.41	3.78	2.87	3.33	3.57	35.7	

Total Iron (mg/kg)	1.02	1.18	0.53	1.17	1.00	1.13	1.81	1.00	1.10	0.75	300	
Nickel (mg/kg)	0.61	1.23	0.96	0.90	0.69	0.93	0.84	0.96	0.74	1.06		
Cobalt (mg/kg)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		123-540
Cadmium (mg/kg)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5	0.6-3.5
Vanadium (mg/kg)	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00		

As shown in Table 6.21 All physico chemical parameters analyzed in the sediment samples were within FMEnv/ISQG threshold values.

6.2.10.11 Sediment Microbiology

Sediment samples were also analyzed for microbial content. Table 6.18 presents the result. The microbial composition of sediments is similar to those observed in the surface water samples, except for the absence of faecal contamination indicators.

Table 6.18: Microbial species observed in the surface water samples

	Total Heterotrophic Bacteria (THB)	Count (cfu/ml)	Hydrocarbon utilizing Bacteria (HUB)	Count (cfu/ml)	Total Heterotrophic Fungi (THF)	Count (cfu/ml)	Hydrocarbon Utilizing Fungi (HUF)	Count (cfu/ml)
SW1	*Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces sp* *Proteus sp*	3.86×10^3	*Staphylococcus sp* *Micrococcus sp*	2.0×10^2	*Aspergillus sp* *Candida sp* *Rhodotorula sp*	3.24×10^3	*Aspergillus sp* *Candida sp*	1.68×10^1

SW2	*Staphylococcus sp* *Micrococcus sp* *Actinomyces* *Pseudonomas sp* *Bacillus sp*	4.63×10^{3}	*Micrococcus sp* *Actinomyces* *Bacillus sp*	3.18×10^{2}	*Aspergillus sp* *Candida sp* *Rhodotorulasp* *Penicillium sp*	3.42×10^{3}	*Rhodotorulasp* *Penicillium sp*	2.11×10^{2}
SW3	*Pseudonomassp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces sp* *Proteus sp*	4.91×10^{4}	*Pseudomonas sp* *Staphylococcus sp* *Micrococcus sp*	2.6×10^{2}	*Candida sp* *Rhodotorulasp* *Penicillium sp* *Mucor sp* *Fusarium sp*	3.1×10^{3}	*Penicillium sp* *Mucor sp*	1.52×10^{2}
SW4	*Pseudonomassp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces* *Proteus*	3.41×10^{4}	*Bacillus sp* *Staphylococcus sp* *Micrococcus sp*	2.14×10^{2}	*Aspergillus sp* *Candida sp* *Rhodotorulasp* *Penicillium sp*	3.03×10^{3}	*Aspergillus sp* *Candida sp*	1.2×10^{2}
SW5	*Micrococcus sp* *Actinomyces sp* *Pseudonomas sp* *Bacillus sp* *Protues sp*	4.2×10^{4}	*Pseudonomas sp* *Bacillus sp*	2.16×10^{2}	*Penicillium sp* *Mucor sp* *Fusarium sp*	3.28×10^{4}	*Fusarium sp* *Penicillium sp*	2.04×10^{3}

SW6	*Micrococcus sp* *Actinomyces sp* *Proteus sp*	3.75×10^5	*Actinomyces sp* *Proteus sp*	2.14×10^3	*Candida sp* *Rhodotorulasp* *Penicillium sp* *Mucor sp*	3.22×10^4	*Penicillium sp* *Mucor sp*	2.42×10^3
SW7	*Staphylococcus sp* *Micrococcus sp* *Actinomyces sp* *Proteus sp*	3.44×10^3	*Actinomyces* *Proteus*	2.83×10^1	*Rhodotorulasp* *Penicillium sp* *Mucor sp* *Fusarium sp*	2.79×10^2	*Mucor sp*	1.2×10^1
SW8	*Staphylococcus sp* *Micrococcus sp* *Actinomyces* *Proteus*	5.23×10^6	*Actinomyces sp* *Micrococcus sp*	3.51×10^4	*Rhodotorulasp* *Penicillium sp* *Mucor sp* *Fusarium sp*	4.2×10^3	*Penicillium sp* *Mucor sp*	3.17×10^2
SW9	*Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces sp*	2.89×10^4	*Staphylococcus sp* *Micrococcus sp* *Actinomyces sp*	2.13×10^3	*Aspergillus sp* *Candida sp* *Rhodotorula sp*	2.06×10^3	*Candida sp*	1.34×10^1
SW10	*Actinomyces* *Pseudonomassp* *Bacillus sp* *Protuessp*	3.6×10^4	*Bacillus sp* *Pseudomonas sp* *Protues sp*	2.78×10^2	*Aspergillus sp* *Candida sp* *Rhodotorulasp* *Penicillium sp* *Mucor sp* *Fusarium sp*	2.38×10^3	*Rhodotorulasp*	1.85×10^2

6.2.10.12 Results of Fisheries Studies

A fishery study was obtained via market survey and professional observation *in situ* as well as interviews from fisherman and the local vendors. Pictorial evidence of these fishes from the study area is further presented in Plate 6.4 while Table 6.19 presents the Fish Composition within the Study Area.

Table 6.19: Fish Composition of the Study Area

S/N	Common Name	Biological Name	2018 IUCN Ranking
1	Bagrid catfish	*Chrysicthys nigrodigitatus*	Least Concern
2	Trunkfish	*Cyphomyrus psittacus*	
3	Elephantnose fish	*Gnathonemus pestersii*	
4	Sudan catfish	*Baggrus docmak*	
5	Nile tilapia	*Oreochromis niloticus*	
6	Elongate tigerfish	*Hydrocynus forskahlii*	
7	African pike Characin	*Phago loricatus*	
8	Freshwater rat-tail	*Gymnarchus niloticus*	
9	Heterotis	*Heterotis niloticus*	
10	Electric eel	*Electrophorus electricus*	
11	Cichlid	*Tilapia galilaeus*	
12	Clupeid	*Pellonula afzellusi*	
13	Silver catfish	*Chrysichthys nigrodigitatus*	
14		*Gnathonemus enegalensis*	
15		*Marcusenius senegalensis*	
16	African catfish	*Clarias lazera*	
17	Mud catfish	*Clarias anguillaris*	
18	Mud catfish	*Clarias gariepinus*	
19	Niger/Nile Perch	*Lates niloticus*	

*Species 13-19 are additional species reported present but in literature for this geographic range

Source: GNL Field Study, 2019



(A) Oreochromis niloticus **(B)***Phago loricatus* **(C)** *Chrysichthys nigrodigitatus*

(D) Gnathonemu senegalensis

Plates 6.4 (A-D): Some Fish Species of the study Area

Length – Weight Relationship

The computed Length – Weight Relationship (LWR) for representative fish species obtained in the markets is presented in Table 6.20**.** The LWR for all the fishes correlated significantly with r = 0.704 - 0.873, and p < 0.01. Most of the fishes exhibited almost identical mean length exponent (b). The regression exponent (b), which signifies the type of growth, ranged from 1.719 – 3.011. When b = 3 growth is considered isometric, meaning that the weight of the body is closely proportional to the cube of its length. Most of the species recorded coefficient which did not differ remarkably from 3.0 indicating growth in such fishes to be isometric. The regression exponents for all other species were less than 3.0 indicating growth in these fishes to be negatively algometric.

Table 6.20: Computed LWR for Fish Species obtained from markets in the study area

Fish species	Total Length (cm)	Weight (g)	Condition Factor (K)	Gonado Somatic Index (GSI)
Hydrocynus forskahlii	25.9	294	2.42	2.99
Phago loricatus	38.3	195	0.31	2.09
Gymnarchus niloticus	28.8	171	1.21	1.92
Heterotis niloticus	55	1309	0.91	1.19
Mean	37	492.25	1.2125	2.0475

**LWR-length weight relationship*

Length Frequency Distribution

Condition Factor

The mean condition factor (k) was also computed for some selected species. The k values ranged from 0.39 to 2.40 with a mean 1.16. This is slightly greater than unity (k < 1.0) and depicts unstressed body condition for fish assemblage in the study area. The condition factor expresses the relative robustness of a fish. The poor body condition for most of the fishes observed indicated the presence of environmental degradation and reduced abundance of food resource base, which negatively affected the good body fitness and growth of the fish. It is also an indication that other environmental variables were not very favorable to the fishes.

Physical Deformities and Fish Health

Most of the fishes examined were found to be healthy with no physical deformities. This may be due to attack by piscine predator. Examination of gut contents revealed traces of fish in the diet. Few specimens of *Gymnarchus niloticus* and *Tilapia galilaeus* showed part of the dorsal and caudal fin affected. No other physical deformity or parasitic infestations were observed apart from marks and wounds due to fishing gears.

Food Items of Fish species

Fish are regarded as highly successful in their feeding habit, because of the ability to utilize varied food items. Their feeding habits vary from predators through plankton to detritus feeders. The physical and chemical characteristics determine the composition of fish food items in a given environment. Plankton and aquatic vegetation and fish parts were found in the stomach of many fishes in this study and a few with empty stomachs.

Threatened or Endangered Species

IUCN 2019 version revealed that none of the species is threatened.

Craft and Gear Survey

Crafts Survey

Fish capture techniques used in the study area included, seining, and trapping (Nwabeze*et al*., 2013) However, some of the fishers use selective and non-selective gears, which indiscriminately catch juveniles and could deplete the stock and reduce the sustainable yield.

Fisheries Survey Socio-economic

There is actually no secluded location for fishermen as they live among other people of various trades and occupation in the study area. Majority of the ethnic groups were the Igbos. The educational qualification of these people ranged from non-formal educational to secondary education. The age structure of the fishermen was mostly in the range of 25 to 60 years old. Most of the fishermen in this area are monogamous with very few having two or more wives. Most of the Fishermen do not have any source of finance other than the money that accrues to them from the sale of their fish. At this time of the year a fisherman makes about N2, 000 to N5, 500 for the sale of fish per day depending on the total catch.

Fish Processing and Marketing

The commonest fish processing and preservation method is by smoke-drying. The study revealed that traditional fish storage techniques were still prevalent. Immediately after landing, fish were thoroughly washed with either clean water or saltwater to remove dirt and microorganisms on the surface. This also enhances cooling the fish which temperature might have been raised due to ambient temperature. This slows down rate of deterioration. The recorded traditional fish storage techniques were thatched house, hut roof, smoke house, kitchen roof and eaves of houses. Traditional storage technologies were dependent on moisture content of the fish, and this should be less than 8% to prevent bacteria attack and autolytic activity will be prevented. Also, the presence of salt retards bacteria action and it aids the removal of water through osmosis (Clucas and Sctcliffe, 1991). Remarkably, from personal communication with Market women (They objected to having snap shots) some folks had big refrigerators powered by generators to keep the fish in its frozen state, others preserve the fishes in coolers stuffed with ice-blocks. It was revealed that virtually all processing and marketing of fish landed by fishermen were carried out by female members.

6.3 Biological Environment

There are nine distinct ecological zones in Nigeria which can be streamlined into five, namely (i) Sahel/Sudan Savanna, (ii) Guinea Savanna, (iii) Derived Savanna, (iv) Lowland rainforest/montane forest and (v) Freshwater swamp forest/mangrove forest and coastal vegetation (Figure 6.10).

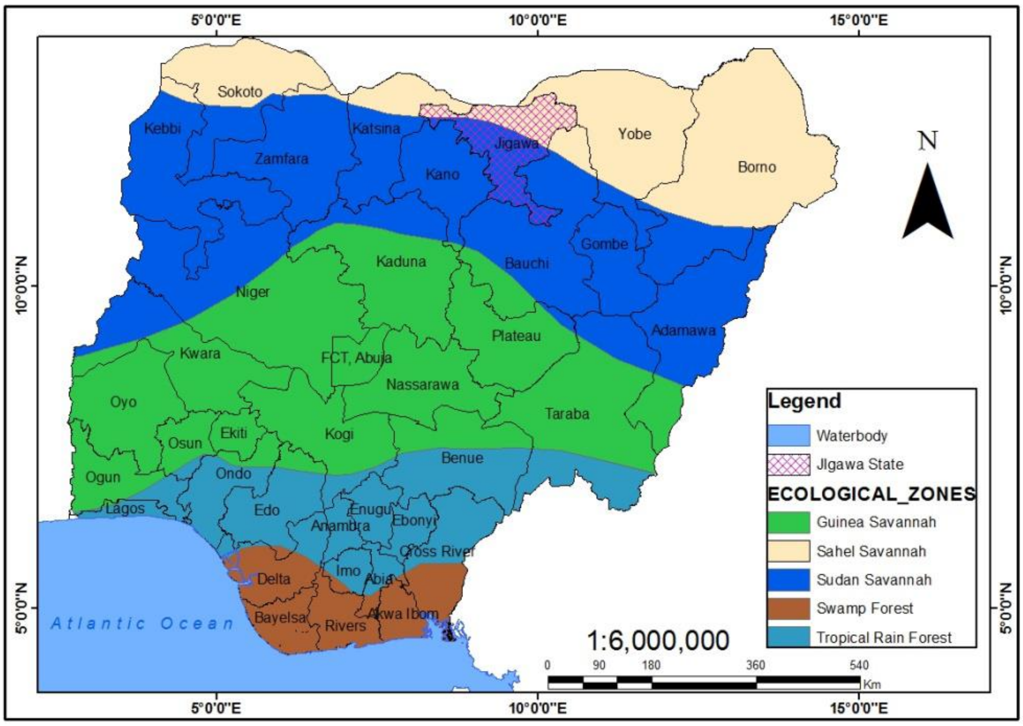


Figure 6.10: Map Showing Different Vegetation Belts of Nigeria

6.3.1 Habitat Types and Flora Studies

6.3.1.1 Sampling Parameters and Methods (Flora)

Specific and standard methodology was adopted for specific floral taxon for which baseline information were obtained. Some of the floristic parameters to be determined as shown in Table 6.21 include specific and family information (life forms, diversity richness, alien species inventory and indigenous uses). A total of fifteen 100m line transects was established for vegetation study along the RoW.Species touching or overshadowing the line transect were manually enumerated and converted to the Blanquet scale. Species type, habitat type, DBH, growth habit and interviews on indigenous uses and local names of species was conducted. Also, the IUCN data base of alien invasive and IUCN 2018 version 2 standard was used in computing IUCN status. Table 6.21 is a summarize methodology protocols. A total of 12 vegetation plots were studied.

Table 6.21: Biodiversity Survey Methods and Procedures

Flora		
Sampling Parameter	**Sampling Method**	**Sampling Analytical Method**
Species and family diversity	Line transect of 500 x 500m	Field botanical characters used for identification include flowers, fruits, leaves, slash, exudates, and sometimes smell. Field guides include Letouzey 1986, Hutchinson and Dailziel, 1963, 1972. Hawthorne1993, Souane 1985, White and Abernethy 1997, Akobundu and Okezie 1998, Arbonnier 2006, Nyannanyo 2006 and Ebigwai 2012
Species Diversity Indices		H= -ΣPilnPi, Where H = Shannon's index, In = log. E= EQ = -ΣPilnPi / InS; Where EQ = equitability, S = total number of species (Begon, et al 1986))
Species		Abundance of species was evaluated by counting the number of individuals of a species in each Whittaker transects. Family abundance was evaluated by counting the number of individuals of species belonging to a family (Gauch, 1982).
Species frequency		<u>Number of plots in which species/family is recorded</u> x 100 Total number of plots censured (Sutherland et al 1996).
Species density		<u>Number of plant species recorded</u> Total number of plots censured
Indigenous uses	Ethno botanical questionnaires	The various indigenous uses of the recorded plant species were compiled in addition to plant species with the most diverse uses

Alien & invasive species	IUCN & Literatures and absence of local names	The occurrence of exotic species was compiled based on literature searches and absence of local names. Odugbemi 2006
Conservation status	IUCN Red List of 2018	Number of threatened species x 100 Total number of species
Protected species	IUCN database 2018 and CITES ACT 2016	-

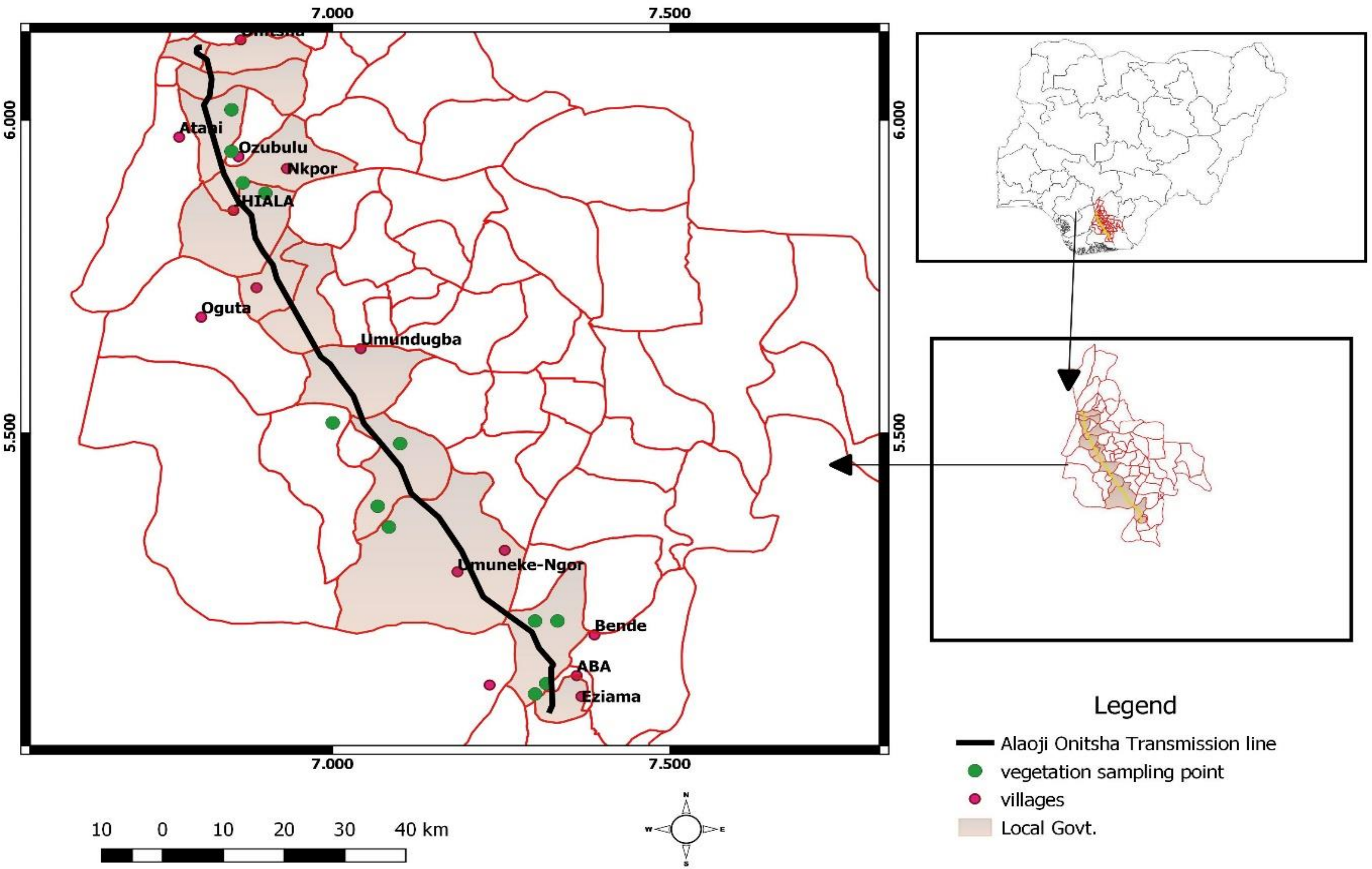


Figure 6.11: Vegetation Sampling Points

6.3.1.2 Baseline Characterization

6.3.1.2.1 Habitat types

Habitat study is essential to understanding spatio-temporal patterns in species distribution and hence significant towards implementing conservation efforts. The study area consists of three habitats. They are Secondary Forest (SF), Derived Savanna (DSF) and Seasonal Swamp forests (SSF). The habitat size estimated from sampling plots indicated 2,000m^2 (26%) for SSF, 2,000m^2 (26%) for DSF and 3,500m^2 (46%) for SF, making the SSF the dominant habitat along the proposed line route studied. Plate 6.5 are representative photographs of the three habitats. Figure 6.11 shows vegetation sampling points.

(A) Derived savanna (B) Secondary forest (C) Seasonal swamp forest

Plate 6.5 (A-C): Overview of the Study Area Habitats

6.3.1.2.2 Species diversity of the study area

Species Richness

This is the total number of species censored in a defined area. It is often used as a criterion for ecosystem disturbance or stability. A total of ninety-one (91) species were censored in the study area. A comprehensive list of the censored flora including those for each habitat is shown in Appendix 6.3 while the summarized result is presented in Table 6.22.

Table 6.22: Species Richness per Habitat

Habitat	Species Richness	Species Richness per transect														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Seasonal Swamp Forest	43			19	10			16			15					17
Derived Savannah	39	18	17		10				8				13			
Secondary Forest	58					14	16			10		14		13	15	17

Source: GNL, 2019

As could be seen in Table 6.22 expectedly, the Secondary Forest (SF) had the highest number of species, followed by the SSF, and then the DS with recorded species richness of 58, 43 and 39 respectively. The challenging access to the swamp may be responsible for the higher species richness observed. The observed wildfire and intense grazing activities at the savanna habitats would have contributed significantly to the recorded sparse species.

Species Density

Density refers to the number of species per given area. In this project, species density is used to evaluate number of plant species in the route. This in turn helps in vegetal waste quantification as shown below: Tree to Ton Conversion Standard (inch ft) = 24 trees at 40 ft x 7 inch (where 24= number of tree species in one ton with an average height of 40ft and an average DBH of 7inch). No tree satisfies the stated criteria and hence vegetal waste from TL clearing is negligible.

Shannon and Evenness Indices

Shannon Wiener Index and evenness index were used to evaluate species diversity for the habitats. The SSF with a Shannon index of 2.98 was more diverse than the Savanna with 1.24. This is indicative of more species biomass in the habitat than the others.

Species Growth Habit

Species Growth Habit is the form in which a species exists. The censored species exhibited six (6) growth habits comprising about two-third woody (Tree and shrubs) and one-quarter, non woody (ferns, grasses, climbers and herbs). The relatively high proportion of non- woody species as well as woody species with low DBH is indicative of habitats under disturbances.

6.3.1.2.3 Alien and invasive species

Alien species are plant resources that are inadvertently introduced into an area while invasive species may or may not be alien except that they may out-compete other species and establish dominance. International Union for the Conservation of Natural Resources (IUCN) listed about 24 plant species that are alien to Nigeria, while the global invasive database listed the occurrence of 29 invasive floras in Nigeria. A review of the alien species data base for Nigeria showed that two (2) of these species (*Ageratum conyzoides,* and *Chromolaena odorata)* occur in the study area. On the other hand, three (3) species (*Chromolaena odorata, Dalbergia sisso* and *Mimosa pudica*) were invasive. The presence of these alien/invasive species in the study area signifies a disturbed ecosystem possibly from anthropogenic activities. Plates 6.6 and 6.7 are pictures of some of these species.


(A) Ageratum conyzoides *(B) Chromolaena odorata* (awolowo weed)

Plate 6.6 (A-B): Alien species of the study area


*(A) Mimosa pudica (*Touch me not*)* *(B) Dalbergia sisso*

Plate 6.7 (A-B): Invasive species of study area

6.3.1.2.4 IUCN Status

The IUCN status of the plant resources of studied area was evaluated using the IUCN red list version 2018 -2 criterion. Results showed that five species are of conservation concern. These are *Sericanthetoupetou* (Endangered) and *Afzelia africana, Dalbergia latofolia, Ricinidendron heudelotii* and *Lophira alata* in the Vulnerable category. *Sericanthe toupetou* was censored in Irogun-agire community (10) with an abundance of 6 individuals. Interestingly most of these species are under protection in Gele Gele forest reserve, Omo forest reserve and Olokemeji forest reserves. Plate 6.8 shows pictorial images of these threatened species.




(A) D. latofolia (VU) (B) *A. Africana* (VU) (C) *R. heudelotii* (VU) (D)*Sericanthe toupetou* (EN)

(E) Lophira alata (Azobe) (VU)

Plate 6.8 (A-E): Pictures of Threatened Species in the Study Area

Table 6.23 provides reviewed data on the five Threatened species.

Table 6.23: Threats and Conservation Actions of the Threatened Plant Taxa of the Study Area

Species	Common name	2019 IUCN Conservation status	Threats	Reserves Protected in Nigeria
Dalbergia latifolia	Black Rosewood	Vulnerable A1d ver 2.3	Habitat fragmentation, exploitation and Logging	Gele gele forest
Afzelia africana	Afzelia	Vulnerable A1d ver 2.3		Kamuku National Park
Ricinodendron heudelotti	African wood oil nut tree	Vulnerable A1d ver 2.3		Omo Forest Reserve
Sericanthe toupetou		Vulnerable A1d ver 2.3		Olokemeji Forest Reserves
Lophira alata	Red iron wood tree	Vulnerable A1d ver 2.3		

Source: Adeyemi, Ibe, Okedimma, (2015), Adegoke Wahab, (2012), IUCN, (2019)

6.3.1.2.5 Habitats of higher ecological integrity

Important flora resources censored in this study were mapped as shown in Table 6.24. Criteria adopted for the mapping are plant species with high indigenous uses, invasive and alien species as well as those categorized under any of the Threatened classes.

Table 6.24: Ecologically sensitive species and their locations

Category	Species	Locations/Habitats		
Species with high indigenous uses	*Gmelina aborea* (11)	(DS)	(SSF)	(SF)
		√	√	√
	Elaeis guinnensis (7)	√	√	√
	Lophira alata (5)	√	√	√
	Pentaclethra macrophylla (5)	√		
	Bambusa vulgaris (4)	√	√	√

Threatened flora species	Afzelia africana (VU)	√	√	√
	Dalbergia latifolia (VU)	√		
	Lophira alata (VU)	(SF)	√	
	Ricinodendron heudelotii (VU)	√		
	Sericanthe toupetou (EN)	(SSF)		
Alien species	Ageratum conizoides	√	√	
	Chromolaena odorata	√	√	√
Invasive Species	Mimosa pudica	(DS)	√	√
	Chromolaena odorata	√	√	√
	Dalbergia sissoo	(SF)	√	√

*DF=Derived Savannah, SF=Secondary Forest SSF=Seasonal Swamp Forest

The high abundance of these species in the SSF and DS could be attributed to their preference for the habitat as well as high proliferation potential in the area (Table 6.24).

6.3.1.2.6 Indigenous uses of Plant Resources in the Study Area

The indigenous uses of the various plant resources censured in the study area were evaluated via interviews as shown in Plate 6.9. Table 6.25 provides a list of data obtained via the interview session.

Table 6.25: Plant Species and Their Indigenous Uses

S/N	SPECIES	INDIGENOUS USES	NO OF USES
1	*Ageratum conyzoides*	Fodder	1
2	*Albizia zygia*	Medicinal, Gum & Adhesives, Tannin, Wattles	4
3	*Alchornea cordifolia*	Medicinal	1
4	*Annona muricate*	Fuelwood, Prevention of Soil Erosion	2
5	*Anthoclesista djalonensis*	Fuelwood and Wattles	2

6	*Azadirashta indica*	Fuelwood, Medicinal and Fence	3
7	*Bambusa vulgaris*	Fuelwood, Chewing Sticks, Fence and Wattles	4
8	*Baphia nitida*	Fruits&Seeds and Nuts	2
9	*Ceiba pentandra*	Medicinal, Fruits & Seeds and Frames for Doors & Windows	3
10	*Chromolaena odorata*	Fence	1
11	*Dialium guineese*	Fuelwood, Medicinal and Chewing Sticks	3
12	*Elaeis guineesis*	Medicinal, Nuts, Sweeteners, Beverages & Drinks, Shade from Sun and Roof Trusses (Roof Rafters & Purloins)	7
13	*Gmelina aborea*	Fuelwood, Charcoal, Medicinal, Chewing Sticks Fodder, Fence, Wattles, Poles, Green Manure & Soil Reclamation Shade from Sun, Prevention from Soil Erosion, Frame for Doors and Windows	11
14	*Harungana madagascariesis*	Medicinal, Chewing Sticks	2
15	*Lophira alata*	Fuelwood, Medicinal, Roof Trusses (Roof Rafters & Purloins), Frame or Doors & Windows, Stairs	5
16	*Mitragyna stipulosa*	Fuelwood, Frame for Doors & Windows, Stairs	3
16	*Musanga cecropioides*	Medicinal	1
17	*Pentaclethra macrophylla*	Fuelwood, Charcoal, Medicinal, Spices, Flavouring & Thickeners, Green Manure& Soil Reclamation Shade from Sun	5

Source: GNL, 2019

Seventeen (17) species representing about 18.7% have indigenous uses. *Gmelina aborea, Elaeis guineensis, pentaclethra macrophylla*, *Lophira alata* and *Bambusa vulgari* are the most used plant species in the study area as a result of the wide range of products they offer.

This include; Medicine, fuel wood, raw material (wood for construction of bridge, houses and electric pole, etc). On the other hand, *Ageratum conyzoides, Alchornea cordifoia, Annona muricata, Anthoclesista djalonensis* and *Musanga cecropioides* were less use due to the limited number of products they offer. The inventory of some species in one plot with reduced individuals is a worrying sign of over harvesting. Plate 6.9 shows some of the indigenous uses.

(A) Fuel wood

(B) Fence made from wood

(C) Palm fruits

Plate 6.9 (A-C): Products from Plant Taxa Censored

6.3.2 Hepatofauna

6.3.2.1 Study Methodology

Direct observations

Diurnal and nocturnal expeditions to recognize evidence of herpetofauna species presence was undertaken. Formal transect surveys of reptiles and amphibians were conducted simultaneously, following thetransects already established for flora. Transects were walked slowly and all reptiles and amphibians encountered carefully observed. The sighted herpetofauna were snapped were possible and identified to the lowest possible taxa by specialist. Appropriate field data sheets were employed to capture information like species list with scientific, common and local names and abundance.

Indirect observations

The recorded evidence was represented both by direct (collections and observations) and indirect (tracks, footprints, scats/faeces, feeding activity, tracks, holes/diggings or scratching and carcass, habitats and dwelling places, vocals and call outs etc.). Local land users were also interviewed about hepatofauna they had seen or hunted in the area, and these were identified from pictures. The local language names were recorded. Other information gathered from the locals includes habitat history, faunal distribution pattern, seasonal migration, harvesting methods and threats to biodiversity in the study area. A summarized sampling protocols is provided in Table 6.26.

Table 6.26: Sampling Methods used for the Hepatofauna groups

Hepatofauna Group	Survey Technique	Survey Effort per Vegetation Community
Reptiles		
Diurnal searches	Habitat searches	0.1 ha search for one-person hour on 2 days per site
Nocturnal searches	Spotlight searches	Walking rate of 400 metre per hour per person on 2 nights
Specific habitats	Diurnal + nocturnal Searches	One-person hour diurnal + One-person hour per 0.1 ha. Nocturnal
Pitfall trapping		
Amphibians		
Diurnal searches	Systematic searches	0.1 ha search for one-person hour per habitat
Nocturnal searches	Spotlight searches	30 mins on two separate nights
	Playback of recorded calls	Once on each of 2 separate nights
Specific habitat searches	Pitfall trapping	2hrs per 200 metre of water body

Conservation Statuses

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2018-2. The IUCN categories rank the relative risk of individual taxa becoming extinct in the wild based on a set of standardized criteria.

6.3.2.2 Result

6.3.2.2.1 Hepertofauna

Result showed that herpertofauna species were censured across the three habitat types in the study area. Table 6.27 shows this information.

Table 6.27: Herpetofauna Checklist

Taxa	Species		Conservation Status			Habitat Censored			Reviewed Literature		
		Common name	Endangered Act 2016	IUCN	Endemism	Sec. forest	Swamp	Savanna	Breeding	Feeding	Threats/Conservation Actions
Amphibians	*Hoplobatrachus occipitalis*	Groove Crowned frog	Not listed	LC	NO	1	1	2	Late Feb-March	Insects, algae, leaves, fish	Not under threat
	Amnirana Albolabris	-	Not listed	LC	NO	3			Feb -April		
	Hyperolius concolor	Variable reed toad	Not listed	LC	NO	3	1		Feb-April		
	Hyperolius fasciatus		Not listed	DD	NO		5		March - April		
	Ptychadena pumilio		Not Listed	LC	NO	1	2	2	Feb -April		

	Xenopus muelleri		Not Listed	LC	NO	3		1	March-Early May		
Reptilia	*Agama boensis*	Common Lizard	Not Listed	LC	NO	4		2			
	Crocodylus noliticus	Nile crocodile	Absolutely prohibited	LC	NO	Censored via indirect evidence			April - May in sands or under rotten vegetation	Fish aves, amphibians, Mammals, fruits	Legislation and enlightenment
	Afronatrix anoscopus	African brown water snake	Not Listed	LC	NO		1		Dry season	Amphibians and fish	Biological resource use and Agricultural activities. In situ conservation in reserves
	Bitis arietans	Viper	Not Listed	LC	NO	Censored via indirect evidence			Variable	Amphibians and fish	
	Holaspis guentheri		Not Listed	LC	NO				October - December	Amphibians and fish	

	Mehelya egbensis	*Egbe file snake*	Not Listed	DD	NO			1	Not Available	Amphibians and fish	

As could be seen in Table 6.27, secondary forest recorded the highest number of species and species abundance. This indicates the relative preference for this habitat by herpetofauna in the study area. This could be attributed to the availability of food, breeding grounds, vegetative cover and the fertile environment provided by this habitat in the area.

In terms of species abundance, reptilian group recorded a remarkable lower attendance with 2 individuals. Reptiles are biological predators of amphibians; hence, the lower abundance of the former promotes habitat proliferation by the later. Also, reptiles are hunted by man and predatory birds, which might possibly, be responsible for their low diversity and abundance in the study area.

There was no species of conservation interest in the study area; however, the censored reptilian taxa are under localized threat from biological resource use and Agricultural activities. In situ conservation in reserves is suggested since this group of herpetofauna play important role in ecosystem balancing and moderation.

6.3.2.3 Avian Fauna

6.3.2.3.1 Study methodology

Methodology for birds' surveys

The bird surveys provided information on:

- Estimation of number/density of birds regularly present or resident within the study area before its construction;
- Patterns of bird movements in the vicinity of the line route before construction;
- Presence, abundance and use of habitats from endemic and threatened species inside the planned Right-of-Way (RoW)
- Identification of breeding/wintering grounds if present
- To meet these objectives, three inventory methods will be used. These methods are described herein.

Counting stations along transect

In order to estimate the number and density of birds, birds were sampled using counting stations along each transect visited. The distance in between each counting station may vary according to habitat patches size but should be of 250 m minimally. The number of counting stations will be determined depending of the number of different habitats to inventory and field accesses. However, a minimum of two counting stations should be made along each transect. Counting stations should be maximised during early morning when singing bird activity is at its maximum. The counting stations will be located preferably in homogenous habitat patches. Additional points will be also placed in rare habitats.

At each point count, ornithologists will arrive at a site and wait still for one minute to let the birds settle down, in case they had been disturbed. The observer will then make a fifteen-minute count, noting all birds seen or heard at the station and the distance from the observer to the bird in the following distance classes: 0-50m, 50-75m, 75-100m, >100m. In the first 5-minutes period, observer will note all bird seen or heard. Subsequently, only the additional individuals will be noted (for second and third 5-minutes periods).

General information taken were

- station name
- observer name
- date
- time (start and end)
- temperature (°C)
- cloud (%) precipitation (rain, fog etc.)
- wind speed (Beaufort scale)
- wind direction
- observation conditions
- Finally, general notes on the inventoried habitats were taken, as well as pictures

Observation Stations - Migratory Survey

The observation stations (see Figure 6.12) was located where the field of view is optimal (hill) or open areas. When weather conditions are not appropriate for viewing the targeted species (e.g. pouring rain, fog), inventories will be postponed until weather conditions improve. These conditions will be compiled on a field datasheet.

The field crew will note observations at each station for 60 minutes. Binoculars will be used by the observers to identify birds (raptors, waterfowl and other aquatic birds, passerine, others). The surveys will be done between 8 a.m. and 4 p.m. to maximize the observations, as migrating raptors travel more frequently at this time of the day. The field crew will log all birds observed and the travel characteristics of each individual. These characteristics include the sequential number of the observation, the number of individuals if possible, the activity (e.g. flight, feeding, resting), the flight direction and the approximate distance from the ground. When possible, the age of the birds (adult or juvenile) will also be determined.

The observations were compiled on a field datasheet. Finally, general notes and pictures will be taken on the inventoried habitats.

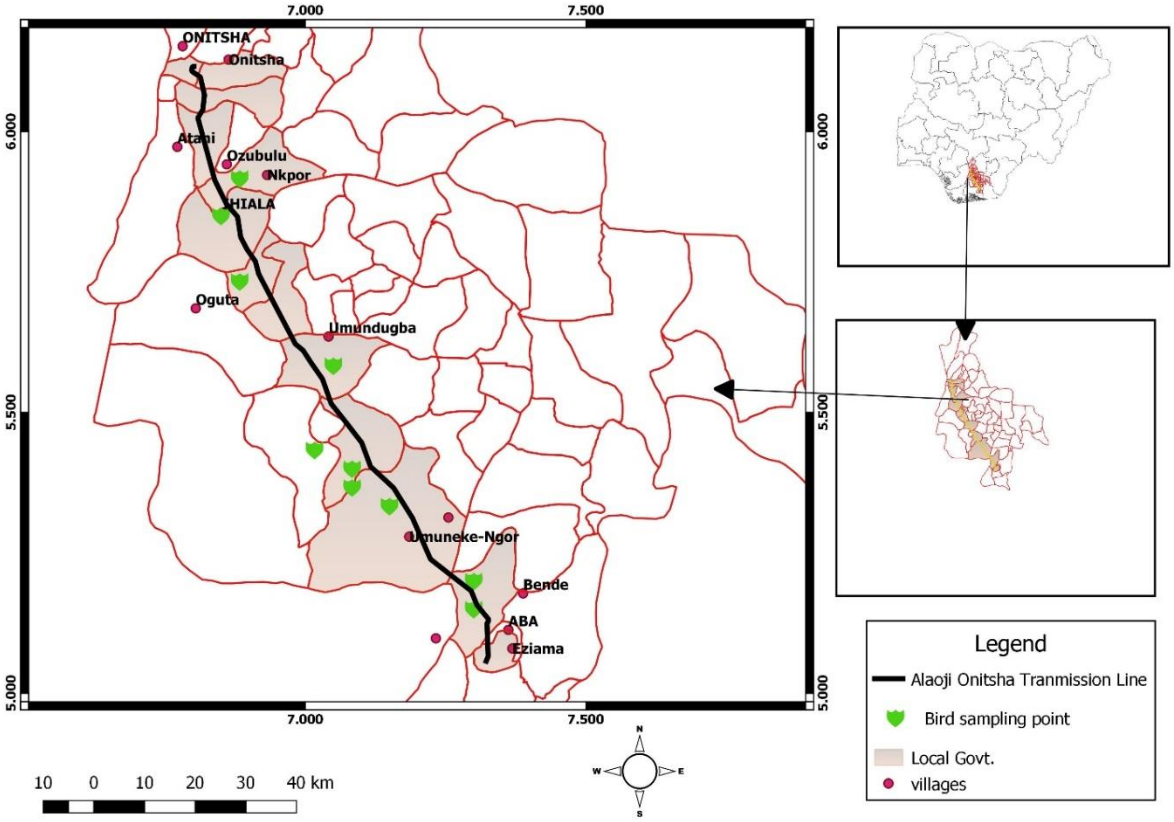


Figure 6.12: Observation Points for Birds

Conservation Status

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version2 2018 while Endangered species Act 2016 was used in compiling the national status

6.3.2.3.2 Result

Avifauna Diversity

Each biogeographically zone is known to support a distinct array of taxa resources including bird. Transmission projects have been recognized as a driver of bird species (UNEP, 2011). It is in light of this that bird study was conducted to document their baseline data.

Species richness

Species richness is the number of different species represented in an ecological community. A total of twenty-five (25) sighted avian species were censored. Some inventoried species include *Delerinis*, *Bleda, Hylia, Malimbus and Sylvietta*. Plate 6.10 is a representative picture of some avian species in the study area.

(A) Corvus albus *(B) Merops gularis*

Plate 6.10 (A-B): Representative Avian Taxa Censored

Secondary forest accounted for the highest bird diversity. Their preference for this habitat could be linked to food resources, breeding grounds and space loving. Species diversity was evaluated for the entire study area and for the habitats. Table 6.28 is the avian check list.

Table 6.28: Check list of Bird species in the Project Site

Species	FREQUENCY	ABUNDANCE	BEHAVIOUR	SEX	FLIGHT DIRECTION	ALTITUDE
Corythornis leucogaster	1	1	F		NE	0-50
Deleornis fraseri	1	1	F		NE	50-75
Baeopogon indicator	2	3	R, F, F	M, F	NE	50-75.50-75,50-75
Blenda syndactyla	1	4	F, F, FL, F	F	NE,	0-50,50-75. 0-50
Campethera nivosa	1	1	FL		SE	0-50,50-75
Cisticola anonymus	1	6	R, F, F, FL, F, F	F, F	NE, NW.	0-5-,50-75,50-75. 50-75,50-75
Corvus albus	2	3	F, F, F	M	NE. SW	0-50. 50-75,50-75
Halcyon badia	1	3	R, R, R	F	SW. NE	50-75. 50-75,50-75

Polyboroides typus	1	2	F, FL		SW	50-75,50-75
Hylia prasina	1	1	FL		SW	75&ABOVE
Malimbus rubricollis	1	1	FL		SW	75 & ABOVE
Malimbus scutatus	1	4	F, R. F. F	F, M, M	NE	0-50,0-50. 50-75. O-50
Merop gularis	2	4	F. FL. F, F		NE. SW	0-50. 50-75. 0-5-,0-5-
Muscicapa cassini	2	2	R. F		NE. SW	0-50. 0-50
Muscicapa comitata	1	3	FL. FL. R		NE. SW	50-75. 50-75
Nectrarinia cyanolaema	3	3	F. R. R		NE	0-50. 50-75, 50-75
Cinnyris superbus	2	2	FL. R		SW. NE	50-75. 0-50
Nicator chloris	3	7	R, R, F, FL. FL.FL. FL	M, M	NE	0-50,0-50,50-75. 0-50
Oriolus nigripennis	1	2	R, R		SW	50-75,50-75
Phyllastrephud icterinus	2	5	R, FL. RF. FL, R	M	NE	0-50,50-75,50-75. 0-50. 50-75,0-50
Placeus tricolor	1	6	F, F, FL. F, F, F		NE. SW	0-50,50-75. 0-50. 0-50,0-50
Dyaphorophyia castanea	1	2	R, R	M	NE, SW	50-75,50-75
Sylvietta virens	2	4	R. R, R, FL		NE	0-50,50-75. 50-75,50-75
Tricholaema hirsute	1	3	FL. FL. FL	F	NE	50-75. 50-75,5x0-75
Muscicapa comiqtata	1	2	F. F		NE	50-75

Species abundance

A total of 79 individuals were censored across the counting and observation stations. The findings revealed that *Nicator chloris, Phyllastrephus icterinus, sylvietta virens and Baeopogon indicator* accounted for about 40% the total counts. Backland 1994 recorded similar species abundance and attributed their dominance to adaptability to a variety of habitats. In terms of habitat, secondary habitat recorded 48 individuals as against 20 for the swamp habitat and 11 for savanna. *Nicator chloris* was the most dominance in both secondary forest and savanna while the *Ploceus tricolor* was the most abundant in swamp forest.

Species Frequency

Bird species frequency was also evaluated. *Phyllatrephusicteinus* was observed six times, *Ploceus tricolor, Bleda syndactylaand Merops gularis* were observed five times each. Noteworthy is the observation of these species in at least two different habitats making them highly adaptable to wider food source as food availability in habitat varies. Those observed in only one habitat are highly specific and enjoy territorial dominance. However, they encounter declining population and range when their habitat is challenged with threats**.**

Bird Behaviour

Three behavioural tendencies were evaluated at the time of censoring; feeding, resting and on flight.

- A total of twenty (20) individuals were observed in flight
- Twenty-three (23) were observed resting.
- Thirty-two (32) individuals were observed feeding.

In terms of habitats evaluations, the derived savanna had nine individuals each observed to be feeding and on flight as against eleven (11) resting. In the secondary forest habitat, nine were observed feeding, eight on flight and 12 on rest. In the swamp forest habitat, fourteen were feeding, four were on flight and 1 was resting. *Corvus albus* was always observed feeding, *Halycon badia, Oriolus nigripennis and Dyaphorophyia castanea* was observed always resting. *Tricholaema hirsute* on the other hand was always on flight. Derived bushing would adversely impact these species observed as resting always.

Sex evaluation

The bright colouration of the male was used as discriminatory character. A total of 15 individuals were identified as belonging to any of male or female. Seven were female and eight were male. No defined flocking pattern was observed either among the individuals or among the specific sexes in anyone habitats.

Altitude

Flight altitude was also evaluated, and the findings showed that:

- Twenty-seven (27) individuals were flying within 0-50m altitude
- forty-one (41) individuals were observed within the 50-75m range, a height typical of a transmission tower
- nine (9) individuals were seen flying above 75m.
- all individuals of *Tricholaema hirsute, Dyaphorophyla nigriipennis, Muscicapa comitata* were observed flying in the 50-75 m range only.
- *Hyliaprasina* and *Malimbusrubricolis* had 2 individuals flying in the 75m altitude.

Other species observed in the 50-75 and above the 75m active were in flight. Conversely, there was no species observed exclusively within the 0-50m range. Species within this altitudinal range seems attracted to feeding and resting. Since species in this range were also observed in the 50-75m range, it is most likely that the height of the trees in the habitat is determining factors. They perch on the trees after a long flight duration to rest or when they needed food. A strong correlation coefficient of 0.79 was obtained between altitude and bird behaviour in this study.

Species migration

Some avian species are known to migrate. Avian migration is either regular or irregular (Nomadic interruption or invasions) seasonal movement between north and south. Avian migration is usually driven by food, habitat and changes in weather conditions. These movements are usually between breeding and wintering grounds (Veen *et al.,* 2014). In Nigeria as in other countries in the Northern hemisphere, migratory birds commence this movement between February, March and April to warmer areas and return between August, September and October to winter grounds. Migratory movement often results in high mortality and predation. In this study, *Polybroides typhus* was the sole migratory specie sighted. Details are shown in Table 6.29. February - April is more ideal for migratory bird inventory.

Table 6.29: Details of migratory birds censored in the project area

Species		Common Name	IUCN status	Habitat	Nesting Grounds	Breeding season	Major threats	Conservation actions
Polyboroides typus		African harrier hawk	LC	SSF	Tree tops and branches	September to march	Habitat loss.	Colony protection

Plate 6.11 is a Polybroides typhus, the only migratory species censored in the study area

Source: GNL, 2019

Plate 6.11: Migratory Species of the Study Area

Raptors

A diurnal predatory bird that hunts and feed on rodents, insects and small animals exerts strong biodiversity in fluencies on the ecosystem. In such environments, they act as key stone species by regulating their prey population. Some are known as 'Earth Cleaners; for their role in eating up dead carcasses. Raptors are members of Accipitridae, Pandionidae, Sagittaridae, Falconidae and Cathartidae of Acciptriformes, Apodidae and Falconiformes orders (Fowler *et al*., 2009). In this study, a total of 5 raptor species, belonging to Alcedinida, Ploceidae, and Muscicapidae families were sighted. Table 6.34 shows details of raptors sampled in the study area.

Table 6.30: Raptors of the Study Area

S/N	Species	Common Name	Prey
1	*Halcyon badia*	chocolate-backed kingfisher	Seeds, small fish, amphibians, lizards and insects
2	*Polyboroides typus*	*Harrier hawk*	Rodents, bats, birds, amphibians, lizards and insects
3	*Merops gularis*	black bee-eater	Worms, wood insects, seeds, flies, small fish, earthworm, lava/pupa of insects and lizards
4	*Miscicapa comitata*	dusky-blue flycatcher	
5	*Muscicapa cassini*	Cassin's flycatcher	

Source: GNL, 2019

Species of Conservation Interest

Analysis for the conservation status of the species censored in the project area was conducted using the IUCN 2018-2 Red List of Threatened species. None of the sighted species censored in the study area were of conservation interest as all were categorised as Least Concern (LC).

Ecologically Important Habitats for Birds

The importance of the three study habitats for birds was evaluated by rating each habitat against the 8 ecological indicators. Selected characters were based on birds' activities that would be impacted the most during construction and operational phases of the project. Table 6.31 shows the result.

Table 6.31: Ecologically important habitat for birds

Indicator	Seasonally Flooded Forest	Secondary Forest	Derived Savanna
Species Diversity	7	12	9
Flight Altitude above 50m	11	19	13
Species Abundance	11	18	13
Bird Behaviour – Resting	1	12	11
Bird Behaviour – Feeding	14	9	9
Migratory Species	1	0	0
Raptors Species	3	4	2

Flight Direction in relation to line route (NW and SW)	6	5	2

Source: GNL, 2019

Analysis on sensitivity index for the three habitats showed secondary forest as priority habitat for the bird species. There is no statistically significant difference between bird preferences for savanna and swamp habitat although Derived Savanna had higher value importance.

6.3.2.4 Mammals

6.3.2.4.1 Study methodology

Direct observations

Diurnal and nocturnal expeditions to recognizing evidence of Mammalia species presence was undertaken. Formal transect surveys (already established for flora) were used. Transects were walked slowly and all mammals encountered were identified by sight or sound. In addition, small mammals were systematically surveyed by walking transects. Trapped individuals were marked on the ears to identify subsequent recaptures, and then released.

The trapped as well as the sighted mammals were snapped where possible and identified to the lowest possible taxa specialist. Appropriate field data sheets were employed to capture information like species list with scientific, common and local names and abundance. Same sampling transect was adopted for both plant and animal grouped.

Indirect observations

The recorded evidence was represented both by direct (collections and observations) and indirect (tracks, footprints, scats/faeces, feeding activity, tracks, holes/diggings or scratching and carcass). Local land users were also interviewed about mammals they had seen or hunted in the area, and these were identified from pictures in Powell (1993). The local language names were recorded. Other information gathered from the locals includes habitat history, faunal distribution pattern, seasonal migration, harvesting methods and threats to biodiversity in the study area. Table 6.32 presents the sampling methods.

Table 6.32: Sampling Methods used for the Mammalian groups

Mammalia Group	Survey Technique	Survey Effort per Vegetation Community
Small terrestrial	Small mammal traps	5 traps over 2 consecutive nights
	Hair tubes	2 sites- per site
	Pitfall trapping	2 sites- per site
	Line transect	2 sites- per site
Medium terrestrial	Cage / B Elliott traps	-5 traps over 2 consecutive nights per sampling site
	Hair tubes	2 sites- per site
Arboreal mammals	B Elliott traps	Trapping grid of 0. 1 ha sampling each
		Sampling site, with 5 traps per grid opened for 2 consecutive nights.
	Fecal pellet counts	Minimum of one plot per 100 m^2
	Spotlighting	Walking rate of 200metre/ hour.
	Hair tubes	2 consecutive nights per site
Micro chiropteran		
Bats	Harp traps	1 harp trap nights per site
	Echolocation call	45minute continuous recording plus I call activated all night
	Trip lining	3 hours commencing from dusk
	Mist netting	3 hours commencing from dusk
Mega chiropteran	Spotlighting and listening	Refer to spotlighting for arboreal bats

Conservation Statuses

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2018-2. IUCN categories rank the relative risk of individual taxa becoming extinct in the wild based on a set of standardized criteria.

6.3.2.4.2 Result

A total of 12 Mammalian species were censured in the study area. These include the 7 species that were sighted, and the 5 species censured via indirect evidences. Table 6.33 shows details of the findings.

Table 6.33: Result of Mammalian fauna in the study area

S/N	Scientific name	Local names (Igbo)	Common name	Family	Swamp Habitat	Savanna	Secondary Forest	IUCN	National	Endemic	Breeding	Feeding	Threats/Conservation Actions
1	*Chaerephon nigeriae*		Nigerian free-tailed bat	Molosidae		1	2	LC	Nil	No	March - April	Mainly fruits	Logging
2	*Chaerephon pumilus*		Little free-tailed bat			2	1	LC	Nil	No			
3	*Hypsignathus monstrosus*		hammer-headed bat			2	1	LC	Nil	No			
4	*Nycteris arge*		Bate's slit-faced bat	*Nycteridae*			1	LC	Nil	No			
5	*Xerus erythropus*	Osa	Striped ground squirrel	Sciuridae				LC	Nil	No			

6	*Atherurus africanus*		African Brush-tailed Porcupine	Hystricidae				LC	Absolutely prohibited	No			Hunting
7	*Crocidura nigeriae*		Nigerian shrew	Soricidae				LC	Nil	Yes			
8	*Thryonomys swinderianus*	Oke	*Greater cane rat*	Thryonomyidae	1			LC	Nil	No			
9	*Crossarchus obscures*		ong-nosed kusimanse	Herpestidae				LC	Nil	No			
10	*Epomops franqueti*		Fruit bat	Pteropodidae			1	LC	Nil	No			
11	*Perodicticus potto*		Potto	Lorisidae.				LC	Licence	No			
12	*Scotophilus dinganii*		African yellow bat	Vespertilionidae		1		LC	Nil	No			

6.3.2.4.3 Species diversity

This is the record of all censored taxa in a sampled area. The sighted species in this study area were *Chiroptera*, and *Rodentia* with the exception of *Thryonomys swinderianus* observed in the other habitat. Species were censored in eitherthe savanna or secondary forest. Secondary forest was the preferred habitat for mammals in the stud area. Availability of food, breeding grounds, vegetative cover and the absence of predation and noise are possible attractive features as they provide luxurious habitat for mammals. Their preferred habitats in the study area were encountered at V6, V7, V10 and V13.

6.3.2.4.4 Species abundance

The total number of individual sighted where thirteen (13) with bats accounted for twelve (12) and rat one (1). Six bats individuals were censored in the savanna and another six in the secondary forest. Food resources are perhaps the attraction. The abundance of bats population in relation to pollinators and as prey for important bird species is imperative for efficient ecosystem functioning. However, bats are specifically vulnerable to habitat change such as illumination and physical obstructions caused by electrocution.

6.3.2.4.5 IUCN status

All sighted species were of Least Concern (LC) status using the IUCN Red list 2018 version two criterion. However, two non sighted species *Crocidura nigeriae and Perodicticus potto* are classed in Nigeria Endangered Species Act 2006. as absolutely prohibited and under license respectively. The major threat for the two species is hunting. Also, no endemic species was recorded.

6.3.2.4.6 Habitat of high value

Secondary forest and savanna forest habitats are priority habitats to the mammalian taxon.

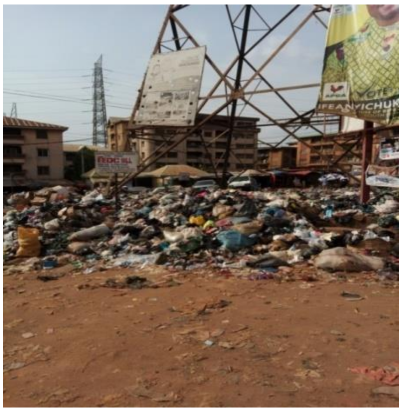
There was no species of conservation interest according to IUCN in the study area. However, 2 species were of conservation interest. These are *Atherurus africanus* (absolutely prohibited) and *Perodicticus potto* (license). Both species were found in secondary forest habitat (V6, V10, V7 and V13). Therefore, conservation of this habitat is imperative.

6.3.3 Protected Areas

Across Nigeria, there are at least 23,608.34km^2 (or 2,360,800 hectares) of land that are designated by national authorities as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes, and areas managed mainly for sustainable use. The only protected area is the National Park around the project zone is Anambra game reserve which is more than 65km away from the project area. However, the project is to be executed on an existing RoW.

6.3.4 Key Ecological and Social Concerns

Some key ecological and social concerns observed during reconnaissance survey are shown pictorially in Plate 6.12.



(A) Gully erosion sites at Ama Apu Ife ***(B) Dumpsite at tower (T1) at Ugwuagba Obosi,***

***(C) Onitsha -* Cross section of the encroached line route at OsokeAma'ato community**

Plate 6.12 (A-C): Some key ecological and social concerns in the project area

The following ecological and social concerns were observed during field gathering process

- High level economic activities under transmission line at Onitsha, Owerri, Ihiala, Aba and Imo axis. It is estimated at about 3,000 encroachers will be evacuated;
- The presence of alien/invasive species;
- Poor access route to most communities in Imo State;
- Line route crossing highway roads; and
- Online route which would result in physical and economic displacement.
- Encroachers The areas are prone to flooding and erosion
- Over harvesting of bio resources and illegal felling of woods for fuel wood
- Unsustainable agricultural practices is prevalent in the area
- High incidence of gas flaring is prevalent in some sections of Imo and Abia State
- There is mutual suspicion of grazing land invasion by pastoralists by the natives

6.4 Social Environment

6.4.1 Political context and Admininstrative Structure

Nigeria is a Federal Republic made up of 36 States and a Federal Capital Territory. Nigeria became an independent state in 1960 and a republic in 1963. Information on the administrative structure and political context of the project area is summarize in Table 6.34.

Table 6.34: Administrative structure

<table>
<tr><td colspan="3">System of Government
Nigeria operates a Three tier arms of government. Federal, State and Local Government Area. She operates a Presidential System of Government</td></tr>
<tr><td rowspan="3">Federal Arm</td><td colspan="2">Executive - Implementation of laws, maintenance of law and order, initiates bill into parliament. It is headed by a President</td></tr>
<tr><td colspan="2">Legislature- Nigeria operates a bicameral (Senate and House of Representatives) legislature. They make laws, approves annual budget, ratification of treaty negotiated by the executive and conduct oversight functions on government activities. The senate is headed by Senate Preseident and the House of Representative is headed by a Speaker</td></tr>
<tr><td>Senatorial District</td><td>House of Representative</td></tr>
</table>

	There are 109 senatorial districts in Nigeria. The project area is represented three senators representing the Central, South and North Senatorial district (Abia state), South, Central and North Senatorial District(Anambra state) and North, West and East (Imo State) senatorial district	There are 360 House members. Abia has eight House members; Anambra has eleven members while Imo has ten members. The project cut across four Federal constituency in Abia State- Osisioma, Aba north, Aba south and Ugwunagbobo), four in Anambra State. (Ekwusigo, Ihiala, Idemili South and Ogbaru) and eight in Imo State (Owerri West, Owerri North, Oru East, Oru West, Njaba, Owerri Municipal, Mbaitoli, Ngor-Okpala) Federal Constituencies
	Judiciary - There is the supreme court, appeal court, federal courts, Industrial court, customary courts of appeal and magistrate court. They Interprets laws, protects the right of individuals. It is headed by a Chief Justice	
State Arm of Government	**Executive**- There are 36 states in Nigeria and the Federal Capital Territory. The Executive arm of the state government is headed by an elected Governor. The proposed project traverse 3 states (Abia, Anambra and Imo state).	
	Legislature - Each state operates a unicameral system headed by a Speaker of the State House of Assembly.	
	Judiciary -There is the State High court, customary courts, andMagistrate courts. The head of the state judiciary arm is the Chief Judge.	
Local Government Arm of Government	**Executive**-The executive arm is headed by a Chairman. This arm performs similar functions to that of the President and Governor at federal and State levels respectively. There is one executive governor each for Abia, Anambra and Imo state.	
	Legislature - The legislature is formed by at least ten wards in each LGA. They make bye laws for the LGA. It is headed by a Speaker. The project cut across four LGA houses of assembly in the project area in Abia State, four in Anambra State and eight in Imo state.	

6.4.2 Land Planning and Uses

Land ownership in the project areais either by community or family. However, by virtue of the Public Lands Acquisition Law, the state government may acquire land compulsorily for public purpose from individual landowner, subject to the payment of compensation to such landowners. A lot of grazing activities is also practiced by the Fulani pastorals. The wayleave is served by the existing road infrastructure and other rural roadways from which access along the wayleave is provided.

The residential areas in Anambra state axis of the project area are mostly rural settlements except Ogbaru (and Beninthat are urban settlements. The population in the PACs is predominately made up of many low and middleincome earners with few high- income earners in the mentioned urban towns. The residential areas and the surrounding sub-places consist largely of single unit residential homes. On the other hand, the rural settlements such as Ebrumede, Ugbomro, Okha and Elume are sparsely populated with low cost, single unit dwellings on small stands. Majority of theinhabitants of these areas live on low income (see discussion on livelihood).

6.4.3 Demography

Following the 2006 census, the National Population Commission (NPC) published the population of Nigeria as 140,431,790 comprising 71,345,488 males and 69,086,302 females. The NPC estimated annual population growth at 3.2% (NDHS, 2008). The current population, projected at 3.2% annual growth and using the exponential model is 180,735,714, with a density is 198.6 per square kilometre. A higher male population and sex ratio of 103 was recorded for the country. Children (age 0-14) constituted 41.8% of the population while those less than 20 years were 52.3% and those less than 25 years 61.9%. The elderly (65 years and above) were 3.2% of the population. The age dependency ratio was 82.0. Given these proportions, the population of Nigeria is quite young. Average household size in Nigeria is 4.9 (NBS 2012), see Table 6.35a and 6.35b.

Table 6.35a: Demographic information of Abia and Anambra States

	Abia				**Anambra**			
	Osisioma	Aba North	Aba South	Ugwunagbobo	Ekwusigo	Idemili South	Ogbaru	Ihiala

Total Area of Land	198km^2	23km^2	49km^2	108km^2	116km^2	137km^2	453km^2	252km^2
Population Density	1,460/km^2	6,087/km^2	11,427/km^2	1,035/km^2	1,807/km^2	1,997/km^2	652.3/km^2	
Population Distribution	220,662	106,844	427,421	85,371	158,429	206,816	223,317	302,277
Men	110,790	53,016	220,541	42,801	80,053	105,830	115,678	152,200
Women	109,872	53,828	206,880	42,570	78,376	100,986	107,639	150,077

Source: NBS 2012

Table 6.35b: Demographic information of Imo state

	Imo							
	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipal	Mbaitoli	Ngor Okpala
Total Area of Land	295km^2	198km^2	93.0km^2	136km^2	84.0km^2	58.0km^2	204km^2	561km^2
Population Density in persons/km^2	474.9/km^2	1,226/km^2	1,713/km^2	1,132/km^2	2,352/km^2	2,976/km^2	1,603/km^2	
Population Distribution	101,754	176,334	115,704	111,743	143,485	125,337	237,474	157,858
Men	49,968	87,094	59,108	56,148	72,401	60,882	118,959	78,829
Women	51,786	89,240	56,596	55,595	71,084	64,455	118,515	79,029

Source: NBS (2012)

6.4.4 Relevant Livelihood Indices of the Project Area

Relevant lively hood of people in the study area are presented in Table 6.36.

Table 6.36: Relevant Livelihood indices of the study area

	General statistics in Nigeria	Abia	Anambra	Imo

Total population (2006 Census)		140,431,790	2,845,380	4,177,828	3,927,563
Projected population (2018 based on an exponential growth rate of 3.2%)		19,435,7597.4	39,380,05.9	57,821,13.9	40,748,46.6
Total Area of Land		923,763km^2	4,900km^2	4,865km^2	5,288km^2
Population Density		198.6/km^2	580.698 persons/ km²	858.752 persons/ km²	742.731 persons/ km²
Population Distribution					
Men		98,742,155.4	19,795,32.43	29,312,89.8	27,354,35.8
Women		95,615,441.9	19,584,73.5	28,508,24.1	27,003,11.328
Children (age 0-14)		41.8%	35.45%	35.5%	36.0%
15–29		28.8%	30.9%	31.3%	30.4%
30 -44		16.56%	16.8%	17.47%	17.111%
Elderly (>65)		3.2%	4.5%	3.9%	4.3%
Literacy rates		59.6	85.1	82.1	74.3
infant mortality level		64.8 deaths/1,000 live births	126 deaths/1,000 live births	27.8 deaths/1,000 livebirths	17.7 death/1,000 live birth
life expectancy		55 years	53Years	51Years	51 years
Youth Literacy in any Language	Female	63.7	97.2	99.2	97.9
	male	79.3	99.4	100.0	96.2

Source: NBS 2012

6.4.5 Community and Household Consultation

Community consultation is an inclusive and culturally appropriate process which involves sharing information and knowledge, seeking to understand the concerns of others project affected persons and building relationships based on collaboration. It allows the community to understand the risks, impacts and opportunities of the project in order to achieve positive outcomes. It involves information dissemination and interaction/dialogues with the host communities of the proposed project.

6.4.6 Conflict Resolution

Civil cases in the communities are arbitrated by the Chiefs-in-Council, Elders-in-Council, religious leaders, traditional priests, age grade, women groups or family heads. On the other hand, inter-communal conflicts are resolved by the representatives (Chiefs) of the communities involved. If it cannot be resolved at that level, the case is taken to the Paramount ruler for adjudication. Criminal cases are referred to the government law enforcement agents. It is of interest to note that most of these communities have never recorded any case of security threat. Nevertheless, the communities have organized themselves into vigilante groups to compliment the security architecture provided by the State.

With respect to the project, predicted sources of conflicts include:

- Non-recognition of communities as critical stakeholders
- Border land disputes
- Agitation for employment/contracts
- Issue of non -payment of compensation when the existing route was acquired
- Perceived intimidation of the communities
- Perceived "divide and rule tactics"
- Ineffective communication channels

This study did not find any specific current issue that could conceivably lead to full blown conflicts with the TCN. However, agitation remains for issues such as economic displacement, loss of land and livelihood, impact of the project on community health and compensation. The TCN shall build on the existing cordial relationship between her and these communities through enhanced continuous engagement and payment of compensation. It is however canvassed that the TCN should carefully study the existing conflict resolution strategies in these communities for adoption since conflicts are better resolved at this level for sustained peace rather than adjudication in the court of law.

6.4.7 Household and Community Characteristics

Two types of questionnaires were administered – Household and community based. The household questionnaires were administered to all available homesteads within 500m on either side of the RoW. A total of 600 household questionnaires wereadministered and 560 retrieved representing a success rate of 93.3 % (about 53% of total household in project area) while 110 community questionnaires were recovered out of 118 initially administered representing a success rate of 93.2% (same as percentage of of communities censored). The results shall be presented on LGA basis for ease of clarity.

6.4.8 Population and Sex

The respondent population and sex of the project area are presented in Tables 6.37 (a-c).

Table 6.37a: Respondent population age and sex in Anambra State

Age Bracket	Ekwusigo		Idemili South		Ogbaru		Ihiala	
	Male (%)	**Female (%)**	**Male (%)**	**Female %)**	**Male (%)**	**Female %)**	**Male (%)**	**Female (%)**
1-18	17.4	17.8	17.0	17.7	18.7	18.0	17.6	18.5
19-39	15.2	15.0	14.9	14.5	14.2	14.3	14.6	14.7
40-65	12.3	11.5	13.0	13.1	12.9	12.7	12.9	12.1
>65	5.2	5.6	4.1	4.3	4.2	5.0	4.9	4.7

Persons with age bracket of (1-18) years form a bulk of the population (above 36%) across the LGAs, while those above 65 years of age were the least (below 10%). This implies that 46% of the respondents are in the dependent category while the remaining 54% which fall under the age bracket of 19-65 years are potential labour force that could participate actively during the initial decommissioning of the existing line and construction of the new line.

Table 6.37b: Respondent population age and sex ofProject Communities in Abia State

Age Bracket	Osisioma		Aba North		Aba South		Ugwunagbobo	
	Male (%)	**Female (%)**	**Male (%)**	**Female (%)**	**Male (%)**	**Female %)**	**Male (%)**	**Female %)**
1-18	17.7	17.9	16.8	17.0	16.6	17.1	18.4	18.2
19-39	15.6	15.3	14.5	14.9	14.5	14.6	14.4	14.5
40-65	12.6	11.8	12.8	13.0	13.2	13.3	12.3	12.2
>65	4.3	4.8	4.7	6.3	4.9	5.8	4.9	5.1

Persons with age bracket of (1-18) years form a bulk of the population (above 35%) across the LGAs, while those above 65 years of age were the least (below 10%). This implies that 45% of the respondents are in the dependent category while the remaining 55% which fall under the age bracket of 19-65 years are potential labour force that could participate actively during the initial decommissioning of the existing line and construction of the new line.

Table 6.37c: Respondent population age and sex of Project Communities in Imo State

Age Bracket	Owerri West		Owerri North		Oru West		Oru East		Njaba		Owerri Municipality		Mba toli	Ngor Okpalla
	M (%)	**F (%)**	**M (%)**	**F (%)**	**M (%)**	**F (%)**	**M (%)**	**F (%)**	**M (%)**	**F (%)**	**M (%)**	**F (%)**	**M (%)**	**F (%)**
1-18	17.1	17.3	16.4	16.1	16.3	16.3	18.1	18.6	18.1	18.2	17.6	18.1	17.4	17.7
19-39	15.1	15.4	14.8	15.1	14.7	14.2	14.9	14.2	15.9	16.3	14.7	14.9	15.2	15.5
40-65	12.4	11.5	12.6	12.9	13.4	13.1	12.6	12.7	13.7	12.0	12.2	12.4	13.1	13.2
>65	5.8	5.4	5.1	7	5.2	6.8	5.3	3.6	3.1	2.7	4.8	5.3	3.4	5

F=female, M=male

Persons with age bracket of (1-18) years form a bulk of the population (above 35%) across the LGAs, while those above 65 years of age were the least (below 10%).This implies that 45% of the respondent are in the dependent category while the remaining 55% which fall under the age bracket of 19-65 years are potential labour force that could participateactively during the initial decomissioning of the existing line and construction of the new line.

6.4.9 Gender of Heads of Household

Information on the gender and number of household heads in the project area is presented in Table 6.38 (a-c).

Table 6.38a: Gender of Head of Respondent Households of Project Communities in Anambra State

Gender	Ekwusigo	Idemili South	Ogbaru	Ihiala	Total	Average (%)
Male	40	29	38	35	142	83
Female	5	6	9	9	29	17

TOTAL	45	35	47	44	171	

The 83% male househeads is less than the Nigerian average of 85.7%, though all areas in the line route have more male house heads. Reasons being because of the culture and traditions of the people in the project area which does not promote female leadership.

Table 6.38b: Gender of Head of Respondent Households in Abia State

GENDER	Osisioma	Aba North	Aba South	Ugwunagbobo	Total	Average (%)
Male	33	36	48	47	164	88.2
Female	3	7	6	6	22	11.8
TOTAL	36	43	54	53	186	

The 88.2% male househead is less than the Nigerian average of 85.7%. Nonetheless all areas in the line route have more male house heads. The culture and traditions of the Ibo'sdoess not promote female leadership.

Table 6.38c: Gender of Head of Respondent Households of Project Communities in Imo State

GENDER	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipal	Mbatoli	Ngor Okalla	Total	Average (%)
Male	28	22	21	24	21	17	19	22	174	85.7
Female	2	3	4	4	3	3	5	5	29	14.3
TOTAL	30	25	25	28	24	20	24	27	203	

Although the 85.7% male househead is consistent with the Nigerian average of 85.7%, all areas in the line route have more male house head. The reason being that of the culture and traditions of the people in the project area which does not promote female leadership.

6.4.10 Marital Status of Head of Households

Table 6.39 (a-c} shows the marital status of heads of household.

Table 6.39 a: Marital Status of Heads of Households of Project Communities in Anambra State

GENDER	Ekwusigo	Idemili South	Ogbaru	Ihiala	TOTAL	PERCENT (%)	NBS (2011) data for Anambra (%)
Single	8	6	9	8	31	18	38.2
Married	24	18	23	23	88	52	48.2
Widowed	9	7	10	9	35	21	12.0
Divorced/Separated	3	4	5	3	15	9	1.6
TOTAL	44	35	47	43	169	100	100

There are more married household heads in all the communities within Anambra state. Most female households in the project area are widows. When compared to the result obtained from NBS, 2011, the result for all statuses slightly fell short except for the single category which revealed a huge margin of about 20.2%.

Table 6.39b Marital Status of Heads of Household of Project Communities in Abia State

GENDER	Osisioma	Aba North	Aba South	Ugwunagbobo	TOTAL	PERCENT (%)	NBS (2011) data for Abia (%)
Single	12	14	16	14	56	30	38.1
Married	15	24	30	24	93	50	50.5
Widowed	6	3	5	12	26	14	10.6
Divorced/Separated	3	2	3	3	11	6	0.8
TOTAL	36	43	54	53	186	100	100

There are more married household heads in all the communities within Abia state. The result for all statuses slightly fell short of those obtained from NBS, 2011.

Table 6.39 c Marital Status of Heads of Household in Imo State

GENDER	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipal	Mbatoli	Ngor Okalla	TOTAL	PERCENT (%)	NBS (2011) data for Abia (%)
Single	5	4	3	5	3	4	5	6	35	17	40.7
Married	13	10	12	11	14	7	14	13	94	47	48.2
Widowed	6	7	8	12	6	4	3	3	49	24	10.7
Divorced/ Separated	6	4	2	0	1	5	2	3	23	12	0.4
TOTAL	30	25	25	28	24	20	24	25	201	100	100

There are more married household heads in all the communities within Imo State. The result for all statuses slightly fell short of those obtained from NBS, 2011.

6.4.11 Nature of Marriages

Data obtained for nature of marriages among for households in the project area is presented in Table 6.40 (a-c).

Table 6.40a: Nature of Marriages among Respondent Households in Anambra State

GENDER	Ekwusigo	Idemili South	Ogbaru	Ihiala	Total	Average (%)
Monogamous	23	16	23	22	84	95.5
Polyganous	1	2	0	1	4	4.5
TOTAL	24	18	23	23	88	

The 95% of monogamous marriages across all the communities in the project area is above the Nigerian and South-East averages of 76.1 and 70.7% respectively. There were more monogamous marriages across all communities in project area. This could be attributed to the religious (Christianity) belief system which prohibits polygamy. However, the culture of the people as informed by the respondents does not prohibit polygamy.

Table 6.40b: Nature of Marriages among Respondent Households in Abia State

GENDER	Osisioma	Aba North	Aba South	Ugwunagbobo	Total	Average (%
Monogamous	10	23	27	23	83	89.2
Polyganous	5	1	3	1	10	10.8
TOTAL	15	24	30	24	93	

The 89% of monogamous marriages across all the communities in the project area is above the Nigerian and South-East averages of 76.1 and 70.7% respectively. There were more monogamous marriages across all communities in project area.

Table 6.40c: Nature of Marraiges among Respondent Households in Imo State

GENDER	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total	Average (%
Monogamous	12	8	7	11	12	6	12	10	78	83.9
Polygamous	1	2	5	0	2	1	2	3	16	16.1
TOTAL	13	10	12	11	14	7	14	13	94	

The 84% of monogamous marriages across all the communities in the project area is above the Nigerian and South-East averages of 76.1 and 70.7% respectively. There were more monogamous marriages across all communities in project area.

6.4.12 Household Size

Information on household size of the communities in each of the LGAs is presented in Table 6.41 (a-c).

Table 6.41a: Household size of communities in Anambra

Numbers per household	Ekwusigo	Idemili South	Ogbaru	Ihiala	(%) Average
1-2	8.4	15.1	11	8.6	10.4
3-5	76	69.1	70.3	66.1	70.7
6-10	13.5	12.3	16.1	19.2	15.3

11-15	2.1	3.5	2.6	3.4	2.9
>15	0	0	0	1	0.3

The dominant household sizes in the project area are those made up of 3-5 persons and 6-10 persons accounting for about 86% of the households. The findings are in tandem with 2010 NBS statistics which put the average family size in Anambra State at 3.9 persons. At the national level, the number of persons in the size class 3-8 was about 136million.

Table 6.41b: Household size of communities in Abia

Numbers per household	Osisioma	Aba North	Aba South	Ugwunagbobo	(%) Average
1-2	5.3	20.4	9.3	6.8	10.4
3-5	78.2	63.1	78.4	80.2	74.6
6-10	14.3	13.4	11	8.9	11.8
11-15	4.1	3.1	1.3	4.1	3.1
>15	0	0	0	0	0

The dominant household sizes in the project area are those made up of 3-5 persons and 6-10 persons accounting for about 86.4% of the households.The findings are in tandem with 2010 NBS statistics which put the average family size in Abia State at 3.7 persons.At the national level, the number of persons in the size class 3-8 was about 136million.

Table 6.41c: Household size of communities in Imo

Number per household	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	(%) Average
1-2	13.4	8.4	11.2	15.7	13.6	12.1	12.5	11.7	12.3
3-5	79.2	75.1	69.7	70.8	72.1	68.5	75	70.9	72.7
6-10	6	9.4	13.9	8.4	11.1	17.5	8.4	12.3	10.9
11-15	1.4	7.1	4.2	5.1	3.2	1.9	4.1	5.1	4
>15	0	0	1	0	0	0	0	0	0.1

The dominant household sizes in the project area are those made up of 3-5 persons and 6-10 persons accounting for about 83.6% of the households. The findings is in tandem with 2010 NBS statistics which put the average family size Imo State at 3.7 persons. At the national level, the number of persons in the size class 3-8 was about 136million.

6.4.13 Ethnic Composition

Ten ethnic groups were observed to be present within the project area. These ethnic groups and their respondent populations in each affected LGA are presented in Table 6.42 (a-c). The data revealed dominance of the landowners (Ibo) where the proposed project is to be sited. The results also revealed high relationship between project area and the contiguous ethnic groupings. This was evident in the presence of Anioma, Iteskiri, Ijaw Afemai, Ishan and Isoko.

Table 6.42a: Ethnic Groups in Anambra Section of the Project Area

Ethnicity	Ekwusigo	Idemili South	Ogbaru	Ihiala	Total	% Total
Ibo	39	29	36	30	134	78.4
Anioma	2	4	5	4	15	8.8
Edo, Afemai & Ishan	0	0	1	2	3	1.8
Hausa/Fulani	1	0	1	1	3	1.8
Ijaw	0	0	0	1	1	0.5
Ibibio & Efik	1	1	1	0	3	1.8
Isoko, Itsekirii & Urhobo	1	0		0	2	1.16
Tiv & Idoma	0	1	1	2	4	2.3
Ikwerre	0	0	0	1	1	0.5
Yoruba	1	0	1	3	5	2.9

Expectedly, the most represented Ethnic group in the communities within Ananbra State is Ibo, accounting for 78.4 % of the population while the Ikwerre and Ijaw were the least represented group.

Table 6.42b: Ethnic Groups in Abia Section of the Project Area

Ethnicity	Osisioma	Aba North	Aba South	Ugwunagbobo	**Total**	**% Average (%)**
Ibo	26	33	38	41	138	74.2
Anioma	5	0	10	7	22	11.8
Edo, Afemai & Ishan	1	1	0	0	2	1
Hausa/Fulani	0	1	0	0	1	0.5
Ijaw	0	0	1	0	1	0.5
Ibibio & Efik	0	1	0	2	3	1.6
Isoko, Itsekirii & Urhobo	0	0	1	0	1	0.5
Tiv & Idoma	1	0	1	0	2	1
Ikwerre	2	3	3	2	10	5.4
Yoruba	1	4	0	1	6	3.2

Expectedly, the most represented Ethnic group in the communities within Abia state is Ibo, accounting for 78.4 % of the population while the Tiv/Idoma and Ijaw were the least represented group.

Table 6.42c: Ethnic Groups in Imo Section of the Project Area

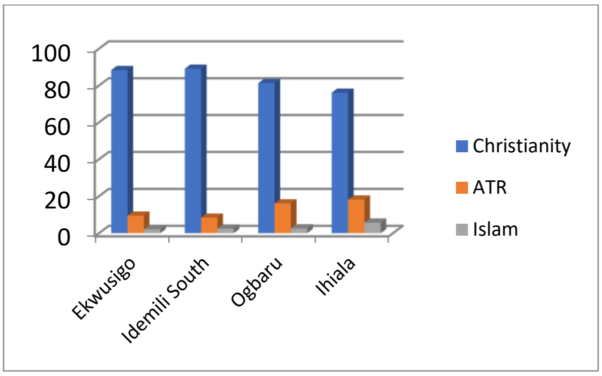
Ethnicity	Local Governments								
	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngorlkalla	**% Average**
Ibo	14	15	16	19	14	8	12	13	54.7
Anioma	5	2	1	4	1	3	2	3	10.3
Edo, Afemai & Ishan	3	0	0	1	1	1	0	1	3.4
Hausa/Fulani	2	2	2	0	0	1	0	1	3.9
Ijaw	0	0	1	0	0	2	2	3	3.9
Ibibio & Efik	0	0	1	0	2	1	1	2	3.4
Isoko, Itsekirii & Urhobo	0	1	0	0	0	1	0	0	1

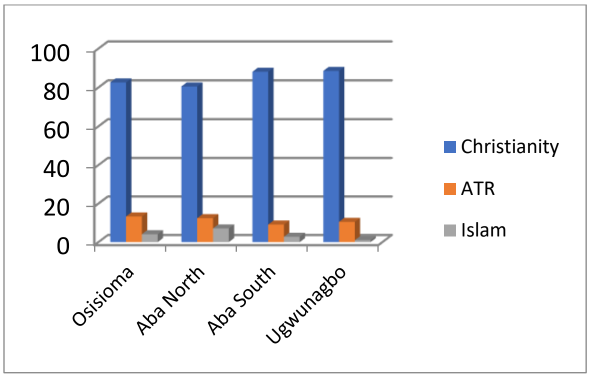
Tiv & Idoma	0	1	1	2	0	0	3	1	3.9
Ikwerre	4	2	2	1	3	1	2	1	7.9
Yoruba	2	2	1	1	3	2	2	2	7.4

Expectedly, the most represented Ethnic group in the communities within Imo state is Ibo, accounting for 78.4 % of the population while the Isoko, Itsekirii& Urhobo were the least represented group.

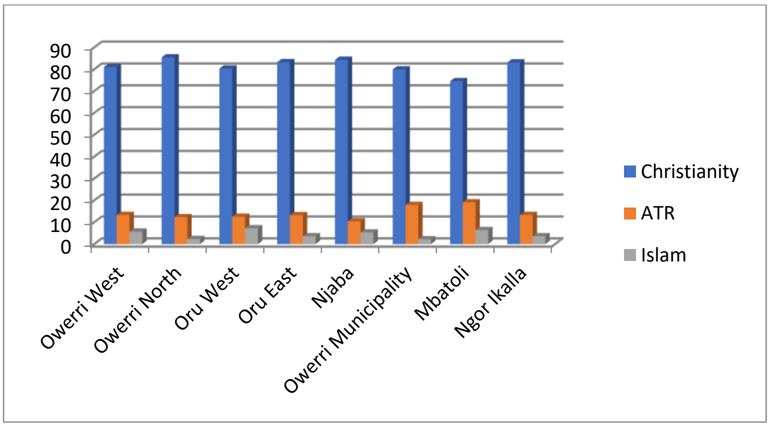
6.4.14 Religion

The study revealed that the people are adherents of three religions. These are Christianity, Animist/ African Traditional Religion (ATR) and Islam. Christianity was the most practiced religion withabout 97.6% of the respondents across all communities within the three project states. This was followed by ATR with an average of 2.8%. While about 0.06% were adherents of the Islamic Faith (Figure 6.13 a, b, c).





Anambra (a) **Abia (b)**



Imo

Figure 6.13 (a, b, c): Religion of the study area

Majority of the christiians in the project area area are catholics. The Islamic and Christianity adherents in the area observe the worldwide traditional Muslim and Christian festivals respectively. Traditional festivals offer opportunities for the people to seek divined favour, prosperity, bumper harvest, peace, security, long lives and good health for the communities. Such days will be observed as work-freeby TCN and the EPC contractor.

6.4.15 Existing Infrastructures

6.4.15.1 Educational Facilities

During the focus group discussion (FGD), information gathered for educational facilities in the project area is as presented in Tables 6.47(a-c). Generally, result revealed the presence of about 329 educational facilities in the project area. This comprise of 219 primary schools, 106 secondary schools and 4 tertiary institutions. Some of the educational facilities include; Umuota Primary School (Obosi), St Peter's Primary School (Ozobulu), Uzoakwa Central School, Umudike (Ihiala), Umuode Community School (Umuode), Umuneke Community School (Ngor), Ohabiam Primary School 1 and 2 (Ohabiam), Commercial Secondary School (Ozobulu), Christ the King Secondary School, okpalla (Ngor), City Laboratory Comprehensive Secondary School (Ariaria), Chukwuemeka Odumegwu Ojokwu University, uli (Ihiala), and Federal University of Technology, Owerri, Imo State University, Owerri, Alvan-Ikoku Federal College of Education, Owerri Municipal.

Table 6.43a: Educational Facilities in Anambra State

Category	Osisioma	Aba North	Aba South	Ugwunagbo	Total
Primary	9	14	20	8	51
Secondary	5	6	11	4	26
Tertiary	0	1	1	0	2
Total	14	21	32	12	79

As could be seen in Table 6.43a, a total of 79 educational facilities are present in communities within the Anambra state section of the project area. A breakdown revealed the presence of 51 primary schools, 26 secondary schools and 2 tertiary institutions.

Table 6.43b: Educational Facilities in Abia State

Category	Ekwusigo	Idimili South	Ogbaru	Ihiala	Total
Primary	15	12	15	10	52
Secondary	13	7	9	6	35

Tertiary	0	0	0	0	0
Total	28	19	24	16	87

As could be seen in Table 6.43b, a total of 87 educational facilities are present in communities within the Abia state section of the project area. A breakdown revealed the presence of 52 primary schools, 35 secondary schools and no tertiary institution.

Table 6.43c: Educational Facilities in Imo State

Category	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipal	Mbatoli	Ngor Okalla	Total
Primary	20	15	10	18	14	20	12	7	116
Secondary	7	6	5	7	5	8	4	3	45
Tertiary	0	1	0	0	0	1	0	0	2
Total	27	22	15	25	19	29	16	10	163

As could be seen in Table 6.43c, a total of 163 educational facilities are present in communities within the Imo state section of the project area. A breakdown revealed the presence of 116 primary schools, 45 secondary schools and 2 tertiary institutions.

Generally, the manpower in virtually all the schools in the project area are inadequate with an average teacher/student ratio of over 1:38. About 43 % of the existing schools lack basic facilities like water supply and toilet. In addition, instruction materials are grossly inadequate.

6.4.15.2 Water

Information on the number of boreholes as well as protected streams in each of the project LGA is presented in Table 6.44 (a-c). A total of 294 are present in the project area. This comprises of 268 private boreholes, 21 communal boreholes and 5 protected/unprotected springs. The number of privately-owned boreholes is higher compared to communally owned ones. All the functional boreholes rely more on AC powered sources to pump water. It was also observed that the communally owned boreholes have obsolete pipes and fittings.

Table 6.44a Number of water sources across the project area in Anambra State

Category	Ekwusigo	Idimili South	Ogbaru	Ihiala	Total
Communal boreholes	3	0	3	0	6
Private boreholes	21	18	18	12	69
Protected spring (wells)	1	0	3	1	5

As could be seen in Table 6.44a, a toal of 69 private boreholes is present in communities within Anambra section of the project area, with 6 communal boreholes and 5 protected springs (wells).

Table 6.44b Number of water sources across the project area in Abia State

Category	Osisioma	Aba South	Aba North	Ugwanag	Total
Communal boreholes	2	3	0	2	7
Private boreholes	19	14	18	17	68
Protected spring (wells)	0	0	0	0	0

As could be seen in Table 6.44b, a toal of 68 private boreholes is present in communities within Abia section of the project area, with 7 communal boreholes and no protected springs (wells).

Table 6.44c: Number of water sources across the project area in Imo State

Category	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total
Communal boreholes	1	2	0	3	0	2	0	0	8
Private boreholes	19	13	17	18	13	29	12	10	131
Protected spring (wells)	0	0	0	0	0	0	0	0	0

Source: GNL 2019

As could be seen in Table 6.44c, a toal of 131 private boreholes is present in communities within Abia section of the project area, with 8 communal boreholes and no protected springs (wells).

6.4.15.3 Household Facilities

Several facilities were surveyed to be present in the households of the project area. These include power generators, televisions, cars/trucks, refrigerators, etc. (Table 6.45a-c). Lighting and cooking equipment were the most frequently found in the households of the project area. Most of these facilities are meant to improve the livelihood of the households while others are income generating. They serve as indices to infer the quality of life of the PAPs.

Table 6.45a: Household Facilities among Respondents in Anambra State

FACILITIES	Ekwusigo	Idemili South	Ogbaru	Ihiala	TOTAL
Power generator	12	15	10	13	50
Gas stove/Kerosene	13	15	12	11	51
Refrigerator	10	13	12	9	44
Television	15	14	13	8	50
Radio/cassette/music system	16	13	15	6	50
Car/Truck	8	8	9	4	29
Motorcycle	3	5	2	2	19
Bicycle	1	3	0	1	5
Plow	0	0	0	0	0
Cart	0	0	0	0	0
House in town	2	2	1	2	7
Land in town	2	1	3	1	7
TOTAL	82	89	77	57	**305**

A total of 305 facilities were reported to be owned by PAPs in communites within Anambra state of the project area. Gas stove/Kerosene and Radio systems recorded the highest amount while facilities like carts and ploughs were absent.

Table 6.45b: Household Facilities among Respondents in Abia State

FACILITIES	Osisioma	Aba North	Aba South	Ugwunagbo	TOTAL
Power generator	12	14	15	16	57
Gas stove/Kerosene	15	13	17	13	58

Refrigerator	10	9	13	12	44
Television	14	11	10	13	48
Radio/cassette/music system	17	9	10	17	53
Car/Truck	2	3	5	5	15
Motorcycle	3	2	2	4	11
Bicycle	1	2	1	0	4
Plow	0	0	0	0	0
Cart	0	0	0	0	0
House in town	2	2	2	2	8
Land in town	1	1	1	3	6
TOTAL	77	66	76	85	**304**

A total of 304 facilities were reported to be owned by PAPs in communites within Abia state of the project area. Gas Power generator and Gas stove/Kerosene recorded the highest amount while facilities like carts and ploughs were absent.

Table 6.45c: Household Facilities among Respondents in Imo State

FACILITIES	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	TOTAL
Power generator	16	13	14	11	8	20	12	11	105
Gas stove/Kerosene	12	15	15	9	11	21	11	9	103
Refrigerator	14	14	10	12	8	17	9	9	93
Television	15	13	9	15	8	20	11	10	101
Radio/cassette/ music system	16	10	12	16	3	22	13	12	104
Car/Truck	10	4	4	6	2	14	9	3	52
Motorcycle	4	5	2	3	3	5	4	2	28
Bicycle	1	2	1	0	2	2	1	1	10
Plow	0	1	0	0	0	1	0	0	2

Cart	0	0	0	0	0	0	0	0	0
House in town	3	3	2	2	2	3	2	1	18
Land in town	2	1	1	4	1	3	1	1	14
TOTAL	93	81	70	78	48	128	73	59	**630**

Source: GNL, 2019

A total of 630 facilities were reported to be owned by PAPs in communites within Imo state of the project area. Power generator and Radio systems recorded the highest amount while facilities like carts and ploughs were the least owned.

6.4.16 Household Construction Materials

The types of materials used in constructing household dwellings were also surveyed. These materials are those used in roofing, walling and flooring. These parameters are an indirect index of life quality.

6.4.16.1 Roofing materials

Iron sheets and aluminum accounted for a high percentage of the roofing materials in the area. The least used roofing material is the bamboo/reed. The percentage of uncompleted building could be indicative of the prevailing economic situation in the area. Results on the roofing materials is presented in Table 6.46 (a-c).

Table 6.46a: Roofing Materials of Houses in Communities within Anambra State

Material	Ekwusigo	Idimili South	Ogbaru	Ihiala	Total	Average (%)
Corrugated Iron Sheets	19	21	16	18	74	68.5
Thatch	5	0	2	4	11	10.2
Asbestos	1	3	0	1	5	4.6
Bamboo/reed	2	0	0	0	2	1.9
Aluminum roofing	0	2	7	2	11	10.2
Nil / No roof / Not completed	1	1	3	0	5	4.6
Total	28	27	28	25	108	

Table 6.46b: Roofing Materials of Houses in Communities within Abia State

Material	Osisioma	Aba North	Aba South	Ugwanag	Total	Average (%)
Corrugated Iron Sheets	17	15	19	15	66	66.7
Thatch	1	2	3	2	8	8.1
Asbestos	0	1	3	0	4	4.0
Bamboo/reed	2	0	0	3	5	5.1
Aluminum	5	3	1	2	11	11.1
Nil / No roof / Not completed	1	2	0	2	5	5.1
Total	26	23	26	24	99	

Table 6.46c: Roofing Materials of Houses in Communities within Imo State

Material	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total	Average (%)
Corrugated Iron Sheets	10	9	8	5	3	10	6	5	56	35
Thatch	2	1	2	1	2	6	1	1	16	10
Asbestos	0	1	0	2	0	0	2	3	8	5
Bamboo/reed	0	0	0	0	0	0	0	0	0	0.0
Aluminium	8	3	5	7	5	11	8	7	54	33.8
Nil / No roof / Not completed	3	2	1	3	1	6	5	5	26	16.3
	23	16	16	18	11	33	22	21	160	

Source: GNL Survey, 2019

Over 60% of houses in the project area are roofed with corrugated Iron Sheets except in communities in Imo State with a bulk of the buildings (33.8%) had also roofed with aluminium sheet.

6.4.16.2 Walling Materials

On the average, the use of concrete blocks as walling materials is predominant in the study area. However, the use of thatch is most pronounced in some communities. It was also observed that woods were not recorded as walling material. Results of household walling materials are presented in Table 6.47 (a-c).

Table 6.47a: Walling Materials of Houses in Communities within Anambra State

Walling Material Type	Ekwusigo	Idimili South	Ogbaru	Ihiala	Total	Average (%)
Mud	2	1	1	0	4	3.7
Mud bricks	0	0	0	1	1	0.9
Wood	0	0	0	0	0	0.0
Thatch	4	1	1	3	9	8.3
Compacted (combine)	0	0	0	1	1	0.9
Concrete (blocks)	21	25	26	20	92	85.2
Others (Taupulin, zinc)	1	0	0	0	1	0.9
TOTAL	28	27	28	25	**108**	

Concrete block was the predominant household walling material used for the construction of houses in communities within Anambra state. On the other hand, mud bricks, and compacted materials were the least used while no house within this section was built with wood. This is an indication that PAPS in this section of the project area have a good standard of living.

Table 6.47b: Walling Materials of Respondent Houses in Abia State

Walling Material Type	Osisioma	Aba North	Aba South	Ugwunagbobo	Total	Average (%)
Mud	0	2	2	3	7	7.0
Mud bricks	3	0	0	1	4	4.0
Wood	0	0	1	0	1	1.0
Thatch	0	1	1	1	3	3.0
Compacted (combine)	0	0	0	1	1	1.0
Concrete (blocks)	23	21	22	18	84	84.0
Others (Taupulin, zinc)	0	0	0	0	0	0.0

The discussion is same as for communities within Anambra State.

Table 6.47c: Walling Materials of Respondent Houses in Imo State

Walling Material Type	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total	Average (%)
Mud	2	2	2	1	1	4	2	1	15	9.4
Mud bricks	1	3	1	1	0	2	1	2	11	6.9
Wood	1	0	0	0	0	0	0	1	2	1.3
Thatch	0	1	0	0	2	2	1	1	7	4.4
Compacted (combine)	0	0	0	2	0	1	2	1	6	3.8
Concrete (blocks)	19	10	13	14	8	21	12	15	112	70
Others (Taupulin, zinc)	0	0	0	0	0	3	4	0	7	4.4

Source: GNL Survey 2019

The discussion is same as for communities within Anambra state.

6.4.16.4 Flooring Material

Five flooring materials were observed to be in use in the entire project area details of the flooring materials are presented in Table 6.48 (a-c).

Table 6.48a: Flooring Materials of Houses in communities within Anambra State

Material type	Ekwusigo	Idemili South	Ogbaru	Ihiala	Total	Average (%)
Earth/sand/dirt/straw	4	2	1	3	10	9.3
Smoothed mud	2	0	1	2	5	4.6
Smooth cement	14	19	19	16	68	63
Wood/planks	1	0	0	0	1	0.9
Ceramic tiles	7	6	7	4	24	22.2

Smooth cement is the most used walling materials used for houses in communities within Anambra state representing about 63% of the flooring materials while wood and plank recorded the least.

6.48b: Flooring Flooring Materials of Houses in communities within Abia State

Material type	Osisioma	Aba South	Aba North	Ugwunagbo	Total	Average (%)
Earth/sand/dirt/straw	1	1	2	3	7	7.2
Smoothed mud	1	0	2	2	5	5.2
Smooth cement	14	16	15	14	59	59.2
Wood/planks	1	1	0	1	3	3.2
Ceramic tiles	9	5	7	4	25	25.2

Smooth cement is the most prevalent walling materials used for houses in communities within Abia State, representing about 59.2% of the flooring materials while wood and plank recorded the least.

6.48c: Flooring Materials of Respondent Houses in the Project Area in Imo State

Material type	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total	Average (%)
Earth/sand/dirt/straw	1	2	3	2	1	5	4	2	20	12.5
Smoothed mud	1	3	0	1	2	5	5	2	19	11.9
Smooth cement	15	8	12	12	7	16	10	12	92	57.5
Wood/planks	1	1	0	1	0	2	1	2	8	5.0
Ceramic tiles	5	2	1	2	1	5	2	3	21	13.1

Source: GNL. 2019

Smooth cement is the most prevalent walling materials used for houses in communities within Imo State, representing about 57.5 % of the flooring materials, while wood and plank recorded the least.

6.4.17 Transport Facilities

Atani road

Plate 6.13: Linked roads to TL

The project area is traversed by several roads.

There are about 26 linked roads from any of the three roads to the transmission line as shown in Table 6.49.

Table 6.49: Details of Roads in the Project Area

	Name of Road	Length (m)	Land Use
Owerri-Aba Express Way	Umunekelhitte road	2,499.27	Farming and Built-up Area
	Along Umu Owa	1,857.73	Built-up Area
	Emi Agabrii road	1,147.21	Farming
	Umuakpara road	2,226.48	Built-up Area and Farming
	Owerri Ring Road	4,000.76	Built-up Area, riparian vegetation and farmland
Port Harcourt-Aba Express Way	Omenazust	381.712	Built-up Area
	Portharcourt road	386.46	Farming
	Umojima road	1,096.52	Built-up Area and Farming
	AbayiAriara road	374.87	Built-up
	Deeper Life Road, Aba	355.34	Built-up Area
	Faulk Road	381.34	Built-up area
	Awoomuma Rd,	3,546.98	Built-up area

Owerri – Onitsha express Way	Isieke Road	2,909.32	Built-up area, forest, farmland
	Mgbidi Omima powerline Rd,	3,266.17	Built-up area farmland and riparian vegetation
	Uli Powerline Rd,	4,467.34	Build-up
	Ihiala Orlu Rd,	2,412.86	Built up area
	Okija poweline Rd,	717.78	Built up area
	Ozubulu Rd	1,484,33	Built up area
	Oraifite Rd,	286.56	Built up area and riparian forest
	Old Oba Rd,	195.34	Built up area
	New Oba	475.32	Built up area
	Obosi Rd,	437.85	Built up area and riparian vegetation
	Awada powerline Rd.	339.98	Built up area

Public buses, cars and motorcycles are the major means of transportation in the project area. Public motor vehicles ply roads that link the project communities to major towns while motorcycle transport is used for shorter distances and unpaved roads.

6.4.18 Communication Facilities

The people in all the communities have access to mobile communication through fixed wireless lines provided by communication service providers like MTN, GLO, AIRTEL and 9 Mobile. There are postal services in most of the communities in Abia. But there are no postal services in the communities in Anambra and Imo, but the inhabitants obtain news about other parts of Nigeria and the world through radio, television and the mobile handsets.

6.4.19 Health

This section presents the baseline health data based on information generated from sampled groups in the study communities. Data obtained from these facilities were subsequently compared with state and National data and averages that are available.

Health Facilities

There are about 53 health facilities in the project area. This comprises of twenty-four (24) Primary Health Centres (PHC) and twenty-nine (29) hospitals. Majority of the hospitals are privately owned. The health facilities provide both outpatient and in-patient services. Some of the health facilities in the project area include; General Hospital at Oriafite, Urban Hospital and Maternity, Comprehensive Health Centre, General Hospital at Ihiala, Government Cottage Hospital at Osisioma, Bethel Hospital in Aba, New Cross Hospital Limited, Owerri North, Federal Medical Centre at Owerrri, and Imo University Teaching Hospital annex. The number of health facilities present in each LGAs of the project area is presented in Tables 6.50 (a-c).

Table 6.50a: Number of health facilities in Host communities of Anambra state

Category	Ekwusigo	Idimili South	Ogbaru	Ihiala	Total
PHC	2	2	2	1	7
Hospital	2	1	1	1	5
Total	4	3	3	2	12

The health facilities in the communities within Anambra State are twelve (12) in total. This comprises of seven (7) Primary Health Centres (PHC) and five (5) hospitals.

Table 6.50b: Number of health facilities in Host communities of Abia State

Category	Osisioma	Aba North	Aba South	Ugwunagbobo	Total
PHC	2	2	2	1	7
Hospital	1	5	4	2	12
Total	3	7	6	3	19

The health facilities in the communities within Abia state are 19 in total. This comprises of seven (7) Primary Health Centres (PHC) and twelve (12) hospitals.

Table 6.50c: Number of health facilities in Host communities of Imo State

Category	Owerri West	Owerri North	Oru East	Oru West	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total

PHC	2	1	2	1	0	2	1	1	10
Hospital	2	1	1	1	2	2	1	2	12
	4	2	3	2	2	4	2	3	22

Source: GNL 2019

The health facilities in the communities within Imo state are 22 in total. This comprises of ten (10) Primary Health Centres (PHC) and twelve (12) hospitals.

Prevalence of Diseases in in the study area

Causes of Morbidity and Mortality in the study Area

The commonest and most prevalent diseases affecting all age groups in the communities are Malaria Fever (39.2%), Upper Respiratory Tract Infection (19.2%), Typhoid Fever (10.5%), Diarrhea/vomiting (5.2%) and Hypertension (7.2%). Other common ailments in across all project LGAs: include Worm Infestation, Diabetes Mellitus, Lower Respiratory Tract Infection, and Arthritis. The high prevalence rate of malaria could be explained by the following factors:

- The abundance of mosquitoes (the insect vector of malaria, which consists predominantly of *Plasmodium falciparum,* and less of *Plasmodium vivax* and *Plasmodium malariae);*
- Presence of stagnant water;
- Absence of pest control practices, and
- Inadequate prophylactic drug supply.

A cursory look at Table 6.51 shows that water related diseases have the highest prevalence percentage. Upper Respiratory Tract Infection has the second highest prevalence occurrence in the region. This could be due to bush clearing/ burning and unpaved surfaces.

Table 6.51: Prevalence of Diseases in the project area

S/N	Disease	Prevalence (%)
1	Malaria Fever	39.2
2	Upper Respiratory Tract Infection	19.2
3	Typhoid Fever	10.5
4	Hypertension	7.2
5	Vomiting and Diarrhoea	5.2
6	Worm Infestation	5.1

7	Diabetes Mellitus	4.2
8	Lower Respiratory Tract Infected	4.3
9	Arthritis	2.4
10	**Others**	2.7

Source: GNL 2019

Sexual Activities and Knowledge of Sexually Transmissible Infections (STI)

Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) have become very important public health concern in Nigeria. However, there are no data on sexual practices, knowledge and beliefs about HIV/AIDS and other Sexually Transmissible Infections (STIs) in the study area. Therefore, several questions were included in this study to ascertain the level of their awareness about these health problems. Both men and women were asked about their sexual practices. They were also asked about what they believed was the mode of transmission of HIV and where they sought treatment for STIs. Condom use and availability were also reported. The respondents did not divulge information on the numeracy of sexual partners they keep.

Condom Availability and Use

Condoms serve as a good barrier to the transmission of HIV and other sexually transmissible infections. Respondents were asked about condom use. The data presented is limited to those who have had sexual intercourse. Condom was readily available in over 90% of the chemist stores (where one is available) across all Project communities. However, the average number used weekly could not be accurately verified. Survey across all three project LGAs indicate that overall, less than 30% of males and 35% of females aged above 15 years had never used condom before while over 20% of males and 30% females claimed they used condom only occasionally, mainly either for prevention of pregnancy or STI. Only less than 10% of sexually active males and 2% females use condom all the time (i.e. during every episode of sexual intercourse). Condom use by those aged above 65 is virtually absent. Amongst respondents who use condoms, majority were less than 30 years. Condom use was also considerably higher among those who have never married compared to those currently married.

Immunization Status in Children

The proportion of children under 5 years old immunized against DPT, BCG, OPV and Measles were 80% across all sampling stations. These figures were above the national target of 70% (BCG and TT for pregnant women) and over 65% for the other antigens in the National Programme on Immunization. Oral Polio Vaccine (OPV) was the most commonly received vaccine in all the project communities. This may partly be due to the OPV given during the National Immunization days (NIDs) set aside by the Federal Ministry of Health through the National Programme on Immunization every year. Each child below 5 years is expected to receive two drops of OPV during each round of NID. The fact that the few health facilities available in the communities had inadequate record of immunization is an indication of the low practice of routine immunization.

6.4.20 Land Use

Land planning and uses

Land ownership in the project site is either by community or family. However, by virtue of the Public Lands Acquisition Law, the state government may acquire land compulsorily for public purpose from individual landowners, subject to the payment of compensation to such landowners. The wayleave is served by the existing road infrastructure and other rural roadways from which access along the wayleave is provided. The residential areas are mostly rural settlements except Ohabiam, Owerri, Ala-Oji, Ariaria, Aba and Umuocham which are semiurban/urban settlements. The population in the PACs is predominately made up of low and middle with few hig- income earners in the mentioned urban towns. Access to financial institution especially in the rural communities is very poor as there are none within these areas. The residential areas and the surrounding sub-places consist mostly of single unit residential homes. On the other hand, the rural settlements (all other communities except the listed semiurban/urban) are sparsely populated with low cost, single unit dwellings on small stands. Majority of theinhabitants of these areas live on lower income (see discussion on livelihood). Table 6.52 shows the land use pattern of the project area.

Table 6.52: Land use pattern of the project area

Type of Land use pattern	Percentage occupied (ha)	Notable communities in the RoW
Built-Up Area	13.1	Umuode, Obosi, Ariaria, Aba, Owerri, Ihiala, Ohabiam, Ozubulu, Ngor, Ala Oji
Heavy Forest	35.3	
Light Forest	20.3	
Plain land	21.35	
Cropland	7.4	
Water Bodies	2.58	
	100.00	

Figure 6.14 represents the land use pattern of the project area.

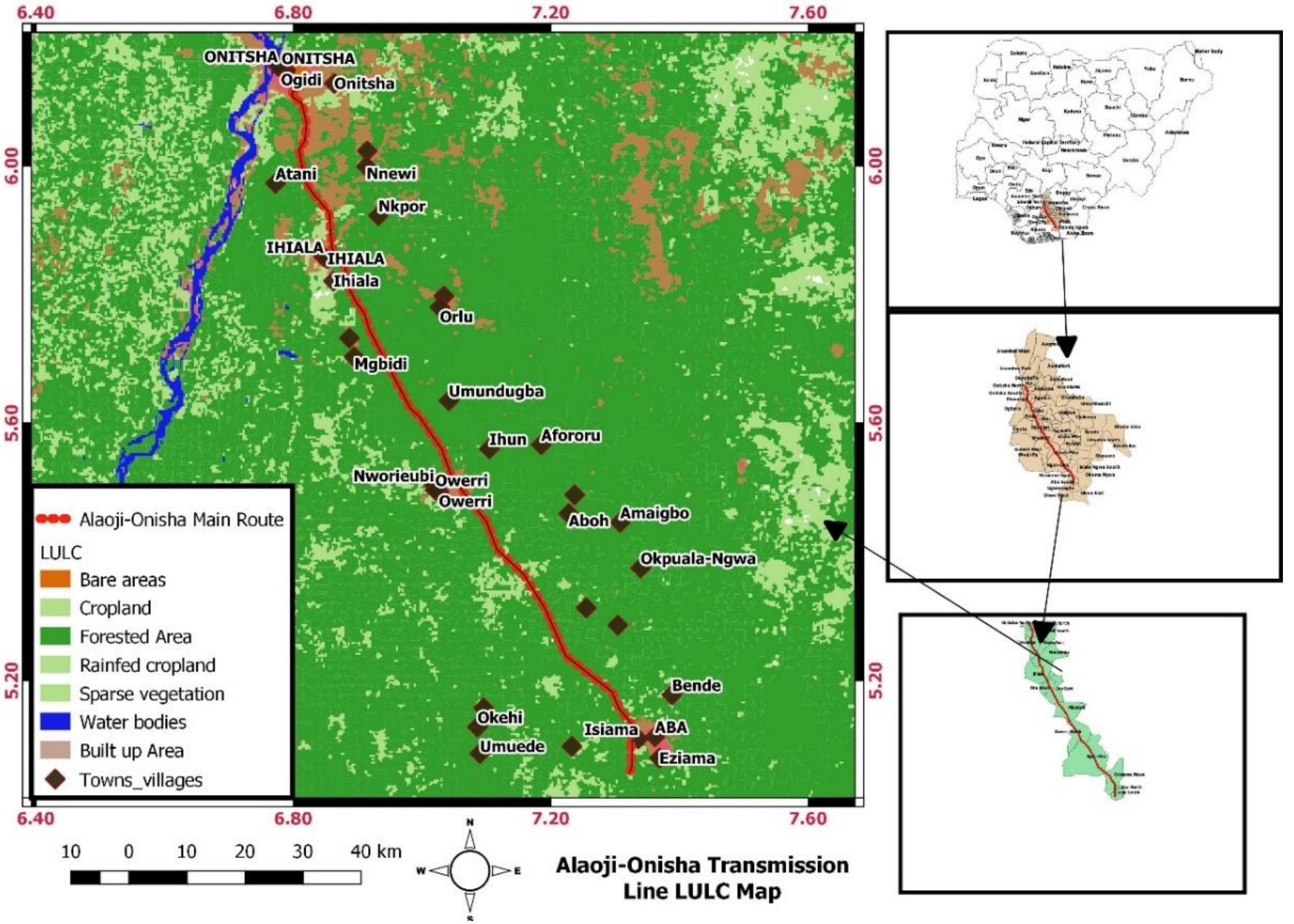


Figure 6.14: Land Use Map

6.4.21 Educational Attainment

The educational attainment among respondents in the Project LGAs is presented in Table 6.53 (a-c).

Table 6.53a: Educational Status among the respondents in Anambra State

	Ekwusigo	Idimili South	Ogbaru	Ihiala	Average (%)
No formal education	16.2	17	15	16	16
Primary	42.1	43	40	39	41
Secondary	30.2	31	30	22	28
CoE and polytechnic	6.4	4	7	12	7
University Degree	5.1	5	8	11	7

The literacy level in the communities in Anambra state of the project area is 84%. This is the number of respondent populations having at least a first school living certificate. About 16% of the PAP have no formal education.

Table 6.53b: Educational Status among the respondents in Abia State

	Osisioma	Aba North	Aba South	Ugwunagbo	Average (%)
No formal education	16	14	20	13.5	16
Primary	34	37	39	45.5	39
Secondary	32	33	26	25	29
CoE and polytechnic	10	6	8	6.2	7
University Degree	8	10	7	4.8	7

The literacy level in the communities in Abia state of the project area is 84%. This is the number of respondent populations having at least a first school living certificate. About 16% of the PAPs have no formal education.

Table 6.53c: Educational Status among the respondents in Imo State

	Ethiope West	Okpe	Sapele	Ughelli North	Uvwie	Ikpoba Okha	Mbatoli	Ngorokalla	Average (%)
No formal education	15	20	10	16	18	14	21	12	16
Primary	40.8	40	41	42	41.7	42	35	48	41
Secondary	29	29	29	31	30.3	37	33	35	32
CoE and polytechnic	6	5.4	11	5.3	5	4	6	3	6
University Degree	9.2	5.6	9	5.7	5	3	5	2	5

About 84% of the respondent population in the communities in Imo statehave atleast a first school living certificate while the remaining 16% have no formal education.

6.4.22 Economic and Livelihoods of Households

Occupation

Trading is the economic main stay of the people in the project area. The most commonly cultivated crops in the project area are cassava, maize, banana, okra, pepper and vegetables. Fruit trees are also cultivated in this area. They include mango, cashew, and guava among others. The percentage occupational distribution of the people of the project area is as shown in Tables 6.54 (a-c).

Table 6.54a: Occupational Distribution of Respondents in Anambra State

OCCUPATION	Ekwusigo	Idemili South	Ogbara	Ihiala	Average (%)
Farming	21	25	27	24	24
Pastoralist	10	9	11	8	10

Self-employed	8	6	7	6	7
Private employee	9	8	7	10	9
Public employee	11	10	8	8	9
Trading	40	42	40	44	41

Source: GNL

According to Table 6.54a, a majority of the PAPs in communities within Anambra state are into trading (41%), followed by farming (21%) while the self employed (7%) formed the least group

Table 6.54b: Occupational Distribution of Respondents in Abia

Occupation	Osisioma	Aba North	Aba South	Ugwunagbobo	Average (%)
Farming	8	27	7	41	21
Pastoralist	10	11	8	9	9
Trading	43	39	40	9	33
Private employee	20	6	25	11	15
Public employee	12	8	12	6	10
Self-employed	7	9	8	24	12

A majority of the PAPs in communities within Abia state are into trading (33%), followed by farming (21%) while the pastorialist (9%) formed the least group. This group are made up of mostly Fulani herders that came from the north to feed their cattle.

Table 6.54c: Occupational Distribution of Respondents in Imo

Occupation	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Average (%)
Farming	24	25	21	25	30	28	27	26	26
Pastoralist	7	8	7	6	5	4	7	8	6
Trading	44	42	44	39	42	48	45	48	44
Private employee	9	8	10	10	7	5	6	7	8

Public employee	8	8	10	11	8	7	8	6	8
Self-employed	8	9	8	9	8	8	7	5	8

Source: GNL Survey 2019

A majority of the PAPs in communities within Imo state are into trading (44%), followed by farming (26%) while the self employed, private employee, Self- formed the least group representing 8% of the population each

6.4.23 Artisanal Skills

The respondents were asked to confirm the existence of twelve artisanal skills (skills related to the proposed project) within their communities using a scale of 0-20 as 1, 21-40 as 2, 41-60 as 3, 61-80 as 4, 81-100 as 5 and >100 as 6. The result indicated the presence of persons with all the skills in the project area. However, majority of the artisanal skills in the area were Commercial Farm workers, maison, Painting, carpentry, taxi driving and plumbing. See Tables 6.55 (a-c).

Table 6.55a Population with skills related to TCN work in Host communities within Anambra State

Skills	Ekwusigo	Idimili South	Ogbara	Ihiala	Total
Experienced pylon assembler	2	1	1	2	6
Carpenter	5	2	3	3	13
Welder	1	1	0	2	4
Electrician	1	1	2	1	5
Truck driver	1	1	2	4	8
Taxi (car, tricycle, motocycle)	3	2	2	4	11
Heavy machinery operator (*shovel operator, caterpillar, etc.)*	1	0	0	0	1
Mechanic	2	3	2	3	10
Mason	3	4	4	6	17

Painter	2	3	5	5	15
Chainsaw operator	1	0	0	1	2
Commercial Farm workers	12	17	13	10	52
Plumbing	3	3	3	4	13
Total	37	38	37	45	**157**

According to Table 6.55a, 157 respondents in communities within Anambra state are into artisanal activities that are related activities required for the proposed project. A majority of the respondents are commercial farm workers (52) available for employment in access road clearing during the preconstruction phase of the project and RoW maintenance during the operation phase.

Table 6.55b: Population with skills related to TCN work in Host communities within Abia State

Skills	Osisioma	Aba North	Aba South	Ugwunagbobo	Total
Experienced pylon assembler	1	0	1	1	3
Carpenter	1	1	1	0	3
Welder	1	2	3	1	7
Electrician	0	0	2	3	5
Truck driver	1	1	1	2	5
Taxi (car, tricycle, motocycle)	0	0	1	0	1
Heavy machinery operator (*shovel operator, caterpillar, etc.)*	0	0	2	0	2
Mechanic	1	1	0	0	2
Mason	3	2	2	3	10
Painter	2	2	4	3	11
Chainsaw operator	1	1	0	0	2
Commercial Farm workers	7	10	10	8	35
Plumbing	1	0	0	1	2

Total	19	20	27	22	88

According to Table 6.55b, 88 respondents in communities within Abia state are into artisanal activities that are related activities required for the proposed project. A majority of the respondents are commercial farm workers (35) available for employment in access road clearing during the preconstruction phase of the project and RoW maintenance during the operation phase.

Table 6.55c: Population with skills related to TCN work in Host communities within Imo State

Skills	Owerri West	Owerri North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	Total
Experienced pylon assembler	1	1	0	0	1	0	1	1	5
Carpenter	2	2	3	3	3	5	3	2	23
Welder	2	2	3	3	3	1	1	1	16
Electrician	1	2	4	2	3	1	3	1	17
Truck driver	1	1	1	2	2	2	2	1	12
Taxi (car, tricycle, motocycle)	3	2	1	3	2	3	3	2	19
Heavy machinery operator *(shovel operator, caterpillar, etc.)*	0	0	0	2	0	0	1	3	6
Mechanic	1	2	1	1	0	0	1	2	8
Mason	1	2	3	2	1	2	2	2	15
Painter	2	1	2	1	1	5	4	2	18
Chainsaw operator	0	1	0	2	0	0	1	0	4
Commercial Farm workers	12	8	15	13	5	12	9	11	85
Plumbing	1	2	1	1	1	4	1	1	12
Total	27	26	34	35	22	35	32	29	240

Source: GNL, 2019

According to Table 6.55c, 240 respondents in communities within Anambra State are into artisanal activities that are related activities required for the proposed project. A majority of the respondents are commercial farm workers (52) available for employment in access road clearing during the preconstruction phase of the project and RoW maintenance during the operation phase.

6.4.24 Income

Crop farming, trading, artisanship, livestock rearing, processing of farm produce and self-employment are the income generating activities of the project area. Annual income level of respondents in the project area is presented in Table 6.56 (a-c).

Table 6.56a: Income Level in Anambra State

		Ekwusigo	Idimili South	Ogbara	Ihiala	
S/N	**Annual Income (Naira)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Average (%)**
1	Less than 100,000	**18.5**	**20.2**	**19**	**14.2**	**18**
2	100,000 –199,999	**11.1**	17.6	15.8	**14.2**	14.7
3	200,000 –	**28.3**	38.2	40.2	**47.9**	38.7
4	300,000 –399,999	**27.4**	12.4	14.5	**12.7**	16.8
5	400,000 –499,999	**9.7**	9	8.8	**9.9**	9.4
6	500,000 +	**5**	**2.6**	**1.7**	**1.2**	**2.6**

A majority of the respondents (38.7%) in communities within Anambra state section of the project area earn 200,000 – 299,999 annually, while those who earn 500,000 and above is least, representing only 2.6% of the population. This is an indication that the quality of lives of the respondents in this section is low. Low patronage of crop farming produce, lack of storage facilities, inadequate credit facilities to expand businesses, absence of electricity, poor access road that hinder intra mobility and inadequate safe drinking water were among the major hindrances to the economic development identified in the study area. The rural access roads are usually inaccessible during the wet seasons thereby hindering movement to market.

This results into large scale post-harvest loss. Most of the communities within this section of the project area are rural. The availability or improvement of electricity supply would hopefully ameliorate the situation.

Table 6.56b: Income Level in Abia State

		Osisioma	Aba South	Aba North	Ugwunagbo	
S/N	**Annual Income (Naira)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Average (%)**
1	Less than	**8.5**	**7.8**	**9.2**	**18.3**	**11**
2	100,000 –	**10.6**	14.5	17.6	**16.8**	14.9
3	200,000 –	**10.5**	20.2	11.2	**34.3**	19.1
4	300,000 –	**36.2**	34	40.5	**14.3**	31.3
5	400,000 –	**21.7**	10	9	**9.8**	12.6
6	500,000 +	**12.5**	**13.5**	**12.5**	**6.5**	**11.3**

A majority of the respondents (31.3%) in communities within Anambra state section of the project area earn 300,000 – 399,999 annually while those who earn below 100,000 are least, representing only 1.1% of the population. This is an indication that the quality of lives of the respondents in this section is avearage.

Table 6.56c: Income Level in Imo State

		Owerri West	Owerri North North	Oru West	Oru East	Njaba	Owerri Municipality	Mbatoli	Ngor Okalla	
S/N	**Annual Income (Naira)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Average (%)**
1	Less than 100,000	**8.5**	**6.8**	**15.2**	**13.2**	**19.8**	**5.1**	**16.3**	**20**	13.1
2	100,000 –199,999	20.6	19.1	27.6	24.8	23.4	**15.3**	28.8	23.2	22.9
3	200,000 – 299,999	13.3	27.2	19.4	23.7	21.4	**11.9**	19.2	26.2	20.3
4	300,000 –399,999	29.4	24.2	18.5	20	19.1	**28.7**	22.5	16.5	22.4
5	400,000 –499,999	18.2	13.2	12.8	14.6	10.5	**20.8**	9.7	9.8	13.7
6	500,000 +	**10**	**9.5**	**6.5**	**3.7**	**5.8**	**18.2**	**3.5**	**4.3**	7.6

Source: GNL 2019

6.4.25 Households' Main Source of Energy

The result on the survey of the sources of energy used by household in the project area revealed that electricity from the national grid is the main source of energy in the project area. Other frequently used energy source for lighting are Kerosene and generator. Conversely, torchlight, wick lamps, solar and candles were the least sources of energy used by the households. On the other hand, kerosene was the most used energy source for cooking. Generally, over 45% of the households in the project area use kerosene for cooking their meals. In addition, charcoal and electricity were the least patronized energy sources in the project area. These energy sources are used by less than 10% of the households in the project area. A total of ten (10) energy sources for both lighting and cooking were identified in the project area. The result is summarized in Tables 6.57 (a-c).

Table 6.57a: Respondents Households' Main Source of Energy (%) in Abia State

	Osisioma		Aba North		Aba South		Ugwunagbo		Total Average (%)	
Source	C	L	C	L	C	L	C	L	C	L
Main electricity	1	70	1	45	3	30	2	50	10.6	29.4
Solar	0	3	1	5	0	3	0	0	1.5	1.7
Gas	30	0	40	0	11	0	30	0	0	16.7
Paraffin/kerosene	45	5	40	11	40	35	40	7	87.9	24.6
Charcoal	2	0	1	0	9	0	5	0	0	2.5
Wick lamp	0	6	0	7	0	12	0	1	0	3.9
Candles	0	2	0	3	0	2	0	1	0	1.2
Firewood (biomass)	16	0	15	0	30	0	12	0	0	11.0
Generators	0	8	0	18	0	11	0	15	0	7.8
Torch light	0	1	0	1	0	2	0	1	0	0.8

C=Cooking, L=Lighting

The major household source of energy for lighting in communities within Abia state is main electricity from the Nation grid (29.4%), followed by Paraffin (24.6%). Establishment of the proposed project will further increase usage and dependency on main electricity which in turn will reduce GHG and noise impacts from generators and fossil fuel (kerosene). Paraffin is the most used energy source for cooking, followed by main electricity.

Table 6.57b: Respondents Households' Main Source of Energy (%) in Anambra State

	Ekwusigo		Idimili South		Ogbara		Ihiala		Total Average (%)	
Source	C	L	C	L	C	L	C	L	C	L
Main electricity	2	80	0	35	2	70	5	65	2.3	60.5
Solar	0	1	0	1	0	2	0	0	0	0.96
Gas	38	0	10	0	34	0	65	0	35.5	0
Paraffin/kerosene	40	7	45	32	41	9	30	0	37.7	11.6
Charcoal	2	0	9	0	5	0	0	0	3.8	0
Wick lamp	0	6	0	12	0	2	0	20	0	9.6
Candles	0	2	0	2	0	1	0	0	0	1.2
Firewood (biomass)	20	0	46	0	20	0	0	0	20.8	0
Generators	0	8	0	15	0	17	0	20	0	14.5
Touch light	0	2	0	2	0	2	0	0	0	6

C=Cooking, L=Lighting

The major household source of energy for lighting in communities within Anambra state is main electricity from the Nation grid (60.5%), followed by Paraffin (11.6%). Establishment of the proposed project will further increase usage and dependency on main electricity in the area. This will in turn reduce GHG and noise impacts from generators and fossil fuel (kerosene). Paraffin is the most used energy source for cooking (37.7%), followed by gas (35.5%).

Table 6.57c: Respondents Households' Main Source of Energy (%) in Imo State

	Owerri West		Owerri North		Oru West		Oru East		Njaba		Owerri Municipality		Mbatoli		Ngor Okalla		Total Average (%)	
Source	C	L	C	L	C	L	C	L	C	L	C	L	C	L	C	L	C	L
Main Electricity	1	78	2	55	0	30	2	64	5	65	5	60	6	55	4	55	3.2	0.55
Solar	0	1	2	5	0	1	0	2	0	0	0	0	0	2	0	1	0.3	0.15
Gas	34	0	30	0	10	0	34	0	70	0	65	0	50	0	45	0	43.5	0
Paraffin/kerosene	45	6	42	12	40	32	40	9	25	0	30	0	45	5	40	4	39.5	8.7
Charcoal	2	0	1	0	9	0	5	0	0	0	0	0	1	0	0	0	23.4	0
Wick lamp	0	6	0	7	0	12	0	2	0	5	0	20	0	8	0	9	0	8.9
Candles	0	2	0	3	0	2	0	1	0	0	0	0	0	7	0	8	0	0.3
Firewood (biomass)	18	0	13	0	35	0	18	0	0	0	0	0	2	0	0	0	11.1	0
Generators	0	8	0	20	0	13	0	17	0	25	0	20	0	17	0	18	0	17.7
Touch light	0	2	0	1	0	2	0	2	0	0	0	0	0	0	1	0	0.2	0.99

Source: GNL Survey, 2019

The major household source of energy for lighting in communities within Anambra state is main electricity from the Nation grid (60.5%), followed by Paraffin (11.6%). Establishment of the proposed project will further increase usage and dependency on main electricity in the area. This will in turn reduce GHG and noise impacts from generators and fossil fuel (kerosene). Gas (43.5%) is the most used energy source for cooking, followed by main Parafin (39.5%).

6.4.26 Households' Main Source of Potable Water

A total of nine (9) potable water sources were reported to be used by households in the project area. Result on the percentage usage of each of the water sources is presented in Figure 6.15.

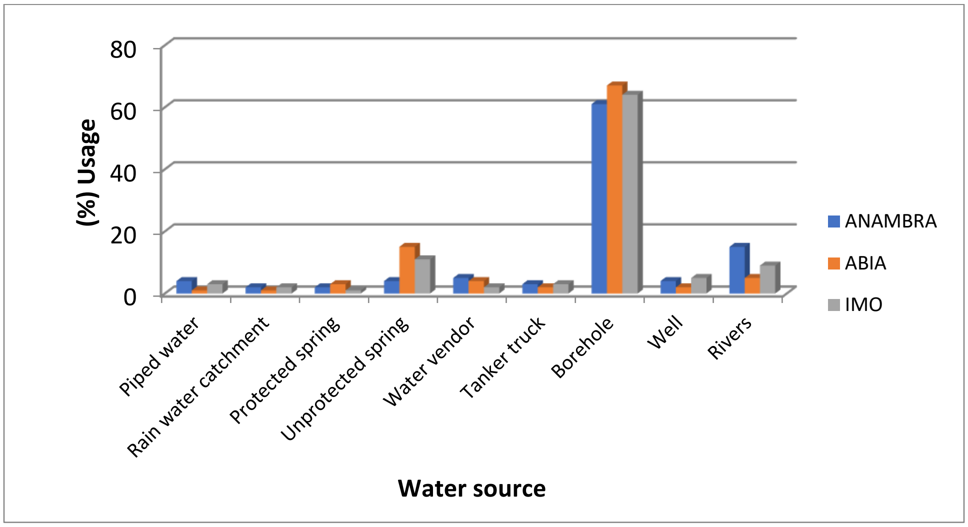


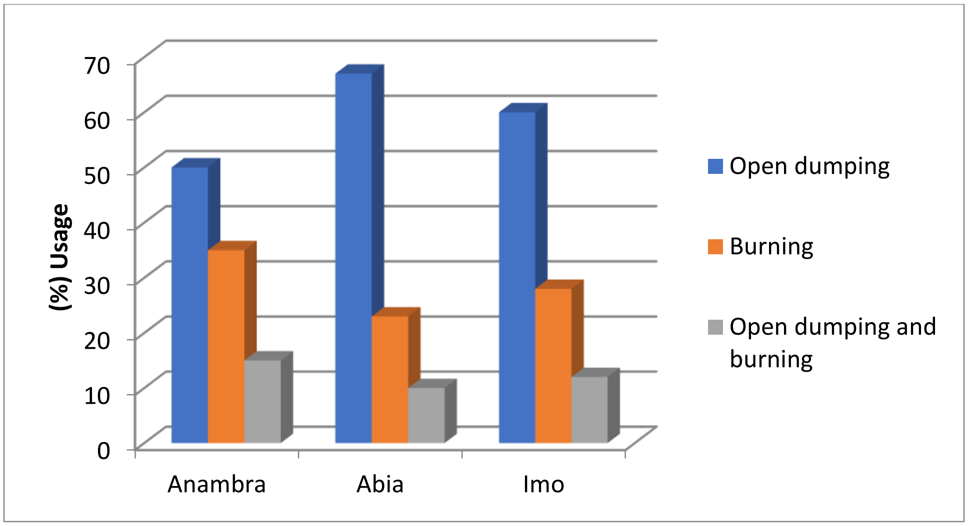
Figure 6.15: Households' Main Source of Potable Water (%)

As could be seen in Figure 6.15, the prominent water source in the project area is borehole, followed by spring and Rivers.

6.4.27 Waste Disposal by Households

Refuse

Figure 6.16 shows refuse disposal methods by households. Open dumping and burning are the two waste methods practiced by the people in the project area Figure 6.16.



Source: GNL Survey, 2019

Figure 6.16: Refuse Disposal

Open dumping (exclusive) is the most practiced waste disposal method across the project area, followed by burning while open dumping and burning (in combination) is the least practiced method.

6.4.27.1 Waste Disposal (Sewage)

Sewage disposal by households were either by pit latrine, bush or by water closet as shown in Figure 6.17.

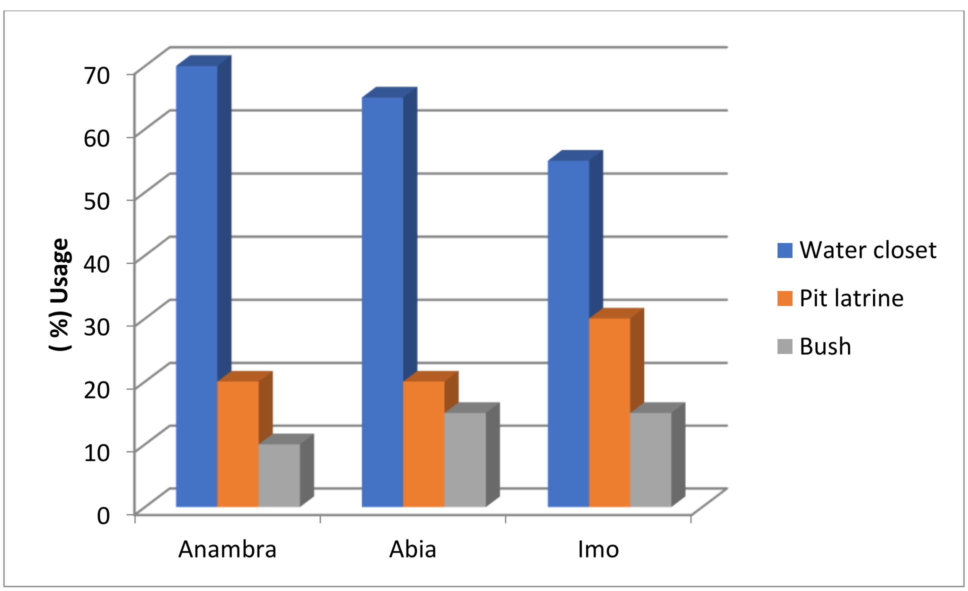


Figure 6.17: Sewage Disposal Methods by Households

According to Figure 6.17, over 55% of households in the project area use the Water Closet (WC) system. About 30% used pit latrine while about 15% of the households, use the bush.

6.4.28 Community Buildings within the Wayleave

This parameter would be studied and reported in the RAP.

6.4.29 Vulnerable Groups

The category and number of vulnerable groups in project area were identified and analyzed as shown in Table 6.58 (a, b, c). This was compiled with assistance with the village heads. A total of 1524 vulnerable persons are present in the project area. A breakdown of the result showed that children (438 individuals), women (410 individuals) and land tenants (318 individuals) were the prominent vulnerable groups in the project area.

Table 6.58a Proportion of vulnerable groups in communities within Abia State

Vulnerable groups / LGAs	Children	Land tenants	Women	Non indigenes	Elderly	Infirm/physically challenged	Herdsmen	Total
Osisioma	38	20	30	10	23	19	9	149
Aba North	40	26	31	23	14	10	3	147
Aba South	22	17	34	10	20	18	8	129
Ugwunagbo	21	21	23	13	15	16	8	117
Total	121	84	118	56	72	63	28	542

As could be seen in Table 6.58a, a total of 542 individuals were censored in communities within Abia state. A great number of the vulnerable persons comprised mainly of children (121 individuals), women (118 individuals) and land tenants (864 individuals).

Table 6.58b: Proportion of vulnerable groups in communities within Anambra State

Vulnerable groups / LGAs	Children	Land tenants	Women	Non indigenes	Elderly	Infirm/physically challenged	Herdsmen	Total
Ekwusigo	28	20	30	10	23	19	9	139
Idimili South	22	17	24	12	29	18	8	130
Ogbara	20	20	17	17	18	11	6	109
Ihilia	28	18	16	11	16	12	4	105
Total	98	75	87	50	86	60	27	483

As could be seen in Table 6.58b, a total of 483 individuals were censored in communities within Anambra state. A great number of the vulnerable persons comprised mainly of children (98 individuals), women (87 individuals) and the elderly (86 individuals).

Table 6.58c: Proportion of vulnerable groups in communities within Imo State

Vulnerable groups / LGAs	Children	Land tenants	Women	Non indigenes	Elderly	Infirm/physically challenged	Herdsmen	Total
Owerri West	18	7	12	15	9	11	9	81
Owerri North	12	6	8	3	7	10	3	49
Oru West	12	7	14	6	5	8	8	60
Oru East	14	6	13	4	5	6	8	56
Njaba	13	4	10	5	7	4	5	48
Owerri Municipality	20	5	15	6	14	9	2	71
Mbatoli	22	4	7	7	8	11	6	65
NgorOkalla	28	8	10	5	6	8	4	69
Total	139	47	89	51	61	67	45	499

As could be seen in Table 6.58c, a total of 499 individuals were censored in communities within Imo state. A great number of the vulnerable persons comprised mainly of children (139 individuals), women (89 individuals) and the Infirm/physically challenged (67 individuals).

6.4.30 Cultural Heritage Resources

There are no cultural sites within the way leave and within the 500m on either side of the RoW.

6.4.31 Gender Issues

Data relating to gender issues were obtained using community questionaires, involving all the communities in the Row. Male and female folks were separated and assisted in responding to the gender indicators parameter. Result is represented in Table 6.59 (a, b, and c).

Table 6.59a: Gender Parameters in communities within Anambra State

Local Governments	Ekwusigo		Idimili South		Ogbara		Ihiala	
	Male	Female	Male	Female	Male	Female	Male	Female
Circumsion	100	0	100	0	100	0	100	0
Land ownership	85	15	91	10	90	10	85	15
Access to credit	60	40	67	33	64	36	65	35
Decision making at household	80	20	75	25	90	10	95	5

The result on gender issues in the communities within Anambra state revealed that all male individuals in the households are circumcised with no female circumcised. Also, over 80% of respondents owning lands are males and less than 16% are females. This is possibly because the culture of the Ibos does not allow females to own family land or take part in its sharing. There are no limitations to access to credit in this section of the project area due to gender differences (Table 6.59b). Results also revealed that decision making in household were mostly done by males. Over 75% male respondents are involved in decision making while only less than 20% of females are involved in household decision making.

Table 6.59b: Gender Parametres in communities within Abia State

Local Governments	Osisioma		Aba North		Aba South		Ugwunagbo	
	Male	Female	Male	Female	Male	Female	Male	Female
Circumsion	100	0	100	0	100	0	100	0
Land ownership	88	12	91	9	95	5	85	15
Access to credit	61	39	70	30	70	30	69	31
Decision making at household	85	15	80	20	90	10	96	4

The trend and possible reasons for the result on genders issues in communities within Abia state of the project area is same as those already discussed for the Anambra section.

Table 6.59c: Gender Parametres in communities within Imo State

Local Governments	Owerri West		Owerri North		Oru West		Oru East		Njaba		Owerri Municipality		Mbatoli		Ngor Okalla	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Circumsion	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
Land ownership	88	12	85	15	90	10	85	15	85	15	85	15	91	10	85	15
Access to credit	60	40	65	35	64	36	69	31	65	35	80	20	67	33	69	31
Decision making at household	80	20	95	5	90	10	95	5	95	5	75	25	75	25	95	5

Source: GNL Survey, 2019

The trend and possible reasons for the result on genders issues in communities within Imo state of the project area is same as those already discussed for the Anambra section.

CHAPTER SEVEN
STAKEHOLDER ENGAGEMENT

7.1 Consultation of Stakeholders

7.1.1 Invitation to Scoping Workshop and Notification of Project

A letter was prepared introducing the Project proponents, the Project and inviting attendance and participation at the Scoping Workshop. These letter notifications were distributed to key stakeholders' groups identified (as listed in Table 7.1).

Table 7.1: Identified Stakeholders

Stakeholder Group and Interest in the Project	Stakeholder Name	Stakeholder Level			Engagement Activity	Mode of Invitation
		National	State	Local	Meeting	Letter
Government Authorities: National, regional and local government of primary political importance to the Project with permitting Requirements that must be met by the Project.	Federal Ministry of Environment (FMEnv)	x			x	x
	Federal Ministry of Agriculture, Forestry and Natural Resources	X			x	X
	Federal Ministry of Lands and Survey	X			x	X
	Federal Ministry of Power, Housing and Urban Development	X			x	X
	Nigerian Electricity Regulatory Commission	x			x	X
	National Environmental Standards and Regulations Enforcement Agency	x			x	X

	Nigeria Electricity Regulatory Commission	x			x	X
	Nigerian electricity management service agency	X			x	X
	Department of state security	X			x	X
	Nigerian security and civil defence corps	X	X		x	X
	Abia Ministries of Works and Housing		X		x	X
	Abia, Imo & Anambra Ministries of Lands and Survey		x		x	X
	All affected LGAs			X	x	X
Local Communities	Sixty-nine affected communities				x	X
Non-Governmental and Community Based Organizations (NGOs and CBOs)	Nigeria Environmental Society (NES)	x			x	X
	Nigeria Conservation Foundation	x			x	X
	Market women / traders' association		x	x	x	X

7.1.2 Stakeholder Information and Consultation Rounds

Four rounds of stakeholder consultation were planned. They were planned according to key stages, or decision moments, throughout the study where the informed participation of stakeholders were likely to make the most significant contribution to the on-going analysis. These included the scoping stage (1st round), the route assessment and the documentation of the displaced households' stage (2nd round is ongoing). The third round of consultations is scheduled for the disclosure of the, ESIA, ESMP and RAP preliminary results (3rd round).

Table 7.2 present outlines the studies' stakeholder engagement process and presents, for each consultation round, the specific engagement objectives, target groups and implementation periods.

Table 7.2: Stakeholder engagement process for each consultation round, specific engagement objectives, target groups and implementation periods

	Objectives and Information Provided for Rounds 1 and 2							
Abia State Round 1			Imo State			Anambra State Round 1		
Target group	Date & Venue	Comment & Implementation	Target group	Date & Venue	Comment & Implementation	Target group	Date & Venue	Comment & Implementation
FMEnv	Government house, Umuahia 27/7/2019	Promised to cooperate with other environment regulators to fast track the ESIA Process for timely approvals and permitting.	FMEnv	Benconn Hotel, Owerri 25/7/2019	Advised we ensure maintenance of the ecosystem, ecological process and preserve biodiversity.	FMEnv	Beautiful Gate Resort, Awka (24 July 2019)	Advised TCN to develop the SEP and strictly implement it throughout the project lifespan, to ensure stakeholder confidence and sustainability.
FMAFNR	Government house, Umuahia 27/7/2019	Promised to be involved in the provision of agricultural extension services to PAPs, to achieve greater agricultural productivity.	FMAFNR	Benconn Hotel, Owerri 25/7/2019	Advised we watch out for flood plains and also construction be done above flood level.	FMAFNR	Beautiful Gate Resort, Awka (24 July 2019)	Compensation for PAPs and PACs was stressed while footprint for access route

								creation should be minimized
FMLS	Government house, Umuahia 27/7/2019	They advised that proper route studies should be carried out and also affected landowners should be compensated	FMLS	Benconn Hotel, Owerri 25/7/2019	promised to facilitate and fast track the processes to gazette the ROW when TCN applies and this should be done before compensations / Resettlements are implemented	FMLS	Beautiful Gate Resort, Awka (24 July 2019)	Promised to send officers to join the TCN's consultant in the field for enumeration exercise, if invited
FMPW&H	Government house, Umuahia 27/7/2019	The acquisition of government owned land but the project will be responsible for the processing charges.	FMPWH	Benconn Hotel, Owerri 25/7/2019	PAPs and PACs should be compensated without delay.	FMPWH	Beautiful Gate Resort, Awka (24 July 2019)	The design and type of equipment should be that which meet international best practice.
NESREA	Government house, Umuahia 27/7/2019	Commended TCN for an early good start in compliance to environmental	NESREA	Benconn Hotel, Owerri 25/7/2019	Advised compliance with environmental laws and regulation	NESREA	Beautiful Gate Resort, Awka (24 July 2019)	Promised to give full support in the best of their ability

		requirements and admonished the Company to keep up that way						
NERC	Government house, Umuahia 27/7/2019	Promised to give full support in the actualization of the project.	NERC	Benconn Hotel, Owerri 25/7/2019	Advised villagers to be hospitable and give full cooperation in the actualization of the project	NERC	Beautiful Gate Resort, Awka (24 July 2019)	Emphasized on the observation of Nigerian Electricity Regulatory Commission standards
NEMSA	Government house, Umuahia 27/7/2019	Requests to be involved in all phases of the project to inspect the standards of the project before commissioning and during operations.	NEMSA	Benconn Hotel, Owerri 25/7/2019	TCN should ensure that materials and equipment to be used are of international standards.	NEMSA	Beautiful Gate Resort, Awka (24 July 2019)	Promised to give technical support in the actualization of the project
DSS	Government house, Umuahia 27/7/2019	promised to provide the necessary security cover needed in all phases of the project	DSS	Benconn Hotel, Owerri 25/7/2019	Gadgets, Equipments and valuables should be carefully safeguarded to avoid theft and vandalism	DSS	Beautiful Gate Resort, Awka (24 July 2019)	Promised to give full support in the actualization of the project.

NSCDC	Government house, Umuahia 27/7/2019	Security guard should be employed.	NSCDC	Benconn Hotel, Owerri 25/7/2019	Promised to provide the necessary security cover needed in all phases of the project and requested that provisions for their logistics be made ab initio in the project budget.	NSCDC	Beautiful Gate Resort, Awka (24 July 2019)	presence of security personnel during any phase of the project activity
ASMEnv	Government house, Umuahia 27/7/2019	They advised we ensure safe health and safety environment	ISMEnv	Benconn Hotel, Owerri 20/3/2019	Waste should be disposed properly to avoid environmental pollution	ASMEnv	Beautiful Gate Resort, Awka (19 may 2019)	Compliance with the state environmental laws and regulation
AMWH	Government house, Umuahia 12/3/2019	Stressed on the gully erosion hazard in the state.	IMWH	Benconn Hotel, Owerri 20/3/2019	Stressed the need for Compensation to PAPs and PACs was stressed	AMWH	Beautiful Gate Resort, Awka (19 May 2019)	Transport Management Plan needs to bedeveloped for heavy duty vehicle to ensure appropriate

								controls during transportation
ASMLS	Government house, Umuahia 12/3/2019	affected landowners should be compensated	ISMLS	Benconn Hotel, Owerri 20/3/2019	promised to provide necessary support needed in all phases of the project	ASMLS	Beautiful Gate Resort, Awka (19 May 2019)	All the communities sought to know the size of the RoW
Ariaria International *Market* Traders *Association*	*Ariaria* market Square 21-5-2019	Asked that PAPs be given adequate time prior to construction	Owerri market women association	Owerri market square 22-5-2019	Harped on the need for locals to be involved in the contracting process	Onitsha market trade union	Onitsha market square 23-5-2019	The project should fully understand the livelihood pattern within the area.
Aba market trader's association	Aba market square 21-5-2019	TCN should actively engaged all stakeholders throughout the project life cycle	Owerri market traders's association	Owerri market square 22-5-2019	affected landowners should be compensated	Onitsha market women association	Onitsha market square 23-5-2019	they asked for improvement of electricity supply in their village

Abia State Women Association	Government house, Umuahia 21-5-2019	Promised to give full support in the actualization of the project	*Anambra State Women Association*	Benconn Hotel, Owerri 22-5-2019	Requested for constant electricity in their community	Anambra market women association	Beautiful Gate Resort, Awka 23-5-2019	affected landowners should be compensated

Round 2 Consultations. The target group is Project Affected Communities											
Imo State				**Abia state**				**Anambra State**			
LGA	**Community**	**Date & Venue**	**Comment & Implementation**	**LGA**	**Community**	**Date & Venue**	**Comment & Implementation**	**LGA**	**Community**	**Date & Venue**	**Comment & Implementation**
Owerri Municipal	Owerri	Igwe's Palace 21-5-2019	They were concerned about the houses around the right of way and relocation measures put in place by the government.	Ossioma Ngwa	Umuode	Town hall 22-5-2019	The people of Umuode wants TCN improve electricity in their community	Idemili South	Obosi	Community primary school 24-7-2019	Compensation for PAPs and PACs must be paid before project commencement
	Nwaorie	Town hall 21-5-2019	The community requested for community		Umuocham		They welcomed the project and		Umuoja	Town hall 22-7-2019	TCN must acquire the ROW now

			development projects and employment opportunities for the youth				asked for improvement of electricity supply in their village				before embarking on the proposed reconstruction project
	Owerri Division	Igwe's Palace 21-5-2019	TCN must pay adequate compensation for the affected houses/structures and crops within the ROW.		Abayi		They showed concern on corona and effect on human health		Obosi	Town hall 22-7-2019	The community requested for community development projects and employment opportunities for the youth
Mbatoli	Awo	Igwe's Palace 21-5-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community		Umuozuo	Igwe's Palace 22-5-2019	They complained about Dust and noise control during construction		Oba Aboji	Igwe's Palace 24-7-2019	The Igwe pledged to fully support the implementation of the project

	Orodo	Community primary school 20-5-2019	They were concerned about the houses and farmlands around the right of way and relocation Measures put in place by the government.		OsiaUmu Mgbede	Community primary school 22-5-2019	TCN must pay adequate compensation for the affected houses/structures and crops within the ROW.		Oba	Igwe's Palace 20-7-2019	They welcomed the project and asked for improvement of electricity supply in their village
	Ohoba	Town hall 20-5-2019	They do not want TCN to build their houses for them but to compensate them in cash.		AmaOkpu	Town hall 22-5-2019	They want the compensation/ resettlement to be implemented within months of enumeration, to avoid unnecessary	Ogbaru	River idemili	Town hall 24-5-2019	The people of Iasi showed major concerned on compensation to landowners affected by the project

							hardship on the PAPs				
	Nkwesi	Igwe's Palace 20-5-2019	They expressed their fear remaining in 'darkness', despite co-hosting a power project of this scale		UmuOjima	Community primary school 22-7-2019	They requested for employment for the youth during the cause of the project		ErunaLagbe	Community primary school 24-5-2019	They requested compensation should be paid before project commencement to avoid by PAPs
	Mbieri	Town hall 21-5-2019	Compensation for PAPs and PACs must be paid before project commencement		Ogbu	Igwe's Palace 23-7-2019	The Igwe promised his full support during the cause of the project		Atani	Igwe's Palace 20-7-2019	The Igwe welcomed the development and pledged full support
	Obaku	Igwe's Palace 21-5-2019	They asked if TL won't cause electrocution in their community		Umuobo	Community primary school	They were concerned about the houses and farmlands		Eze	Community primary school 20-7-2019	They want TCN to prioritize rural electrification and stabilize

						23-7-2019	around the right of way and relocation measures put in place by the government.				power supply in their community
Ngor-Okpala	Akabo	Community primary school 21-5-2019	TCN must acquire the ROW now before embarking on the proposed reconstruction project		Umumba	Community primary school 24-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community	Ihiala	Awgbu	Igwe's Palace 24-7-2019	They want the compensation/ resettlement to be implemented within months of enumeration, to avoid unnecessary hardship on the PAPs
	Umunoha	Community primary school	They requested compensation should be paid		UmuAkpara	Community	They shoed their grievance for No		Azira	Igwe's Palace	The community demanded for

		21-5-2019	before project commencement to avoid by PAPs			primary school 20-7-2019	compensation payment after the construction of the existing 330kV SC line.			24-5-2019	community development projects
Owerri North	Umunahu	Igwe's Palace 26-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community		Umuaba	Town hall 24-7-2019	They were scared of corona effect and asked which measures was put in place to reduce the effect		Uli	Community primary school 24-5-2019	They want the compensation/ resettlement to be implemented within months of enumeration, to avoid unnecessary hardship on the PAPs
	Mkpama	Town hall 26-7-2019	TCN must acquire the ROW now before embarking		Okpuala	Igwe's Palace	They asked for the project		Ihiala	Community primary school	The Igwe pledged to fully support the

			on the proposed reconstruction project			23-7-2019	Benefits and also employment opportunities for the youths			24-5-2019	implementation of the project
Oru East	Awomama	Town hall 25-7-2019	The Igwe pledged to fully support the implementation of the project		Mbuntu	Igwe's Palace 21-7-2019	The villages made enquiry on how long the project will take and its benefits to the community		Ozubulu	Igwe's Palace 23-7-2019	The Igwe welcomed the development and pledged full support
Oru West	Ofekata	Community primary school 25-7-2019	They showed their grievance for No compensation payment after the construction of the existing 330kV SC line		MbokoUmuete	Community primary school 23-7-2019	They requested compensation should be paid before project commencement to avoid by PAPs	Ekwusigo	Orifite	Igwe's Palace 24-7-2019	They were concerned about the houses and farmlands around the right of way and relocation

											measures put in place by the government.
	Owelu,	Igwe's Palace 20-5-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community		Ihie	Town hall 21-7-2019	They welcomed the project and asked for improvement of electricity supply in their village		Ihembosi	Igwe's Palace 23-7-2019	They showedtheir grievance for No compensation payment after the construction of the existing 330kV SC line.
	Orji,	Town hall 20-5-2019			AmaApu	Community primary school 23-7-2019	The Igwe promised his full support during the cause of the project		Ozubulu	Town hall 23-7-2019	They want TCN to prioritize rural electrification and stabilize power supply in their community

	Oratta	Town hall 20-5-2019			Ife	Town hall 23-7-2019	They showed concern on corona and effect on human health		Oraifite	Town hall 23-7-2019	They showedtheir grievance for No compensation payment after the construction of the existing 330kV SC line.
Owerri west	Orogwe	Igwe's Palace 20-5-2019	They showedtheir grievance for No compensation payment after the construction of the existing 330kV SC line.		UmuMba	Igwe's Palace 21-7-2019	They welcomed the project and asked for improvement of electricity supply in their village		Ubuluisi uzo	Town hall 20-7-2019	TCN must acquire the ROW now before embarking on the proposed reconstruction project
	Ubomiri	Igwe's Palace	They do not want TCN to build their houses for them		Ariaria	Town hall	They want TCN to prioritize rural				

		20-5-2019	but to compensate them in cash.			24-7-2019	electrification and stabilize power supply in their community				
	Irete	Community primary school 24-7-2019	The community expressed concern over their farmland were the project cuts across and requested for compensation	Aba South	Asia UmuNka	Town hall 23-7-2019	The Igwe pledged to fully support the implementation of the project				
	Awoldemiri	Igwe's Palace 24-7-2019	The Igwe pledged to fully support the implementation of the project		Asia Amanhie	Igwe's Palace 20-7-2019	They requested for employment for the youth during the cause of the project				
Ngor-Okpala	Amaibo	Igwe's Palace	The Igwe welcomed the	Ugwunagbobo	Ala Oji	Town hall	They showed concern on				

		26-7-2019	development and pledged full support			24-7-2019	corona and effect on human health				
	Alulu	Igwe's Palace 26-7-2019	TCN must pay adequate compensation for the affected houses/structures and crops within the ROW.		UmulkuUko	Community primary school 27-4-2019	The Igwe pledged to fully support the implementation of the project				
	Ochicha	Community primary school 26-7-2019	The Igwe welcomed the project and pledge full support								
	Elelem	Igwe's Palace 26-7-2019	They were concerned about the houses and farmlands								

			around the right of way and relocation measures put in place by the government.								

A) Consultation session with stakeholders of Umuode community, Osisioma Ngwa, Abia State, held at the town hall on 22-5-2019

B) Consultation session with stakeholders of Obosi Community Idemmili South, Anambra State, held at community secondary school on 24-7-2019

C) Consultation sessions with stakeholders of Nwaorie community Owerri, Imo State, held at the town hall on 21-5-2019

D) Consultation sessions with stakeholders of Umunahu community, Owerri North, Imo State, held at the Igwe's palace on 26-7-2019

E) Consultation sessions with stakeholders of Orji community, Oru west, Imo State, held at the town hall on 20-5-2019

F) Consultation sessions with stakeholders of Ugwunagbobo community, Alaoji, Abia State, held at the town hall on 24-7-2019

G) Stakeholders at the town hall on 24-7-2019 during the consultation Session at Ugwunagbobo community, Imo State

H) Concerned stakeholders at the town hall on 20-5-2019 during the consultation session at Orji community, Imo State

I) Consultation session with FMEnv Anambra and stakeholders at Beautiful Gate Resort, Awka on 24-7-2019

J) FMEnv officials on 24-7-2019 at Beautiful Gate Resort, Awka during the consultation session

K) Consultation session with concerned stakeholders atUmuakpara Community, osisioma ngwa, Abia State at Community Primary School on 20-7-2019

L) Consultation session with stakeholders at Awgbu community Ihiala, Anambra State at the Igwe's palace on 24-7-2019

M) Speaking with the stakeholders at UmuakparaCommunity, Osisioma Ngwa, Abia state at Community Primary School on 20-7-2019

N) Concerned stakeholders sharing their opinions on the projecton 24-7-2019 at Beautiful Gate Resort, Awka

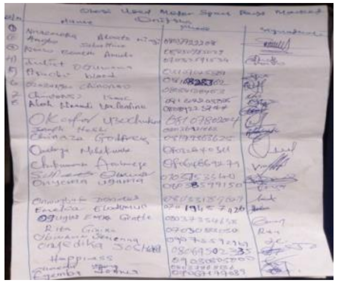
Plates 7.1 (A – N): Pictires Taken During Some Stakeholders' Engagement

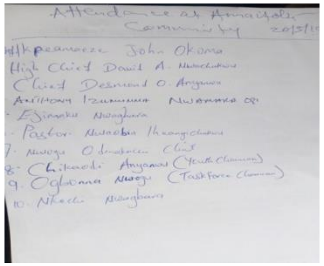
Above are Plates 7.1 (A-N) showing excerpts from the different consultation sessions.

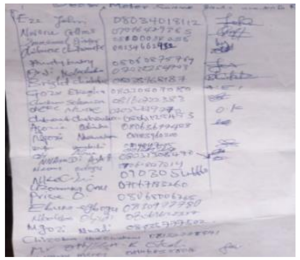
A) Attendance register for consultation session at the Beautiful gate resort on 24-7-2019

B) Attendance register for consultation session at Government houseUmuahia on 26-7-2019

C) Attendaance register taken at Bencomm hotels, Owerri on 25-7-2019







D) Attendance register for consultation session at Obosi Used motor spare part market, Onitsha

E) Attendance at Amaifolu community

F) Attendance register for consultation session at Obosi Used motor spare part market, Onitsha

Plate 7.2 (A-F): Attendance Register

7.1.3 Grievance Management Mechanism

The IFC Guidance Note 1 (IFC, January 2012) provides guidelines for a Grievance Mechanism to receive and facilitate resolution of concerns and grievances from stakeholders. Some of the key characteristics of a Grievance Mechanism are set out below:

- Scaled to the risks and adverse impacts of the project;
- Resolves grievances promptly;
- Uses understandable and transparent engagement processes, that is culturally appropriate and readily accessible;
- No cost to, and without retribution to the complainant;
- Do not impede access to judicial or administrative remedies;
- In place from the beginning of project development and available throughout the life of the project.

Notification: Stakeholders will be notified of the grievance procedure as part of the ongoing stakeholder engagement process.

Responsibilities: It is recommended that the Liaison Officers (LO) be responsible for maintaining the Grievance Register.

Recommended procedure: Grievances are currently received in writing or verbally by the Liaison Officer (LO) directly from the complainant or TCN employees, consultants and/ or contractors.

It is recommended that an LO ensures that:

- The grievance is entered into the Grievance Register and assigned an individual number;
- The complainant is informed of the receipt of the grievance, as soon as possible, by an appropriate means (written or verbal)
- Appropriate action is taken, or the grievance is referred to the appropriate member of the TCN-PIU within 24 hours;
- The complaint is tracked and addressed;
- Feedback is given to the complainant about how the complaint has been addressed;
- Feedback is given to the complainant by appropriate means (written or verbal) within two weeks of being received. If not resolved during this time, further feedback is given once the complaint is addressed (within 30 days).

- Unresolved grievances and disputes are referred to a credible and independent person or body for arbitration.

Figure 6.16 is an overview of a basic grievance management procedure that could act as a framework for future reference of complaints from stakeholders, affected communities or grievances received during the implementation of the Resettlement Action Plan. TCN-PIU is committed to ensuring that all concerns and issues raised by stakeholders will be addressed in a constructive and consultative manner.

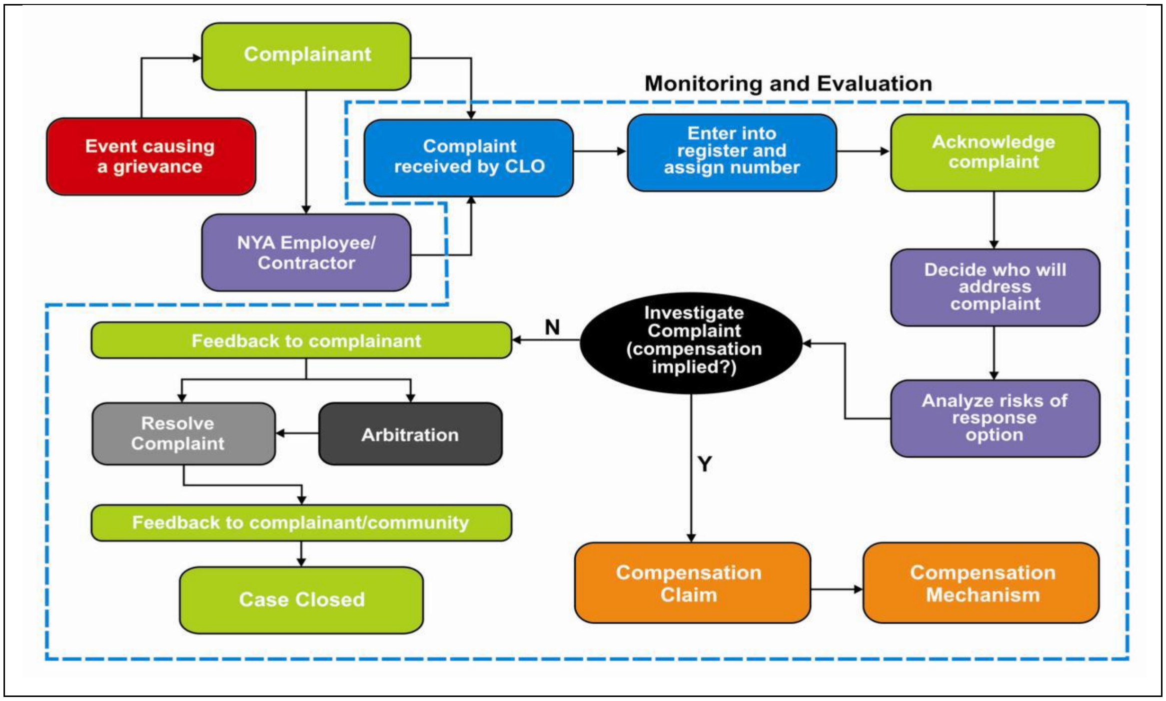


Figure 7.1: An Overview of a Basic Grievance Management Procedure

Source: GNL, 2019

7.4.3.1 Conflict Management

TCN-PIU will conduct a conflict risk analysis from topics brought forward by stakeholders intending to resultin conflict. A process will be put in place to resolve issues of conflict that cannot be resolved within the terms of the grievance procedure. TCN-PIUwill also:

- Create internal capacity to deal with conflict, such as staff training;
- Identify third party facilitators, and mediators to assist in mediating conflict;
- Provide the necessary budget for conflict management and adjust as required.

7.1.3.2 Time Schedule for Redressing the Grievance

The committee shall be mandated to decide the grievance within three weeks of the complaint by the aggrieved party. Compensation as decided by the committee and according to labour laws shall be paid in full to the aggrieved party within two weeks from the date of decision of the committee. The decision of the committee shall be binding on both parties.

7.1.3.2 Stakeholder engagements during operations

Stakeholders to the project will become at the operations phase though consultation with them will be still be sustained. A more dynamic process is required in which the SEP is adapted to suit new stakeholder groups and changing stakeholder concerns for dialogue throughout the life of the project. This may include the use of expert panels, third-party audits, employee forum, community participation in impact monitoring, and the regular communication of the company's environmental and social performance. These all form part of stakeholder engagement that strengthen effective management of impacts during operations.

7.1.3.3 Stakeholder engagements during closure

The stakeholders potentially affected by the project closure will likely be different from those at earlier stages of the project. Impacts such as the loss of local employment, a decline in economic activity, the cutting-back of community services previously provided by the company, and the disbandment of local community involvement in monitoring environmental and social impacts, can potentially introduce long-term financial and reputational liabilities for the company (IFC, 2007).

Engaging with stakeholders needs to take place well before project closure. This can lower potential costs, reduce liabilities and strengthen the overall reputation of the company. For example, engagement will help guide the rehabilitation of the natural environment impacted by the project, integrate operational infrastructure into existing public services, develop worker disengagement programs, and establish funds and management structures for the long-term monitoring of assets.

Consultation with the various stakeholders to the project is a continuous process and shall be continuously carried out throughout the various life cycle of the project.

CHAPTER EIGHT

IMPACT ASSESSMENT AND MITIGATION MEASURES

8.1 Introduction

This chapter provides information on the assessment of potential environmental and social impacts from the proposed Project. It also presents the approach adopted for the mitigation of identified impacts. The impacts from both short-term (initial decommissioning, medium term–pre-construction, construction and decommissioning phases) and the long-term (operational phase) were considered. Provision of the assessment methodology used in evaluating impact significance, taking into account impact magnitude and sensitivity of receptors and resources affected is also outlined.

As part of the impact assessment process, the primary Project activities (source of potential impacts) considered as well as the environmental and social aspects and receptors assessed for potential impacts during the construction and operational phase of the development are presented in Table 8.1.

Table 8.1: Indicative project activities and environmental/social receptors assessed

	Phases	Activities
Indicative project activities	Initial Decommissioning Phase	Tower unstringing Tower dismantling Dismantling of tower foundation Waste management Stakeholder's consultations
	Pre- Construction Phase	Consultation with PAPs, Resettlement and Compensations Vegetation clearance, removal of structures Transportation of men & materials
	Construction Phase	Transportation of men & construction materials, Establishment of a construction yard; Preparation of transmission tower foundation/basis Assembly of machinery and equipment (towers, conductors, Transmission lines); Use of natural resources (water, energy sources);

		Disposal of waste materials (like eroded material) and wastewater; and Non-routine events (e.g. spills, traffic accidents, occupational health & safety incidents). Stakeholder's consultations
	Operation Phase	Operation of the transmission line; Routine maintenance of towers, conductions and lines; and Non-routine events (e.g. tower collapse, line snapping, and fire). Stakeholder's consultations
	Decommissioning Phase	Tower unstringing Tower dismantling Dismantling of tower foundation Waste management
Environmental indicators, resources or receptors considered in the impact assessment	Construction, Operations and Decommissioning	BiophysicalEnvironment Air quality; Noise, vibration & EMF; Soils and geology; Water resources; Terrestrial and aquatic ecology. Groundwater Human Environment Visual amenities; Community level impacts Community health, safety and security; Resettlement; Labour and working conditions; Infrastructure; Employment and economy; and Cultural Heritage

For each of the above-mentioned environmental component, the associated potential impacts of Project activities are identified, and significance of the impacts assessed.

A summary table of all potential impacts with their significance is presented in Tables 8.6 to 8.36.

8.2 Impact Assessment Methodology

This section describes the overall approach used for the assessment of impacts. Topic-specific methodologies are described under each section of the impact assessment.

In general, the assessment of impacts will pass through an interactive process involving the following four key elements:

Prediction of potential impacts and their magnitude (i.e., the consequences of the proposals on the natural and social environment);

Evaluation of the importance (or significance) of impacts taking the sensitivity of the environmental resources or human receptors into account;

Development of mitigation measures to avoid, reduce or manage the impacts or enhancement measures to increase positive impacts; andAssessment of residual significant impacts after the application of mitigation and enhancement measures.

Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are as low as reasonably practicable for the Project.

8.3 Definition of Impact Terminologies

Nature/Type of impacts

There are a number of ways that impacts may be described and quantified. Table 8.2 provides definitions of terms used in this section.

Table 8.2: Definition of Impacts

	NATURE OF IMPACT: An impact is essentially any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity.

	Negative – an impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor. Positive – an impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
2	TYPE OF IMPACT: Direct (or primary) – impacts that result from the direct interaction between a planned project activity and the receiving environment (e.g., between digging tower foundation and injury to the worker). Secondary – impacts that result from the primary interaction between the Project and its environment because of subsequent interactions within the environment. Indirect – impacts that result from other activities that are encouraged to happen because of the Project.
3	TEMPORAL SCALE OF IMPACT: Temporary - impacts are predicted to be of short duration, reversible and intermittent/occasional in nature. The receptor will return to a previous state when the impact ceases or after a period of recovery. Short-term - impacts that are predicted to last only for a limited period (i.e., during construction) but will cease on completion of the activity, or because of mitigation measures and natural recovery (e.g., non-local construction workforce-local community interactions). Long-term - Impacts that will continue for the life of the project but cease when the project stops operating (i.e. 50years or when there is improvement in technology which requires replacement). These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period.
4	SPATIAL SCALE OF IMPACT: On-site – impacts that are limited to the Project site. Local - impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community. For this ESIA, local impacts are restricted to the Project site and adjacent areas. Regional - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries.

	National - impacts that affect nationally important environmental resources; affect an area that is nationally important/protected; or have macro-economic consequences (i.e. Nigeria). International - impacts that affect internationally important resources such as areas protected by International Conventions. Trans-boundary - impacts that are experienced in one country as a result of activities in another.

Magnitude of Impact

The term 'magnitude' covers all the dimensions of the predicted impact to the natural and social environment, including:

- the nature of the change (what resource or receptor is affected and how);
- the spatial extent of the area impacted, or proportion of the population or community affected;
- its temporal extent (i.e. duration, frequency, reversibility); and
- where relevant (accidental or unplanned events),
- the probability of the impact occurring.

For biophysical impacts, the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment were provided in Table 7.1.

For social impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or losses access to, or control over socio-economic resources (1) resulting in a positive or negative effect on their well-being (a concept combining an individual's health, prosperity, their quality of life, and their satisfaction).

Sensitivity of resources and receptors

Sensitivities are defined as aspects of the natural or social environment which support and sustain people and nature. Once affected, their disruption could lead to a disturbance of the stability or the integrity of that environment.

For ecological impacts, sensitivity can be assigned as low, medium or high based on the conservation importance of habitats and species. For habitats, these are based on naturalness, extent, rarity, fragility, diversity and importance as a community resource.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as 'a stakeholder's (or groups of stakeholders') resilience or capacity to cope with sudden changes or economic shocks. The sensitivity of a resource is based on its quality and value/importance, for example, by its local, regional, national or international designation, its importance to the local or wider community, or its economic value.

Likelihood

Terms used to define likelihood of occurrence of an impact are explained in Table 8.3.

Table 8.3: Explanation of terms used for likelihood of occurrence

Definition of likelihood		
High probability	Refers to a very likely impact	Refers to very frequent impacts
Medium probability	Refers to a likely impact	Refers to occasional impacts
Low probability	Refers to a very unlikely impact	Refers to rare impacts

Impact Evaluation

The third stage in the assessment procedure involved the evaluation of the impacts identified in order to determine their significance. This was based on the methodological framework set by (ISO) 14001 – EMS and EMSP Aspects and Impacts – Determining Significance developed by the University of Bristol in 2015.The evaluation of impact significance was based on the following clearly defined criteria:

- Environmental Legislation and Policy
- Stakeholders' Concern and Interest
- Severity of Environmental and Social Impacts
- Magnitude/Scale of Impacts
- Frequency of Occurrence of Impacts

The above criteria and the rating adopted for the evaluation are described in Table 7.4.

Table 8.4: Impact Evaluation Criteria and Ratings

	Consequence		
A	Environmental legislation and corporate Policy	Is there any legislation affecting the aspect?	Score
		The impact is covered by legislation & Policy	3
		The impact is covered by legislation	2
		The impact is covered by Policy	1
		The impact is not covered by legislation or Policy	0
B	Stakeholder concern / interest	What stakeholder concern or interest does the stakeholder raise?	Score
		The impact raises considerable global, national and local interest or would have serious detrimental effect on the reputation of the client	3
		The impact raises some interest and may have some detrimental effect on the reputation of the client	1
		The impact raises no interest and would have no effect on the reputation of the client	0
		The impact raises some interest and may have some positive effect on the reputation of the client	-1
		The impact raises global, national and local interest or would have a significant positive effect on the reputation of the client	-3
C	Severity of Environmental Impact	What is the severity of environmental impacts?	Score
		The impact has a moderate detrimental effect on the environment or a scarce, non-renewable resource. Long Term/ Irreversible Impact.	3

		The impact has a moderate detrimental effect on the environment or a scarce, non-renewable resource. Impact not reversible within a year.	2
		The impact has a minor detrimental effect on the environment and on scarce, non-renewable resource. Impact reversible within a month to a year.	1
		The impact has no known effect on the environment	0
		The impact has a minor positive effect on the environment and on scarce, non-renewable resource.	-1
		The impact has a moderate positive effect on the environment and on scarce, non-renewable resource.	-2
		The impact has a major positive effect on the environment or a scarce, non- renewable resource	-3
D	Scale of Impacts	What is the scale of the impact?	Score
		The negative impact occurs in high or large quantities	3
		The negative impact occurs in medium quantities	2
		The negative impact occurs in low or small quantities	1
		The positive impact occurs in low or small quantities	-1
		The positive impact occurs in medium quantities	-2
		The positive impact occurs in high or large quantities	-3
	LIKELIHOOD		
Z	Frequency	How frequently does the impact occur?	Score
		The impact occurs on a daily basis	5
		The impact occurs on a weekly basis	4
		The impact occurs on a monthly basis	3
		The impact occurs on an annual basis	2
		The impact is unlikely to occur	1

Overall Significance Ranking

Following the evaluation of each impact using the criteria highlighted in Tables7.1 to 7.4 above, the identified environmental impacts are categorized and scored according to Table 7.5a and the equation below.

Consequence (A+ B + C + D) X Likelihood (Z) = Significance evaluation score

Table 8.5a: Significance Level Categories

Impact Significance	Score
Low Negative Significance	1 – 25
Medium Negative Significance	26 – 50
High Negative Significance	> 50
Positive Significance	< -1

The definition of the impacts, terminologies, sensitivities, Tables, etc. are are too lengthyrather been direct and definite.

8.4 Approach to mitigation measures

The approach used in this ESIA for identifying mitigation measures where there were significant impacts include:

Environmental laws and regulations in Nigeria, with emphasis on permissible limits for waste streams (FMEnv (formerly FEPA), 1991);

The AfDB

Best available Technology for sustainable Development;

Feasibility of application of the proposed mitigation measures in Nigeria;

Views and concerns of stakeholders as expressed during extensive consultations carried out during the study.

Mitigation measures are developed to avoid, reduce, remedy or compensate for any negative impacts identified, and to create or enhance positive impacts such as environmental and social benefits. In this context, the term “mitigation measures” includes operational controls as well as management actions. These measures are often established through industry standards and may include:

- changes to the design of the project during the design process (e.g. changing the development approach);

- engineering controls and other physical measures applied (e.g. substation maintenance facilities);
- operational plans and procedures (e.g. Occupational Health Safety Plans); and the provision of like-for-like replacement, restoration or compensation.

For impacts that are assessed to be of Major significance, a change in design or layout is usually required to avoid or reduce these. For impacts assessed to be of Moderate significance, specific mitigation measures such as engineering controls are usually required to reduce these impacts to As Low as Reasonably Practicable (ALARP) levels. This approach takes into account the technical and financial feasibility of mitigation measures. Impacts assessed to be of **Minor** significance are usually managed through good industry practice, operational plans and procedures. Negligible impacts require no mitigation action, other than those already included in the project design.

In developing mitigation measures, the first focus is on measures that will prevent or minimize impacts through the design and management of the Project rather than on reinstatement and compensation measures.

8.5 Residual Impact Assessment

Impact prediction considers any mitigation, control and operational management measures that are part of the project design and project plan. A residual impact is that which remains even after proffered mitigation measures have been implemented. The residual effects that may remain after the application of the impact mitigation measures have also been discussed for further reduction as possible.

The method for residual impact ranking was exactly the one used in the initial impact assessment. Table 8.5b is the criteria for residual impact determination. The calculations and formula was established with the assumption that the application of mitigation measures can reduce impact severity, consequence and perception to a lower risk.

Table 8.5b: Residual Impact Assessment Method

Consequence criterion	Legend	Explanation
Minor		When the application of any mitigation measure is capable of reducing all five evaluation criteria (legislation, stakeholder concern, severity, scale

		and frequency) to 6-9 after dividing overall rating by 4
Negligible/insignificant		When the application of any mitigation measure is capable of reducing all five evaluation criteria (legislation, stakeholder concern, severity, scale and frequency) to ≤5by after dividing overall rating by 4

8.6 Potential Impacts during initial decommissioning and preconstruction Phase

8.6.1 Impacts on Air Quality

The assessment of potential impacts on **air quality**, sources, rating criteria and mitigation measures are presented in Table 8.6.

Table 8.6 Impacts on Ambient Air Quality during initial decommissioning and preconstruction Phase

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Ambient Air Quality	
A1: Reduction in ambient air quality A2: Contribution to global warming	site preparation (clearing of existing access road and RoW)	Use covered trucks for the transportation of materials that release dust emissions Maintain and operate all vehicles and equipment engines in accordance	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	3
			Severity	2
			Scale	2
			Frequency	4
			Overall rating	40

	transport of materials to site	with manufacturers recommendations	Impact Significance	Medium
Mitigation measures				
Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations; Use covered trucks for the transportation of materials that release dust emissions; and Speed limits on-site of 25km/hr on unhardened roads and surfaces Provide and encourage use of PPEs. Limit vegetal clearing to RoW footprint(10m)				
Residual Impact				
Minor				

A1: Vehicles transporting men and materials will generate PM, SO_2, CO, NOx, CO_2 emissions. This activity is expected to add to baseline concentrations. This impact is rated **Medium** and the implementation of the mitigation measures in Table 8.6 will reduce the impact to a **minor** level.

A2: A small volume of vegetal biomass shall be generated through clearing of existing access roads linking the Aba – Port Harcourt express way, Umuikaa – Owerri, and Owerri – Onitsha express Wayto the existing RoW. This shall contribute to global warming as sink for carbon sequestration will be lost. During transport and clearing activities, operation of the vehicles and machine will also result in the emission of green house gases such as methane and CO. This impact is rated **Medium** and the implementation of the mitigation measures in Table 8.6 shall reduce the impact to a **minor** level.

8.6.2 Impacts on Ambient Noise Level

The assessment of potential impact on **noise**, sources, rating criteria and mitigation measures are presented in Table 8.7.

Table 8.7: Assessment of Impacts and mitigation measures on ambient Noise impact During Initial Decommissioning and Preconstruction Phase

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on Noise</th></tr>
<tr><td rowspan="8">NQ1: Increase in ambient noise level and Vibrations</td><td rowspan="8">Dismantling of tower foundation

Tower dismantling and unstringing of conductors

clearing of existing access road and RoW

Transport of materials to and from site</td><td rowspan="8">Develop a detailed plan for daily activities on site (work start and close time) and agree with the stakeholders around the site that relates to noise control for relevant work practices and discuss this with staff during health & safety briefings</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>1</td></tr>
<tr><td>Severity</td><td>2</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>Frequency</td><td>4</td></tr>
<tr><td>Overall rating</td><td>35</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">Select ‘low noise’ equipment or methods of work
Avoid dropping materials from height, where practicable
Limit work activities to daytime only
Ensure maintenance of vehicles and equipments
Provide and encourage use of PPEs such as earmuffs to cushion high noise level</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Negligible</td></tr>
</table>

Thebaseline noise levels were above regulatory limit for schools, residential areas and churches, the project shall add to the baseline noise level during this phase, the impact is rated **Medium**. However, implementation for the mitigation measures listed in Table 8.7 shall reduce the impact to **Negligible**.

8.6.3 Impacts on Soil and Geology

The summary of the potential impact on **soil and geology**, sources, rating criteria and mitigation measures are presented in Table 8.8.

Table 8.8: Soil and Geology Impacts During Initial Decommissioning and Preconstruction Phase

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Soil and geology**	
SQ1: Change in soil structure SQ2: Exposure of soil to erosion	clearing of existing access road and RoW Dismantling of tower foundation Transport of materials to and from site	Limit vegetation clearing only to the already existing RoW	Impact criteria	Rating
			Legislature	2
			Stakeholder concern	1
			Severity	3
			Scale	1
			Frequency	5
			Overall rating	35
			Impact Significance	**Medium**
Mitigation measures				
Ensure that the land around tower sites is physically restored (include revegetation where possible) Use overburden from specific tower foundations to establish new tower foundations during construction Use of existing track for transport of man and material to the extent possible.				

Limit vegetation clearing only to the immediate area as required Reforestation of affected areas after construction Include mitigation measures for upturned soil due to towers base diggings
Residual Impact
Minor

Impact Description

S1: Transportation of materials to site may change the structure of the soil making it more compacted. Clearing of vegetation for access round widening will also expose the soil to water erosion. Soils in the project area are prone to erosion. This impact is rated **Medium** according to the criteria in Table 8.8

S2: Minimal widening of the existing access roads linking the major access road to the RoW is likely to render soils vulnerable to water erosion. This impact is also rated **Medium**.

Implementation of the mitigation measures in Table 8.8 will reduce both impacts to **Minor**

8.6.4 Impacts on Surface and Groundwater

The potential impact on **water resources**, sources, rating criteria and mitigation measures are presented in Table 8.9.

Table 8.9: Impacts on water Resources during Initial Decommission and Preconstruction Phase

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on water resources**	
W1: Potential surface and groundwater contamination W2: Potential groundwater contamination	Dismantling of tower foundations Clearing of access roads and RoW Operation and maintenance of	Accidental spills from machine maintenance shall be properly managed	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	3
			Scale	1
			Frequency	4
			Overall rating	32
			Impact Significance	Medium

W3: Sedimentation of streams and Rivers	preconstruction equipment/machines			
Mitigation measures				
- Accidental spills from machine maintenance shall be properly managed - Use of trained personnel for tower works - Limiting clearing to the RoW - Herbicides shall not be used to eradicate vegetation - Implement where appropriate sediment run-off controls and visually inspect after rainfall events - Lay down areas shall be designed to include erosion control - Reclaim as practicable possible the topography of excavated or compacted upland areas upon completion of activities - Install siltation traps within the drainage design to collect silt and sediments ensuring that they do not end up in adjacent aquatic areas. - Avoid crossing permanent waterways with machinery; if necessary, locate the crossing where the banks are stable and the waterway most narrow areas. .				
Residual Impact				
Negligible				

Impact Description

W1: Baseline surface water turbidity levels were above regulatory limits at all sampling points. Earthworks during tower dismantling will potentially produce overburden which may be washed down by rain into nearby water bodies. This shall add to the baseline turbidity level which is currently above WHO regulatory limits Vegetation clearing will increase runoff rate into these water bodies, adding to the present turbidity levels. Also, runoff may carry oil spilled accidentally during machine/equipment repair and maintenance into nearby water bodies.

W2: Depending on the magnitude of spill, huge accidental spill may seep into groundwater region and contaminate the water source. This shall lead to groundwater pollution thus, rendering these waters unsafe for drinking.

W3: Clearance of existing vegetation will expose the upper layers of the soil horizon to soil erosion. The transport of eroded soil into surface water resources, will impact on water quality. The stockpiling of excavated earth and construction materials can result in runoff to the water bodies.

W1, W2, and W3: On the overall, impacts resulting to sedimentation problems and groundwater/ surface water and groundwater contamination problems are predicted to have a medium significance. Implementation of the actions outlined in Table 7.9 shall reduce the impact to negligible.

8.6.5 Impact on Biodiversity

The potential impact on **biodiversity**, sources, rating criteria and mitigation measures are presented in Table 8.10.

Table 8.10: Biodiversity Impacts during Initial Decommission and Preconstruction Phase

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on biodiversity	
B1(A): Loss of threatened species and plants of important indigenous uses B1 (B): Habitat loss B1(C): Migration of fauna species as a result of decommissioning noise and vibrations	(1) Vegetation clearing for access road widening (2) Transport of men & materials	Final route optimization to possibly avoid locations of Threatened species (See Baseline data)	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	3
			Severity	3
			Scale	2
			frequency	5
			Overall rating	55
			Impact Significance	Medium
Mitigation measures				

Clearing of vegetation (which are habitats of wild anials) shall be minimized and restricted to the RoW Preconstruction equipment shall be optimally maintained in order to reduce noise generation that may lead to species migration Enlighten contractors and third-party agents against indiscriminate poaching of wildlife during clearing
Residual Impact
Medium

Impact Description

It is estimated that a negligible vegetal biomass shall be cleared for the establishment of this project for widening of existing access roads.

B1 (A): Baseline result showed that five flora species were of conservation interest. These are *Sericanthe toupetou* (Endangered), and *Afzelia africana, Dalbergia latofolia, Ricinidendron heudelotii and Lophira alata*, in the vulnerable category. *Sericanthe toupetou*

Similarly, there are seventeen (17) species inventoried in the study offering Provisioning Services. However, the impacts are rated Low, considering the insignificant vegetal quantity that would be cleared as well as sensitivity of the habitats and the threatened plant species. Implementation of the mitigation measures listed shall reduce these impacts to **Negligible**.

B1 (B): Vegetal clearing for widening of access roads shall result in the small reduction in area of the secondary forest. The impact is rated minor, considering the duration, magnitude and sensitivity of the receptor. Implementation of the mitigation measures shall reduce these impacts to **Medium**

B1 (C): Decommissioning noise and vibrations are expected to impact on the population of mammalian species censored in the project area of influence. The project would render noise sensitive ground dwelling species like the frogs, common rainbow lizard and rats that were censored in this study homeless temporarily. There is also the possibility of accidental fauna kills, hunting and poaching. The impact is rated **Medium**. However, implementation of the mitigation measures shall reduce these impacts to **Low**

8.6.6 Impacts on land use

The potential impact on **land use**, sources, rating criteria and mitigation measures are presented in Table 8.11.

Table 8.11: Land Use Impacts during Initial Decommission and Preconstruction Phase

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on land use</th></tr>
<tr><td rowspan="8">LI (A) Involuntary displacement of PAPs</td><td rowspan="8">Clearing of existing RoW site</td><td rowspan="8">Site clearance activities to be restricted to the minimum required area

Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>2</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>3</td></tr>
<tr><td>frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>55</td></tr>
<tr><td>Impact Significance</td><td>High</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">Site clearance activities to be restricted to the minimum required area
Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Medium</td></tr>
</table>

Impact Description

LI (A): The existing properties along the right of way shall also be lost. Over the years, locals have been building and farming under line. Lands consisting part of the RoW have also been sold to strangers moving in into the host communities. There is need for these PAPs to be properly resettled according to principles and procedures spelt out in an efficient and robust RAP. About 40 households shall be displaced. The line also passes through some sections of the Aba Market in the Abia state section of the project area. This impact is Rated High, however with the development of Resettlement Action Plan (RAP) (on-going) followed by efficient resettlement and compensation process the residual Impact shall be **Medium**

8.6.7 Impacts on Community Infrastructure, Socio-cultural and Health Status

The potential impact on biodiversity, sources, rating criteria are presented in Table 8.12.

Table 8.12: Impacts on Community Socio-cultural and Health Status

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Community Socio-cultural and Health Status	
SE1 (A): Risks and tensions between incoming expatriate and local workers SE1 (B): Violation of norm and culture by incoming workers SE1 (C): Increase incidences of communicable & non communicable diseases SE1 (D) Pressure on existing social infrastructure	(1) Employment of preconstruction workers (2) Influx of workers and marketers (3) Decommissioning works	Develop a code of behaviorfor workers Funding of local community projects to compensate impacts.	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	2
			Scale	1
			frequency	3
			Overall rating	21
			Impact Significance	**Low**
Mitigation measures				

- Develop a code of behaviours for workers
- All workers to receive training on community relations and code of behaviour
- Employ workers (especially for activities not requiring high skill levels) majorly from host communities
- Management practices aimed at eliminating disease vector breeding sites.

• The provision of alternative facilities for workforce e.g. medical services, firefighting equipment etc. • Carry out enlightenment and Awareness campaign among workers on health matters especially on communicable diseases.
Residual Impact
Negligible

Impact Description

This impact speaks to the TL

SE1 (A), SE1 (B): TCN shall employ about 500 decommissioning and 300 preconstruction workers. Differences in religious and socio-cultural backgrounds between local preconstruction workers and expatriates may lead to tensions and conflicts. Existing norms and cultures of the host communities may also be violated by these incoming expatriates. These impacts are rated low and application of the mitigation measures shall reduce the impacts to a **Negligible l**evel.

SE1 (C): The influx of preconstruction workers and marketers into the project area may increase disease incidence rates in the area. Most of these persons may be carriers of communicable diseases such as HIV/AIDS and interaction with the locals may further spread the diseases. This impact is rated low and application of the mitigation measures shall reduce the impacts to a **Negligible** Status.

SE1 (D): Considering the quantity and nature of materials to be used in lines construction, transportation of these materials to site will increase the burden on existing roads in the project area. This shall indirectly affect roads not also captured in the AoI since materials will be moved from Apapa port in Lagos State to the project laydown area. The major roads in the project area to be impacted include The Aba- Port Harcourt express way, Umuikaa-Owerri, Owerri- Onitsha express way. Although the trucks would ply these roads, it is not expected to cause traffic logjam as the number of trucks is few (see Section 3). Besides, Traffic Management Plan would be developed and implemented. This impact has been ranked Minor. Implementation of the impacts shall reduce these impacts to **Negligible.**

8.6.8 Impacts on Traffic and Safety

The potential impact on **Traffic and Safety**, sources, rating criteria and mitigation measures are presented in Table 8.13.

Table 8.13: Impacts on Traffic and Safety

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Traffic and Safety	
SE1 (E): Risk of Accidents to locals SE1 (F): Traffic congestion	Transportation of materials on-site and wastes offsite Transport of decommissioned materials offsite	Implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines),	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	3
			Severity	3
			Scale	3
			frequency	5
			Overall rating	60
			Impact Significance	**High**
Mitigation measures				
- Implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of - traffic guards, procedures for transport of oversized loads (e.g., engines), - Maintain log of traffic related incidents, sensitization of road users and people living close to the construction site. - Periodic maintenance of transport vehicles - The contractor will develop appropriate strategies to minimize the need for transportation of supplies and will ensure - Compliance with all applicable laws, such as maximum load restriction and speed limits. - An awareness program for truck drivers to speed limits and other precautionary - Prepare and disseminate a Journey Management Guide (JMG) to the trined vehicle drivers and supervisors				
Residual Impact				

Medium

TR1 (A): Increase in traffic during material and personnel transport in the villages and the roads could also be a source of accidents. This impact is rated **High** significance, and implementation of the mitigation measures shall reduce the impact to a **Medium** Level.

TR1 (B): Transportation of decommissioned materials offsite and those for TL construction shall add to the load of traffic laden roads of the project area. This impact is with rated **Medium** significance, and implementation of the mitigation measures shall reduce the impact to a **Minor** Level.

8.6.9 Impacts on Employment and opportunities

The potential impact on **Employment and opportunities**, sources, rating criteria and mitigation measures are presented in Table 8.14.

Table 8.14: Impacts on Employment and Opportunities

Impact Statement	Sources of Impact	Enhancement Measures Integrated in Project Design	Impact on impact on Employment and opportunities	
SE1 (H) Employment	Material requirement and sales Access road widening Tower dismantling and unstringing Dismantling of existing tower foundations Employment of workers	Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities	Impact criteria	Rating
			Legislature	
			Stakeholder concern	
			Severity	
			Scale	
			Frequency	
			Overall rating	
			Impact Significance	**Beneficial**

Enhancement measures
Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities
Residual Impact
Beneficial

SE1: Employment of casual un-skilled labour would occur, for short-term contracts or for the entire preconstruction phase. The main jobs that will be available are the widening of existing access roads, tower and tower foundation dismantling, tower unstringing, sales and requirement of materials. Supplies will include raw materials that meet standards as required for the construction of the transmission line facilities. This is a positive impact and as such does not require mitigation. The enhancement measures are stipulated in Table 8.14.

8.7 Construction Phase Impacts and Mitigation Measures

8.7.1 Impacts on Ambient Air Quality

The potential impact on **Ambient Air Quality**, sources, rating criteria and mitigation measures are presented in Table 8.15.

Table 8.15: Impacts on Ambient Air Quality

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Ambient air quality	
AQ1 (A): Reduction in ambient air quality AQ1 (B): Dust emission from land	Operation of construction equipment and machine	• Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	2
			Scale	2
			Frequency	5

preparation and vehicle movements AQ1 (C) Impact on climate change	Transportation and traffic	• Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area	Overall rating	40
			Impact Significance	**Medium**
Mitigation measures				
• Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations; • Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt; • Use covered trucks for the transportation of materials that release dust emissions; and • Speed limits on-site of 25km/hr on unhardened roads and surfaces • Cover properly loose materials and keep top layers moist • Use binder material for erosion and dust control for long term exposed surfaces • Implement re vegetation action plan				
Residual Impact				
Minor				

AQ2 (A): The movement of vehicles for the construction will result in PM, SO_2, CO, NOx, CO_2 emissions. It is noteworthy to mention that the quantity of emissions is dependent on the vehicle type, amount and their conditions. Light-duty petrol vehicles not equipped with pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration and idling cycles. Frequent cycle changes characteristic of congested urban traffic patterns thus tends to increase pollutant emissions. At higher cruise speeds hydrocarbon and CO emissions decrease, while NOx and CO_2 emissions increase. Emissions from

diesel-fuelled vehicles include particulate matter, NOx, SO_2, CO and hydrocarbons, the majority of which occurs from the exhaust. Operating at higher air-fuel ratios (about 30:1 as opposed to 15:1 characteristic of petrol-fuelled vehicles with electronic fuel injection engines), diesel-powered vehicles tend to have low HC and CO emissions, despite having considerably higher particulate emissions.

Particulates emitted from diesel vehicles consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel-fuelled vehicles the contribution of soot to particulate emissions is between 40% and 80%. The black smoke observed to emanate from poorly maintained diesel-fuelled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase. Particulate emissions from petrol-driven vehicles are usually **negligible**. Such emissions when they do occur would result from unburned lubricating oil, and ash-forming fuel and oil additives.

The impact of emissions arising from vehicles and equipment's associated with construction activities is considered **Medium** and application of the mitigation measures in the Table 8.15 shall reduce the impact **Minor** level

AQ2 (B)Dust emission from land preparation and vehicle movements

The dust emissions arising from the construction activities of the Project are as a result of land preparation activities and vehicular movements. Dust emissions have the potential to create impact on the close receptors due to the physical appearance, deposition on the roof of the residential areas and creating nuisance for the surrounding community. Removal of material usually takes place with a bulldozer, cleared material is then stored in piles for later use or during rehabilitation procedures. Fugitive dust is generated during the clearing of material, as well as from wind-blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be generated during the transportation of the material, usually by truck, to the stockpiles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation.

The impact is rated **Medium**. However, implementation of the mitigation measures shall reduce the impact to **Minor**.

AQ2 (C) Impact on climate change

A series of stages are involved in estimating the climate change impact of an electricity transmission network. During the construction stage, following activity is considered for climate change impact.

Process from material production:

GHG will be emitted from the manufacturing process of construction material though it is indirect impact of the project, but still necessarily considered as part of lifecycle of the project. The assumption used for the GHG emission calculation on this item, based on Global Emission Model of Integrated Systems (GEMIS) database (World Bank, 2010).

The weight of each tower was estimated to be 4.5 tons (for 330 kV) and 2.8 tonnes (for 132 kV). Normal Voltage 330 kVrms (for 330 kV) and while 132 kVrms (for 132kv). The average distance between each 330 kV tower is 400 m – 450 m and 325 – 350 m (for 132 kV). Right of way for 330 kV TL is 50m while that of 132 kV TL is 30 m. It is estimated that the height of towers will range between 28m -32m (for 330 kV).

Total emissions of GHGs from project equipment and vehicles were determined using the SCEG tool version 5.1 created by the US Environmental Protection Agency. Results are presented in Table 8.16.

Table 8.16: Total GHG Emission from Activities Related to the Project

GHG supply Component		**GHG Demand Component**	
Project Phases	**$MTCO_2$ Equivalence**	**Activities by PAPs**	**$MTCO_2$ Equivalence**
Initial Decommissioning	196.06	Energy consumption rate	636,609.66
Construction	73.20	Fuel wood for cooking	75,940,746.9
	269.25		76,577,356.56
Total **GHG Footprint**	**76,577,625.81**		
Project predicted to reduce GHG emisions by 7.5 % in the project area	7.5 x 76,577,625.81/100		5,743,321.94
Net **$MTCO_2$ Equivalence**	**70,834,303.88**		

See Chapter 4 for detailed calculations *Source GNL 2019*

GHG will be emitted from material production as well as energy use in construction activity. GHG emission during construction stage is short and temporally, the impact on climate change is considered to be **Medium**. Implementation of mitigation measures will reduce impacts to a **low** level.

8.7.2 Impacts on Ambient Noise Level

The potential impact on **Ambient Noise Level**, sources, rating criteria and mitigation measures are presented in Table 8.17.

Table 8.17: Impacts on Ambient Noise Level

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on Ambient noise level</th></tr>
<tr><td rowspan="8">NQ2: Increase in ambient noise level</td><td rowspan="8">Operation of construction equipment and machine

Transportation and traffic</td><td rowspan="8">Inform all potentially impacted residents of the nature of works to be carried out; the expected noise levels and duration, as well as providing the contact details of the CLO.</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>1</td></tr>
<tr><td>Severity</td><td>2</td></tr>
<tr><td>Scale</td><td>2</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>40</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings
Select ‘low noise’ equipment or methods of work
Restrict construction activities to daytime
Avoid dropping materials from height, where practicable
Avoid metal-to-metal contact on equipment</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Minor</td></tr>
</table>

NQ 2: During the construction phase, construction activities, traffic, as well as the use of construction equipment and machinery are likely to lead to a temporary increase in noise levels that may disturb neighboring communities and local fauna.

The project area is noise degraded. Noise levels were above recommended threshold limit for specific receptors which include residential, schools and churches. The project shall add to the baseline noise level. Communities likely to be affected include built up areas and commercial farming areas such as; Osisioma, Aba North, Aba South, Ugwunagbobo, Idemili South, Ihiala, Ekwusigo, Ogbaru, Mbatoli, Ngor-Okpala, Oru West, Oru East, Owerri North, Owerri West, Owerri Municipal, Njaba communities. The construction activity will be undertaken during daytime. Construction activities will be concentrated and done sequentially so that no area is prone to long duration of noise impacts. There will be some noise generated from the movement of tractors and trucks transporting the materials and equipment, but the traffic volumes are expected to be occasional.

Considering the construction activity schedule and nature of construction, overall noise impact on nearby sensitive receptors with embedded controls in place will be of **Medium** significance, however, application of the mitigation measures will reduce the impact to **Minor** level.

8.7.3 Impacts on Soil and Geology

The potential impact on **Soil and Geology**, sources, rating criteria and mitigation measures are presented in Table 8.18.

Table 8.18: Impacts on Soil and Geology

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Soil and Geology**	
SQ2 (A): Change to soil structure (erosion and compaction SQ2 (B): Potential contamination of soil	Creation of tower foundation Erection of tower	Ensure that the land is physically restored (include re vegetation where possible) before	Impact criteria	Rating
			Legislature	2
			Stakeholder concern	1
			Severity	3

from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminum oxide paint, etc.		leaving to next tower location	Scale	1
			Frequency	5
			Overall rating	35
			Impact Significance	**Medium**
Mitigation measures				
• Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers. • Ensure that the land is physically restored (include revegetation where possible) before leaving to next tower location and before the next rainy season. • Accidental spills from machine maintenance shall be properly managed • Develop project specific waste management plan and ensure proper implementation • Provide adequate containers for waste collection • Periodically audit contractor activities to check the level of compliance to regulatory waste management requirements • Ensure engagement of government approved waste management contractors • Safe operating practices are enforced during construction				
Residual Impact				
Minor				

SQ2 (A): During the construction phase, the main activities likely to affect soil structure and quality are digging of foundation pits for the towers and removal of vegetation (for foundation purposes). Foundations will be dug up to variable depths, depending upon the tower type and soil characteristics. Although existing roads and tracks will be used to access the corridor, vehicle movement around the project area can lead to soil compaction in those areas where soils are clayey or highly saturated. This impact is rated **medium** and shall be reduced to **Minor** if the proffered mitigation measures are implemented.

SQ2 (B): Also, Soils can be contaminated during the construction phase by accidental oil/fuel spills from heavy machinery either at storage yards or work sites. In the event of an accidental spill, the proportion of soil contamination will depend on the magnitude of these accidental events. A significant amount of solid waste (including, wood, metal scarps, office and domestic wastes, etc.) will be generated in this phase of the project. The methods put in place for handling and disposing of these wastes to be generated play an important role in the significance of impacts expected from wastes management. Waste handling and disposal have been assessed to pose a **medium** impact to the environment. Application of specific mitigation measures such as de-compaction of soils following construction as well as avoiding construction activities during times when soils are saturated and avoiding storage of materials within these areas as well as implementation of an Emergency Response Plan will help manage accidental spills properly will reduce the impact to a **Minor** Status.

8.7.4 Impacts on Water Resources

The potential impact on **Water Resources**, sources, rating criteria and mitigation measures are presented in Table 8.19.

Table 8.19: Impacts onWater Resources

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on Water Resources</th></tr>
<tr><td rowspan="8">WQ2 (A): Potential surface contamination
WQ2 (B): change in hydrological flow regimes of surface water
WQ2 (C): Potential groundwater contamination
WQ2 (D): Exploitation of water resources</td><td rowspan="8">Operation and maintenance of construction machines and equipment</td><td rowspan="8">Rivers and streams shall not be dammed for the purpose of water abstraction

Deepen foundations of transmission towers in areas prone to landslide</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>1</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>40</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• Rivers and streams shall not be dammed for the purpose of water abstraction</td></tr>
</table>

• Accidental spills from machine maintenance shall be properly managed • Continuous training of workers on HSE protocols • Conducting daily safety briefings • using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas • pylon spacing of an average of 300- 400m • no pylons will be installed in any of the rivers, since all are less than 500m in with
Residual Impact
Minor

Sources of impacts to water resources are removal of vegetation, vehicle movement along the RoW and construction sites and excavation/piling for tower installations.

WQ2 (A): Vegetation removal in swampy areas can increase soil erosion in erosion prone areas, causing sediment to be deposited into the water bodies, especially during rain events. This shall likely add to the baseline surface water Turbidity levels at all sampling points which are above threshold limits. These areas are likely to be most impacted. Poor waste management practices are likely to have an effect on water quality (e.g. improper waste disposal in surface waters). The risk of accidental oil spills from heavy machinery during construction phase could result in surface water contamination. This shall likely add to the baseline surface water DO levels at all sampling points since hydrocarbon utilizing microbes are known to increase DO levels in water. However, the contamination level resulting from accidental spills will depend on their magnitude which of this case is small, but the receptor is very sensitive leading to a Medium Impact Rating. However, proper application of the mitigation measures listed in the Table above will reduce the impacts to a **minor** level.

WQ2 (B): Construction of access routes as well as vehicular movement along the construction sites can result into changes in hydrological flow regimes of watercourses. Depending on the level of disturbance, watercourses can be temporarily or permanently impaired. Erection of pylons within watercourses could also potentially modify watercourse dynamics, reducing water flow and ultimately converting a lotic system into a lentic system. This impact is rated **Medium**. However, mitigation measures such as using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas will reduce impacts on water resources to **Minor.**

WQ2 (C): Groundwater could be contaminated during digging of foundation pits for the tower, particularly near watercourses or the areas around any of the water bodies in the area. This Impact is rated **Medium** and the application of the mitigation measure shall reduce the impact to **Minor.**

WQ2 (D): Water to be used for construction activities shall be sourced from borehole. The impacts are rated **Medium** and implementation of the mitigation measures listed above shall reduce impacts to **Minor status**.

8.7.5 Impacts on Aquatic Species

The potential impact on **Aquatic species**, sources, rating criteria and mitigation measures are presented in Table 8.20.

Table 8.20: Impacts onAquatic species

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Aquatic biota during construction**	
AS 1: Loss/disturbance of aquatic species	Tower erection Transport and traffic	Natural flow of a River shall not be blocked	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	3
			Scale	2
			Frequency	5
			Overall rating	45
			Impact Significance	**Medium**
Mitigation measures				
Conduct activities during the dry season to minimize disturbance of sensitive water bodies • Adjust pylon siting to span rivers and stream areas, or limit equipment access in water bodies, wherever possible. • Perform all vegetation clearing work manually along streams/rivers.				

• Avoid vegetation clearing along stream shores and on steep slopes. • Based on an appropriate project design, avoid erecting towers within water bodies. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. • Prohibit construction of permanent access roads along riverbanks or in areas where soils are saturated • Maintain vegetated buffer zones within and around rivers and along both sides of watercourse crossings. • Complete project timely to enable ecosystem rejuvenation and stabilisation
Residual Impact
Minor

AS 1: Construction related activities will result in water quality deterioration with attendant impacts on macro-invertebrates, fishery resources. This impact would however be limited in terms of duration and is ranked at a medium significance level. Implementation of the mitigation measures is predicted to reduce the impact to **Minor.**

8.7.6 Impacts on Biodiversity

The potential impact on **Biodiversity**, sources, rating criteria and mitigation measures are presented in Table 8.21.

Table 8.21: Impacts on Biodiversity

Impact Statement	**Sources of Impact**	**Recommendation Measures Integrated in Project Design**	**Impact on Biodiversity during construction**	
B2(A): Further migration of fauna species as a result of construction noise B2 (B): Introduction of invasive and alien species	Construction of tower foundation Transport and traffic	Re-vegetation shall be done using native species for erosion control	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	1
			Scale	1
			Frequency	2
			Overall rating	14

			Impact Significance	**Low**
Mitigation measures				
• Restrict construction activities, including vehicle movements and material storage, inside the RoW • Minimize the construction of new access roads. Promote the use of existing access roads for machinery and vehicle movements. • Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads • Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control				
Residual Impact				
Negligible				

B2 (A): During construction, there shall be faunal disturbance along the entire length of the transmission line RoW in which sensitive ground dwelling animals especially from the reptilian taxon will further migrate from the area during construction. This impact is short termed and rated Low. The application of Mitigation Measures will reduce the impacts to a **negligible** level.

B2 (B): There is possibility of creating fertile loci for alien and invasive flora species being introduced to the area during material transport (sand, gravel). The proliferation of invasive species can have negative impacts on local species, by outcompeting native taxa. Alien invasive species have the potential to substantially modify wildlife habitat which can impact associated fauna populations. *Chromolaena odorata, Mimosa pudica and Dalbergia sisso* listed as invasive to Nigeria were found in this study. This impact is rated Low. The application of Mitigation Measures will reduce the impacts to a **negligible** level.

8.7.7 Community Agitation

The potential impact on **Community Agitation**, sources, rating criteria and mitigation measures are presented in Table 8.22.

Table 8.22: Impacts on Community Agitation

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on community agitation during construction</th></tr>
<tr><td rowspan="7">CA1: Agitation by locals linked to compensation</td><td rowspan="7">Construction activities</td><td rowspan="7">Engage communities in the construction activities to enhance transparency and involvement</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>2</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>2</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>50</td></tr>
<tr><td></td><td></td><td></td><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">
Develop and implement a resettlement action plan to ensure equitable
settlement of all project affected persons
Develop, establish and publicize effective grievance procedures;
Early stakeholders' engagement sessions are held, and all agreed issues properly documented and signed.
All affected stakeholders and legacy issues are identified early, clearly defined, and agreed upon.
Stakeholders (communities, Govt., landowners, etc.) are adequately consulted and relevant issues addressed
Agreed fair compensation/rent for land are paid to identified owners promptly as per set standards.
As far as possible employ persons from the surrounding communities during the construction phase of the development to reduce the numbers of persons that will migrate to the area seeking employment.
The EPC will develop a community relations and engagement plan that identifies fair strategies of engagement for all communities. Contents of the Community Relations and Engagement Plan
Enhance ongoing consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan
</td></tr>
</table>

• Maitain consultation with relevant stakeholders through out the life cycle of the project
Residual Impact
Minor

There is tendency for agitations by some groups of people or individuals over non-satisfactory engagement and compensations over land and other associated properties. This could lead to strife within communities or groups. During labour recruitment and prior to full construction activities, there is also potential for conflicts between neighbouring communities or individuals over employment quota systems, sub-contracting procedures or recruitment methodology. This will pose **High** significant impact on the project construction phase. However, implementation the mitigation measures will reduce the impact to a **Minor l**evel.

8.7.8 Impacts on Socio-economic

The potential impact on **Socio-economic**, sources, rating criteria and mitigation measures are presented in Tables 8.23, 8.24, 8.25 and 8.26.

Table 8.23: Impacts on Socio-economic

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Socio-economic**	
SE2 (A): Risking tensions between outside (partly possibly expatriate and local worker SE2 (B): Violation of norm and culture by outsiders, workers and marketers	Employment of construction workers Temporary influx of outsider and marketers to the communities	Develop a code of behaviours for workers Enhance ongoing consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning of community development activities.	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	2
			Scale	1
			Frequency	3
			Overall rating	21
			Impact Significance	Low

SE3 (C): Increase incidences of communicable & non communicable diseases		Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan		
Mitigation measures				

- Develop a code of behaviours for workers
- All workers to receive training on community relations and code of behaviour
- Employ workers majorly from host communities
- Management practices aimed at eliminating disease vector breeding sites.
- Awareness/health campaigns shall include other communicable diseases such as dysentery and cholera
- Enhance ongoing consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning of community development activities.
- Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan
- Develop a health plan to address potential health issues
- Initiate /enforce TCN corporate health awareness programs for malaria, AIDS, etc)
- Provide site medical personnel to attend to emergency situations
- Engage the services of retainer clinics to manage health issues
- Educate workforce on the prevention of malaria as well as encourage the use of mosquito nets Ensure personnel use appropriate PPE
- Prepare and implement emergency response plan
- Ensure availability of first aid facilities onsite
- Provide information, education and communication about safe uses of water and occupational hygiene and safety
- Ensure Environmental Management for vector control and avoidance via settlement location and

• Develop and implement safe food storage and handling practices
Residual Impact
Negligible

SE2 (A), SE2 (B): Potential socio-economic impacts are expected to arise from socio-cultural conflicts between the construction workforce and natives due to contrast in belief and religion systems. This may also lead to the violation of the existing traditional norms in the project area. These impacts are rated Low as application of the mitigation measures shall reduce the impact to a **Negligible** status

SE3 (C): Construction activities have the potential to create new malaria vector (mosquito) habitats due to establishment of small pit lakes. An influx of workers with no or partial immunity to malaria parasite (*Plasmodium sp*) increases the risk of serious illness which may result to death. This impact if not managed is expected to pose a major significance characteristic. Influx of workers into the project area also increases the risks of Sexually Transmitted Diseases (STDs) and could impact adversely on the spread of HIV/AIDS. This impact if left unmanaged may result in long term health issues which may eventually lead to fatality. Impact arising from this is ranked as **High**. Application of the mitigation measures would reduce the impact to a **Minor** level.

Table 8.24 is an assessment of Socio-economic impacts on existing social infrastructure of the project are expected to occur during the construction phase.

Table 8.24: Impacts on Socio-infrastructure

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Socio-infrastructure**	
	Influx of outside workers		Impact criteria	Rating
			Legislature	1

SE2 (D): Pressure on existing social infrastructure		Funding of local community projects to compensate for impacts	Stakeholder concern	1
			Severity	2
			Scale	1
			frequency	5
			Overall rating	25
			Impact Significance	Low
Mitigation measures				
The provision of alternative facilities for workforce e.g. medical services, fire-fighting equipment etc. Funding of local community projects to compensate for adverse/negative impacts after consultations with community members.				
Residual Impact				
Negligible				

SE2 (D): Another challenge on the socio-economic aspect is increased demand on existing infrastructures due to influx of people to the project area. These impacts have been ranked on a **Low** significance level and application of the mitigation measures shall reduce the impact to a **Negligible** status.

Table 8.25 is an assessment of Socio-economic impacts on road accidents, kidnappings and traffic congestion.

Table 8.25: Impacts on accidents, kidnapping and traffic congestion

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on accidents, kidnapping, banditry and traffic congestion**	
SE2 (E): Risk of road Accidents and Kidnapping	Transportation of materials on-site	Implement a traffic safety plan including design of access point, signalization, speed limits, training of	Impact criteria	Rating
			Legislature	1
			Stakeholder concern	1
			Severity	2

SE2 (F): Traffic Congestion		drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines	Scale	1
			Frequency	5
			Overall rating	25
			Impact Significance	Low
Mitigation measures				
• Implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), • Maintain log of traffic related incidents, sensitization of road users and people living close to the construction site. • All vehicles are certified road / water worthy prior to being mobilized for work activities. • Compliance to all roads safety transport rules including speed limits • Competency training and certification of drivers before mobilization. • Limit movement to daytime only • Setting and enforcing speed limits of 100km/hr (major roads) 40-60km/hr (built-up areas) and 10-30km/hr (construction sites); • Consultation and good public relation with the stakeholder communities. • Ensure government approved security personnel is used on transport vehicles and boats when warranted • Coordinate work activities to avoid heavy traffic periods • Use warning signs and traffic wardens/directors • Ensure activities causing blockages at road crossings are carried out within shortest time practicable • Develop appropriate strategies to minimize the need for transportation of supplies • Ensure compliance with all applicable laws, such as maximum load restriction and speed limits • Prepare and impment JMG for the trained drivers and supervisors				
Residual Impact				
Negligible				

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Construction and transportation activities will increase traffic congestion, risk of injuries, hostage and kidnapping as well as damage to assets.

SE2 (E): Accidents arising from road trips (transport of materials and personnel) along mobilization routes may result in injury or loss of life of personnel as well as damage to company assets. This impact is rated **Low** significance, and implementation of the mitigation measures shall cascade the impact to a **Negligible** Level.

Tb1 (F): Transportation of men and materials for TL, construction shall add to the load of traffic laden roads of the project area. This include: Aba- Port Harcourt express way, Umuikaa-Owerri, Owerri- Onitsha express way. This impact is rated **Medium** significance, and implementation of the mitigation measures listed shall reduce the impact to a **Minor** Level.

The potential on **impact on Employment and opportunities**, sources, rating criteria and mitigation measures are presented in Table 8.26.

Table 8.26: Impacts on Employment and Opportunities

Impact Statement	Sources of Impact	Enhancement Measures Integrated in Project Design	Impact on impact on Employment and opportunities	
SE2 (G): Supply chain opportunities for Nigerian companies and locals that can provide goods and services needed by the company SE2 (H)Employment	Material requirement Employment of workers	Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities	Impact criteria	Rating
			Legislature	
			Stakeholder concern	
			Severity	
			Scale	
			Frequency	
			Overall rating	
			Impact Significance	Beneficial
Enhancement measures				

Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities
Residual Impact
Beneficial

SE2 (G), SE2 (H): Based on the results of the socio-economic assessment, the un-employment rate in the area is high. The locals are however optimistic about possibility of job availability with the project. Any available jobs will provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the regional and national levels. The impact is beneficial. Employment of casual un-skilled labour would occur, for short-term contracts or for the entire construction phase. This could result in a positive spin-off during the construction phase as any level of employment in this region of moderate unemployment and low wage levels will have a beneficial social spinoff. The impact is beneficial. During the construction phase, there will be provision for sub-contracting to local supplies. Supplies will include raw materials that meet standards as required for the construction of the transmission line facilities. Equal opportunities will be given to sub-contractors from the host communities. This is a positive impact and as such does not require mitigation.

The potential impact on **loss ofemployment**, sources, rating criteria and mitigation measures are presented in Table 8.27.

Table 8.27: Impacts on loss of employment

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on loss of employment	
SE2 (J): Loss of employment	Demobilization on completion of construction	Organize career development workshops, skills acquisition and enhancement	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	1

			Scale	1
			frequency	5
			Overall rating	35
			Impact Significance	Medium
Mitigation measures				
• Organize career development workshops, skills acquisition and enhancement • programs to further empower the workforce • Project will develop, establish and publicize grievance procedures; • Adequately pay due wages for worked period and settle all financial commitments to workforce before demobilization				
Residual Impact				
Low				

SE2 (J): Completion of the construction phase of the project will lead to loss of employment and business opportunities. This impact has been assessed with a **medium** significance level. Implementation of the above measures reduces the impact to **Low**

8.7.9 Visual Impacts

The potential on **Visual Impacts**, sources, rating criteria and mitigation measures are presented in Table 8.28.

Table 8.28: Assessment of Visual Impacts

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Visual Impacts	
VI 1: Visual effects	Installation of towers	Rehabilitate disturbed areas around pylons as soon as practically possible after construction. This should be done to restrict extended periods of exposed soil.	Impact criteria	Rating
			Legislature	0
			Stakeholder concern	1
			Severity	1
			Scale	3
			Frequency	5

			Overall rating	60
			Impact Significance	Low
Mitigation measures				
• Rehabilitate disturbed areas around pylons as soon as practically possible after construction. This should be done to restrict extended periods of exposed soil. • Restore temporal work zones after construction • Rehabilitation of disturbed areas around pylons				
Residual Impact				
Negligible				

VI 1: Aesthetic impacts during the construction phase will be limited to work zones. This impact shall not be felt on RoW but in lawdown areas and widened access roads. This will change the landscape in these areas. Domestic waste might be disposed to construction area, creating visual impact. Construction waste will be disposed at sites approved by relevant waste management. The duration of the construction activity is short term in nature and sensitivity of the area is also low, thus the impact is rated low. When all new temporary work zones will be restored after construction and Rehabilitation of disturbed areas around pylons achieved, this impact shall reduce to a **Negligible** Status.

8.7.10 Impact on Workplace Health and Safety

The summary of the potential impacts on **workplace Health and Safety**, sources, rating criteria and mitigation measures are presented in Table 8.29.

Table 8.29: Assessment of Impacts on workplace Health and Safety

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on workplace Health and Safety	
HS1: Risk of workplace accidents and hazards	Tower erection Earthwork Tower stringing	Develop project specific health and safety procedures based on Wärtsilä's standard	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2

	Establishment of tower foundation	health and safety procedures, including provisions for training and certifications to be followed by all workers including subcontractors. Especially slip-trip and fall hazards with tower erection and electrocution need attention.	Severity	3
			Scale	2
			Frequency	5
			Overall rating	50
			Impact Significance	High

Mitigation measures

- Develop project specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training and certifications to be followed by all workers including subcontractors. Especially slip-trip and fall hazards with tower erection and electrocution need attention.
- A local hiring office (or offices) to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.
- Periodic training of staff on workplace health and safety
- Make sure all personnel are qualified and certified for their relevant works
- Make sure approved safe work procedures are provided and complied with at all times prior to commencement of work
- Ensure SHE briefings, job hazards identification and controls, prior to
- commencement of work activities
- Use of appropriate personal protective equipment (PPE) e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site
- Limit work activities to daytime only
- Ensure availability of first aid facilities onsite
- Ensure retainer clinics are engaged and site medical personnel are available in case of accidents

• Maintain medical emergency response plan so that injured or ill persons can promptlyaccess appropriate care. • Ensure all fuel storage tanks are kept at safe distances from work areas • Ensure storage areas are identified with caution signs. • Educate workforce on risks associated around storage areas and prohibit activities (such as smoking) that can ignite storage tanks • Designate no-smoking and smoke areas • Hold SHE meetings and talks on fire hazard • design work area to internationally acceptable standards
Residual Impact
Minor

In any civil works, public as well as construction staff SHE risks can arise from various construction activities such as earth works, operation, and movement of heavy equipment and vehicles, storage of hazardous materials, traffic, waste disposal etc. The probability of an accident occurring at the project site during the phases of the development is **High**. This is due to the intense use of machinery and other heavy-duty equipment used especially in the construction phase. Work related incidents and accidents resulting from trips, falls, object at height during construction activities are likely to occur. Fire and explosions may be described as technological hazards, which can cause serious injury or result in loss of lives and damage to properties and the environment. Flammable substances including diesel and motor oil may be stored or used on the project site for heavy-duty equipment. These substances are precursors for fires and explosions. Envisaged impacts from accidental explosions resulting in fire have been ranked with a **High** significance level. Implementation of the mitigation measures is likely to reduce the impact to a **Minor** level.

8.8 Impacts and Mitigation Measures During Operation Phase

8.8.1 Impact on Ambient Noise Level

The assessment of the potential impacts on **Ambient Noise level**, sources, rating criteria and mitigation measures are presented in Table 8.30.

Table 8.30: Impacts on Ambient Noise Level

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Ambient Noise level	
NQ 3: Increase in ambient Noise level	RoW maintenance Corona Effect	TCN shall install mesh at sensitive receptor locations	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	1
			Scale	1
			Frequency	5
			Overall rating	30
			Impact Significance	Medium
Mitigation measures				
TCN shall avoid overloading the transmission lines TCN shall install mesh at sensitive receptor locations				
Residual Impact				
Low				

NQ 3: Noise during the operation phase, maintenance activities conducted near pylons, transmission line or RoW could lead to an increase in noise levels which may disturb neighboring communities. However, these disturbances will be temporary since they will be felt only during maintenance activities.

Noise produced by transmission lines, can be experienced as a buzz or a crackle, and noise produced by substations comes mainly from power transformers. In general, noise produced by substations is higher than that produced by transmission lines.

The audible noise emitted from high-voltage lines is caused by the discharge of energy that occurs when the electrical field strength on the conductor surface is greater than the 'breakdown strength' (the field intensity necessary to start a flow of electric current) of the air surrounding the conductor. This discharge is also responsible for radio noise, a visible glow of light near the conductor, an energy loss known as corona loss and other phenomena associated with high-voltage lines.

The degree or intensity of the corona discharge and the resulting audible noise are affected by the transmission voltage and weather conditions such as humidity, air density, wind, rain, drizzle and harmattan. Water increases the conductivity of the air and so increases the intensity of the discharge. Also, irregularities on the conductor surface, such as nicks or sharp points and airborne contaminants, can increase the corona activity. The higher the voltages at which transmission lines operate, the higher the noise problem. Also, noise may be especially noticeable during nighttime hours when ambient noise levels are lower.

Consequently, these lines are designed, constructed and maintained so that during dry conditions they will operate below the corona-inception voltage, meaning that the line will generate a minimum of corona-related noise.

Communities likely to be affected are mainly those where the line passes through residential areas.

Overall, noise-related impacts during the operation phase is ranked medium, with implementation of mitigation measures, impacts on noise shall reduce to Negligible Status.

8.8.2 Impact on Soil and Geology

The Assessment of the potential impacts on **Soil and Geology**, sources, rating criteria and mitigation measures are presented in Table 8.31.

Table 8.31: Impacts on Soil and Geology

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Soil and Geology during Operation	
SQ3 (A): Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminum oxide paint, etc.	Maintenance of RoW	Appropriate flow diversion and erosion control structures i.e. earth embankments shall be put in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc.	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	3
			Scale	1
			frequency	2
			Overall rating	16

			Impact Significance	Low
Mitigation measures				
• Appropriate flow diversion and erosion control structures i.e. earth embankments shall be put in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc • Ensure safe operating practices are enforced during TL maintenance • Implementation of project specific spill and Emergency Response Plan • Ensure hydrocarbon/chemical spill containment and prevention measures and equipment are functional and effective on site and for equipment and vehicles • Double handling to be avoided where possible • When transfer has to take place, ensure it is done in lined and secured areas where containment is possible • Educate personnel on hydrocarbon and chemical handling risks/hazards, through SHE briefings/toolbox meetings				
Residual Impact				
Negligible				

SQ3 (B): During the operation phase, oil leaks resulting from equipment breakdown and/or accidental spills from machinery used for maintenance purposes could lead to soil contamination. As during the construction phase, the risk of soil contamination due to leaks and/or accidental spills cannot be completely discarded. This impact has been ranked Low. However, the application of management measures listed above will help reduce this risk significantly to a **Negligible** status.

8.8.3 Impact on Socio-economic

The Assessment of the potential impacts on **Socio-economic**, sources, rating criteria and mitigation measures are presented in Table 8.32.

Table 8.32: Impacts on Socio-economic

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Socio-economic**	
SE3 (A): Effectively evacuate power to be generated for further distribution within the national grid. SE3 (B): Development of new infrastructures or improvement to existing ones.	Electric power transmission using the installed lines after commissioning	Impact is beneficial and shall be enhanced by sustaining the transmission line life span, through adequate and effective maintenance activities as well as complying with federal government's policies and laws on power transmission and distribution	Impact criteria	Rating
			Legislature	
			Stakeholder concern	
			Severity	
			Scale	
			frequency	
			Overall rating	
			Impact Significance	Beneficial
Mitigation measures				
Impact is beneficial and shall be enhanced by sustaining the transmission line life span, through adequate and effective maintenance activities as well as complying with federal government's policies and laws on power transmission and distribution				
Residual Impact				
Beneficial				

SE3 (A): SE3 (B): The improved electricity supply in the area will result in the improvement of social services infrastructure in the area as well as reduced cost of providing these services. These include water supply, schools, telecommunications, etc. that would have otherwise relied on private power generating plants. Furthermore, the existing access roads upgraded during construction will now be available for use by the communities.

Hence, the impact on infrastructure during operation and maintenance is Beneficial

The Assessment of the potential impacts on **RoW encroachment**, sources, rating criteria and mitigation measures are presented in Table 8.33.

Table 8.33: Impacts on RoW Encroachment

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on RoW Encroachment</th></tr>
<tr><td rowspan="8">SE3 (C): Unchecked encroachment on the RoW, leading to land-use conflicts and accident</td><td rowspan="8">Electric power Transmission using the installedlines after commissioning.</td><td rowspan="8">consultations, sensitize stakeholders and members of the communities on government policies along established ROW</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>2</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>frequency</td><td>3</td></tr>
<tr><td>Overall rating</td><td>27</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">Provide warning signs at access roads to warn against unauthorized entry
Through consultations, sensitize stakeholders and members of the communities on government policies along established RoW
Perimeter sensing of Aba, Onitsha and Owerri section of the line route usung native shrubby species</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Low</td></tr>
</table>

SE3 (C): Prior to the operation of the transmission line, unchecked and unauthorized encroachment by locals or individuals into the transmission line RoW may lead to land use conflict and possible accidents. This impact significant is ranked as **Medium** Implementation of the measures in the Table above shall reduce the impact to **Negligible**

8.8.4 Impact on Biodiversity

The Assessment of the potential impacts on **Biodiversity**, sources, rating criteria and mitigation measures are presented in Table 8.34.

Table 8.34: Impacts on Biodiversity

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td>Mitigation Measures Integrated in Project Design</td><td colspan="2">Impact on Biodiversity</td></tr>
<tr><td rowspan="7">B3 (A): Local fauna disturbances from electromagnetic field along the TL RoW
B3 (B): Mortality of birds, due to collision with earth wires on towers</td><td rowspan="7">Electric power Transmission using the installed lines after commissioning
Tower inspection and checks
Line element replacements

RoW maintenance</td><td rowspan="7">Develop policies that prohibiting hunting by staffs</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>2</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>3</td></tr>
<tr><td>frequency</td><td>2</td></tr>
<tr><td>Overall rating</td><td>22</td></tr>
<tr><td></td><td></td><td></td><td>Impact Significance</td><td>Low</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• TCN shall assure during transmission line component testing that national and international standard and limits are met.
• Routine line patrols by TCN maintenance crew to look out for any bird collisions. If any collision “hot spots” are identified, these can be mitigated reactively.
• Disturbance of vegetation during construction and operation should be kept to a minimum.
• Develop policies that prohibiting hunting by staffs</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Negligible</td></tr>
</table>

B3 (A): The electromagnetic fields emitted from the transmission lines may result in some form of faunal disturbance, i.e. faunal species (invertebrates and small mammals) may choose not to spend prolonged periods under the transmission lines due to the electric magnet fields. In the majority of situations, the faunal species will simple move into the large expanses of nearby similar vegetation. The Impact significance is **Medium** based on the rating criteria. Application of the mitigation measures shall reduce the impact to a **Negligible** status.

B3 (B): The presence of the power line is likely to affect bird communities during the operational phase, especially when located in open air space habitats as grasslands. The presence of the power line can affect birds flying from 50m to 75m mainly through:

- Collision with power lines or towers leading to death or injury. Greater collision risk is associated with the thin ground wire which is located above the thicker high voltage wire
- Electrocution: Due to contact with live components.

Tricholaema hirsute, Dyaphorophyla nigriipennis, Muscicapa comitata were the most abundant bird species found to be flying strictly within this range.

The environmental characteristics and location of the power line can greatly influence collision probabilities. Collision rates between birds and the proposed power line could be highly variable both temporally and spatially. There are many factors that can contribute to specie's vulnerability to collisions with power lines, such as flocking behavior, rapid flight, high wing loading, nocturnal migrants, and species with poor vision. There is no peculiar bird breeding areas/migration routes identified along the line. The impact is low as ranked using the criteria in the Table above.

It is not considered practical to recommend marking all line through open areas to mitigate for bird collisions, as this would be a large proportion of the line, and the risk does not warrant it. Also it will create a negative visual impact on those people living nearby. Instead it is recommended that the routine line patrols by TCN maintenance crew be used to detect any bird collisions. If any collision "hot spots" are identified, these shall be mitigated. If these measures are put in place, overall significance of the potential impact shall be **Negligible**.

8.8.5 Impact on Health, Safety and Security

The Assessment off the potential impacts on **Health, Safety and security**, sources, rating criteria and mitigation measures are presented in Table 8.35.

Table 8.35 Impacts on Health, Safety and security

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on Health, Safety and security</th></tr>
<tr><td rowspan="7">HS3(A): Health issues from exposure to EMF
HS3 (B): Death and injury from tower collapse
HS3 (C): Electrocution during TL maintenance</td><td rowspan="7">Operation of TL
Transmission line maintenance</td><td rowspan="7">The towers will be designed according to best practices and standards</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>3</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>50</td></tr>
<tr><td></td><td></td><td></td><td>Impact Significance</td><td>High</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">The towers will be designed according to best practices and standards
Use of appropriate personal protective equipment (PPE) e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site
pylons will also be constructed with devices that prevent climbing beyond safe heights
Use trained Staff in TL maintenance</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Medium</td></tr>
</table>

The presence of power lines is a potential security risk for the people living nearby due to exposure to EMF. Pylon steel and conductor theft can also pose significant risks in the case of the collapse of the tower.

HS3 (A): Health problems and exposure to the EMF are often raised when a new transmission line is proposed. Based on a recent comprehensive review of the scientific literature (World Health Organization - International EMF Project), the WHO concluded that despite extensive research, there is no evidence to date that support harmful impacts of exposure to low intensity EMF to human health (WHO 2007, WHO 2002). Based on the impact rating criteria used, this impact is rated **High** and implementation of the mitigation measures shall reduce the impact to **Minor**.

HS3 (B): There exists the possibility of collapse of the transmission line towers which could lead to injury or fatality of affected persons. The severity and scale of the impact is high, but the likelihood is low, hence the impact is rated **Medium**. The line route was selected to avoid dense areas, and implementation of the mitigation measures in the Table above shall reduce the impact to Negligible

8.8.6 Impact on Surface Water Quality

The Assessment of the potential impacts on **Surface water quality**, sources, rating criteria and mitigation measures are presented in Table 8.36.

Table 8.36: Impacts on Surface water quality

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Surface water quality	
WQ3: Surface water pollution.	Tower inspection and checks Line element replacements ROW maintenance	Appropriate flow diversion and erosion control structures i.e. earth embankments shall be put in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	2
			Frequency	2
			Overall rating	20
			Impact Significance	Low
Mitigation measures				
Appropriate flow diversion and erosion control structures i.e. earth embankments shall be put in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc. Access into the swampy habitats shall be prevented as far as possible. Where access into these areas is required a preferred corridor shall be determined. No deviation from these corridors should be allowed. Areas to be rehabilitated shall be identified and reclaimed				

Residual Impact
Negligible

WQ3: Surface water pollution

There is possibility of accidental spillage occurring during TL maintenance in locations where towers are near water bodies. Runoffs may carry the spilled oil into these water bodies and thereby polluting them. This impact is ranked low based on the rating criteria in the above Table. However, the implementation of the mitigation measures in the Table is likely to reduce the impact to a **Negligible** status.

8.9 Impacts and Mitigation Measures During Decommissioning Phase

The decommissioning phase refers to all the activities which relate to the proposed transmission line when it is no longer in use. Potential issues that relate to the decommissioning phase refers to impacts such as the towers lying strewn around, lack of rehabilitation of the access roads, overgrown vegetation along the RoW etc.

During the decommissioning phase, the demolition activities are likely to have similar impacts on the environment as were identified for the construction phase. These include potential impacts such as sedimentation, surface water, visual impact, dust and noise pollution, a risk of fires and explosions, safety and security and traffic impacts etc. Impacts arising from decommissioning activities have been ranked with significance levels of **Low** to **High**

Mitigation measures for impacts during decommissioning will be implemented in line with practices as at the time of decommissioning. However, to a minimum the following mitigation measures have been put in place for impacts arising due to decommissioning process:

Develop and implement a decommissioning plan in line with requirements as at the time of decommissioning.

Ensure that excavated and stockpiled soil material is stored and bermed on the higher lying areas along the site and not in any run-off channels where it is likely to cause erosion.

Decommissioning activities should preferably take place during the dry season months to prevent soil erosion caused by heavy rains.

Wet all unprotected cleared areas and stockpiles with water to suppress dust pollution. Institute noise control measures (e.g. regular equipment maintenance) throughout the decommissioning phase for all applicable activities.

Take cognizance of peak traffic times and plan transportation of decommissioned structures and personnel so as to avoid obstruction of local traffic by vehicles, heavy machinery/trucks.

The decommissioning contractor as at the time of decommissioning will have to develop a decommissioning security plan and implement its use.

Ensure effective waste management from cradle to grave for all wastes generated during and after the decommissioning period.

Enforce proper waste management policies in line with FMENV standards and requirements as at time of decommissioning.

Ensure use of road worthy vehicles and equipment as well as skilled operators and drivers

Implementation of the above measures reduces the impacts from to negligible

8.10 Cumulative Impacts

8.10.1 Defining Cumulative Impacts

In theory, any development such as the proposed Project may be taking place at the same time as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential development will be cumulative. According to the Performance Standard, cumulative impacts can be defined as impacts that:

"result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted."

Generally, Cumulative Impacts are considered to be impacts that act with impacts from other projects such that:

The sum of the impacts is greater than the parts; or

The sum of the impacts reaches a threshold level such that the impact becomes significant.

The types of cumulative impacts that may be of relevance are detailed below:

Accumulative: the overall effect of different types of impacts at the same location. An example would be fugitive dust emissions, construction noise and construction traffic all impacting the local communities as a nuisance/ disturbance.

Interactive: where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important) (e.g. water abstraction from a watercourse might exacerbate the impacts caused by increased sediment loading).

Additive or In-combination: where impacts from the primary activity (i.e. the construction and operation of the Project) are added to impacts from third party activities e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future).

8.10.2 Identification of Relevant Development(s)

The focus of the cumulative impact assessment is on the combination effects of the Project with potential future development in the immediate area around the Project site. Our assessment cumulative impacts regarding the potential project in view, depends on the status of other projects and the level of data available to characterize the magnitude of the impacts.

In view of the paucity of available information regarding such future developments, this assessment follows a generic pattern and focuses on key issues and sensitivities for this project and how these might be influenced by cumulative impacts with a combination of other developments. Consultations with local and state authorities and identification of relevant and significant developments via searches of relevant documents provided invaluable assistant in this assessment. The main developments identified are

- Cumulative impacts from other projects within 5km on either side of the TL
- Those likely to arise from other transmission line projects

The following proposed and existing projects within 5km on either side of the RoW are expected to exert cumulative impacts. They are;

- Okija – Onitsha Transmission Line
- Construction of Olokoro – Isiala- Oboro- Nnono Junction Road in Abia State
- EPC Of Obiafu/Obrikom to Oben (OB3) Gas Transmission Line
- Rehabilitation of Owerri- Umuahia Road Section I, II, & III Imo/ Abia State.

  However, there are no known transmission project that is ongoing in the project area

8.10.3 Summary of Cumulative Impacts

Air Quality and Noise: Given the findings of impact assessment and the baseline ambient noise quality. it appears unlikely that the cumulative impact on noise will not be significant. With regards to ambient air quality, SO2 levels are very likely to increase since baseline levels are already above regulatory limits. Also, the cumulative impacts from the project area will be localized to immediate environment.

Traffic: The construction phase will require large amounts of material and equipment to be transported to the Project site. It is expected that the ongoing developmental projects listed in cumulative impacts section which will place pressure on the local road network especially during the construction phases of the projects. Given the foregoing, there is increased potential for accidents and disruption to the road traffic network for local users associated with the increase in traffic movements from overlapping construction traffic. It is expected that the traffic management plan to be developed for the project will consider other traffic movements associated with the development of the project in view which will help to mitigate this impact. However, in overall consideration, this impact is considered to be moderate due to the high likelihood of accidents occurring.

Economy, Employment and Skills: The operation of the various considered projects earlier outlined is proposed to occur simultaneously with the project in view. As such, the economic, employment and skills development opportunities will be greater for all the projects combined than a single project.

It should be noted that expectations regarding economic development, employment and skills development will be high amongst stakeholders in the local community and as such, in the event that one project does not meet expectations, there is the potential for all projects within the area to be the target of this negative outcome.

Based on the above, the cumulative impacts of the various proposed industrial projects on the economy, employment opportunities and skills development within the communities is expected to be positive

CHAPTER NINE

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 Introduction

This chapter provides the ESMP for the Alaoji-Onitsha Transmission Line Project. Elements of this plan will be taken forward and incorporated into a comprehensive project Environmental and Social Management System (ESMS)that will be used to deliver the Project's HSE regulatory compliance objectives and other related commitments.

This ESMP is a delivery mechanism for environmental and social mitigation and enhancement measures made in the ESIA Report. The ESMP is formulated mainly from the acquired project area - specific environmental and social conditions (baseline). The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. The ESMP is, therefore, a management tool used to ensure that undue or reasonably avoidable adverse impacts of initial decommissioning, construction and operation are prevented or reduced and that the positive benefits of the Projects are enhanced (Lochner, 2005).

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS). The ESMP is intended to cover those activities described in Chapter 3 of this EIA report; this includes project activities during construction and operation and will be subject to thorough reviews prior to the commencement of activities to ensure completeness. The ESMP does not include measures for activities related to equipment and facility fabrication being done offsite. It should be noted that this provides the outline requirements for environmental management. Provision will be made for updating the outline ESMP once the detailed project design is complete and for adapting the ESMP to relevant project stages as part of the overall ESMS.

The ESMP details the mitigation and enhancement measures TCN has committed to implement through the life of the Project and includes desired outcomes; performance indicators; targets or acceptance criteria; monitoring and timing for actions and responsibilities. If during the construction and operational phase, impacts are found to be higher than initially predicted, additional mitigation measures will need to be implemented to control, reduce or prevent an impact from occurring. Therefore, the ESMP is dynamic document which will need to be continuously updated and amended as necessary, throughout the project life cycle, to ensure that any negative impacts from the Project are prevented or reduced and positive ones are enhanced. Any significant changes will need to be discussed with the Federal Ministry of Environment and the AfDB.

9.2 Objectives of the ESMP

The ESMP is needed to successfully manage the project's environmental and social performance throughout its lifecycle. It provides integration of environmental and social management with overall project engineering, procurement, construction, and operations. The ESMP is prepared to achieve the following objectives:

- promote environmental and social management in the project implementation in all phases;
- ensure that all relevant stakeholders are aware of their respective responsibility -promoter, contractors, regulators and other relevant agencies;
- incorporate environmental and social management into project design and operating procedures and activities;
- serve as an action plan for environmental and social management for the project;
- provide a framework for implementing environmental and social commitments (such as mitigation measures identified in the ESIA);
- prepare and maintain records of project environmental and social performance for monitoring and evaluating performance monitoring, audits and non-compliance tracking).

9.3 Institutional Framework for Implementation of the ESMP

Responsibilities in the implementation and monitoring of the ESMP are shared between multiple stakeholders, including regulatory and concerned agencies, the AfDB, AfDB-PIU, the TCN and the contractors. These are represented in Figure 9.1.

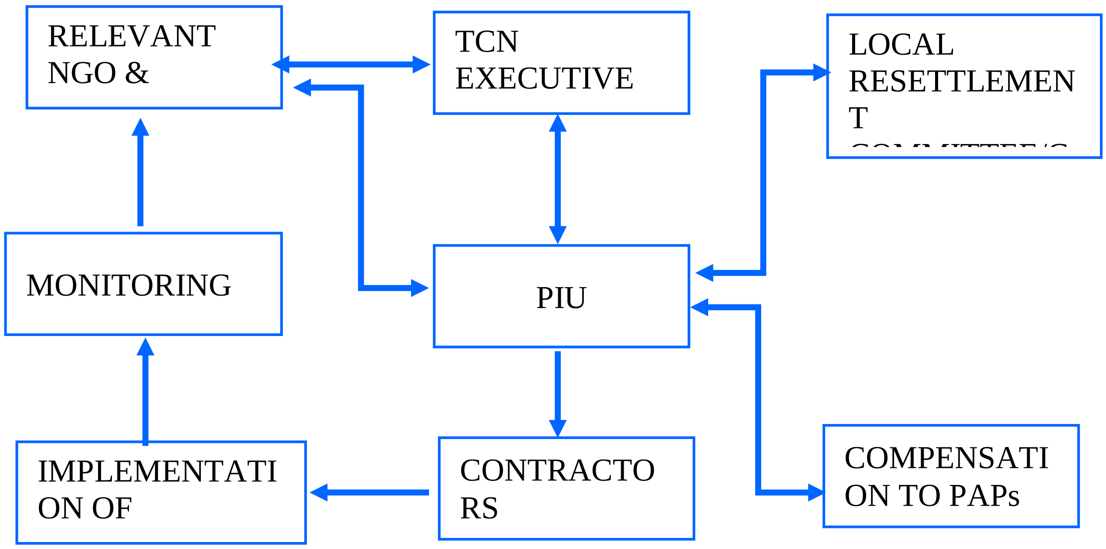

Figure 9.1: Institutional Arrangements for the implementation of ESMP of the Alaoji – Onitsha 330kV Transmission Line Project

Figure 9.2 is the organogram for TCN-AfDB PIU.

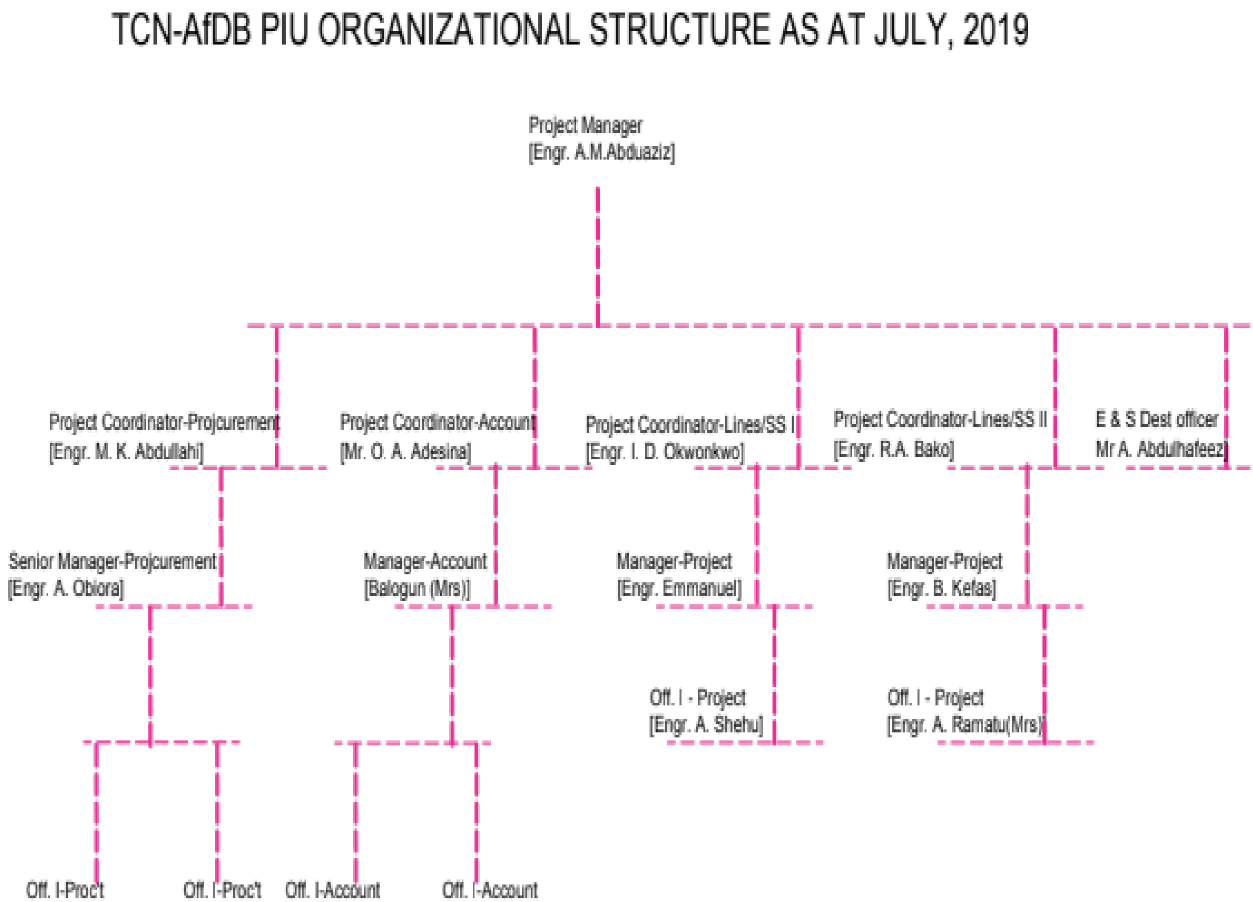

Figure 9.2 TCN-AfDB PIU Organogram

The key roles and responsibilities for the implementation of the ESMP are presented below.

Overall:

- TCN will have principal responsibility for all measures outlined in the ESMP for the construction phase.
- TCN is responsible for the implementation of the measures in the operation phase.
- Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, this is clearly indicated in Tables 9.1 and 9.2.

- Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.

Project Implementation Unit (PIU) will manage the project.

The PIU shall hire and manage contractors, a witness NGO shall be accredited to monitor and evaluate the implementation of the RAP and ESMP to a certain extent. EPC contractors are responsible for implementation of the ESMP and an independent consultant responsible for RAP implementation. Overall regulatory agencies at National State and Local Government levels are responsible for the implementation of ESMP.

9.3.1 Project Proponent (TCN)

TCN is the implementation agency for this project. Hence, has the overall responsibility for its success. The PIU for AfDB projects has been established by the TCN Management to handle this responsibility. The PIU is headed by a Project Manager who reports to the General Manager, Programs.

9.3.2 Project Implementation Unit (PIU)

The PIU set up by TCN-AfDB is saddled with the responsibility of project implementation. It is headed by a Project Manager. Members of the PIU consist of technical experts and environmental, social as well as two liaison officers shall be appointed drawn from relevant departments of TCN, including HSE, Projects, Lines, procurement, planning, etc.

TCN/PIU is responsible for the overall project planning and execution, including preparation of bidding documents, hiring of project management consultants, EPC contractors and supervision of the works. This approach includes ensure proper implementation of the environmental and social management measures contained in the ESMP, the RAP and their surveillance and monitoring.

In order to provide additional oversight, the project PIU will hire an independent consultant to manage the RAP and ESMP implementation including payment of compensation. The PIU will also invite relevant NGO to monitor and insure effective implementation of the RAP. It shall be responsible for Ensure that the Project’s detailed design of the ESMPis based on the final detailed engineering design and ensure that measures to be undertaken during construction and environmental technical specifications are included in the bidding documents and contractual obligations with the winning bidder for each of the contracted elements of the Project.

9.3.3 TCN Environment Division

The Environment Unit of TCN shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations the operations.

9.3.4 Regulatory Agencies and Other Concerned Authorities

The Federal Ministry of Environment (FMEnv) has the responsibility for the implementation of the EIA Act 86 of 1992. Furthermore, State Ministries for Environment (Abia, Anambra and Imo States) and affected LGAs, Osisioma, Aba North, Aba South, Ugwunagbobo, Ekwusigo, Idemili south, Ihiala, Ogbaru, Owerri municipal, Mbatoli, Ngor–Okpala, Owerri-north, Owerri-west, Oru-east, Oru- west, Njaba have certain oversight roles, which they perform under coordination of the FMEnv.

Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the TCN and the contractors as presented in the Table 9.1.

Table 9.1: Responsibilities of PIU, TCN and Contractors

Concerned ministries	Competent authorities	Project implementation unit (PIU),	TCN and the contractors
• Federal Ministry of Environment (FMEnv) • Imo State Ministry of Petroleum and Environment (ISMPEnv) • Abia State Ministry of Environment (ASMEnv)	• Federal Government of Nigeria • Imo State Environmental Protection Agency (ISEPA) • Imo State Ministry of Health, Women Affairs and Social Development (ISMHWASD) • Imo State Ministry of Works (ISMW)	AfDB Project Implementation Unit (PIU)	• Transmission Company of Nigeria • Local Government Area Representatives

• Anambra state Ministry of Environment (AnSMEnv)	• Imo State Ministry of Land Survey Housing and Urban Planning (ISMLSHUP) • Abia state Ministry of Physical Planning and Urban Development(renewal) (ASMPPUD) • Abia State Environmental Protection Agency (ASEPA) • Abia State Ministry of Land Survey and Urban planning (ASMLSUP) • Abia State Ministry of Women Affairs (ASMWA) • Abia State Ministry of Transport (ASMT) • Anambra State Environmental Protection Agency (AnSEPA) • Anambra State Ministry of Transport (AnSMT) • Anambra State Ministry of Lands,survey and Town planning (ASMLST) • Local Government Authority (LGA) • Village chiefs of affected Communities		

The responsibilities and roles of each of the institutions are discussed below.

The Federal Ministrty of Power and Finance

Section 20 of the constitution of Nigeria makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively, can also be linked to the need for a healthy and safe environment to give these rights effect. The executive council of the federation approves all national policies including the National Policy on Environment.

Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the Country. It has the responsibility for ESIA approval and implementation, in accordance with the EIA Act. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures, when the project commences. And they can issue directives to the project on specific actions related to the environment in the project area. The Ministry normally involves the states and sometimes local governments in this responsibility depending on the specific activity.

Project Implementation Unit

It is a unit established by TCN with responsibility for the end to end delivery of all AfDB funded projects, including planning, feasibility, ESIA and RAP, engineering, procurement and construction (EPC). PIU is headed by a substantive Project Manager. Furthermore, the PIU shall ensure:

- The ESIA and RAP studies are conducted in line with legal requirements as well as requirements of the lender
- Proper implementation of the ESMP
- Supervise the EPC contractor in conjunction with the Owner Engineers in Project Department to ensure implementation of management measures.
- Provision of information on activities and consultations with the PAPs.
- Maintain an inventory of the assets to be resettled and a detailed valuation of the compensations.
- Ensure proper information and participation of PAPs and affected communities.
- Management of compensation payments.

- Monitoring the resettlement work.
- Implementation of community-approved projects financed through the EPC contractors.
- Production of monitoring reports to appropriate government authorities, TCN and the contractor in charge of the line construction and the Lender.

Transmission Company of Nigeria

Transmission Company of Nigeria (TCN) manages the electricity transmission network in the country. TCN's licensed activities include electricity transmission, system operation and electricity trading. It is responsible for evacuating electric power generated by the electricity generating companies (GenCos) and wheeling it to distribution companies (DisCos). It provides the vital transmission infrastructure between the GenCos and the DisCos' Feeder Substations.

Electricity Distribution Companies (Port Harcourt)

These two electricity distribution companies are part of 13 distribution companies unbundled from defunct PHCN during electricity reform in 2004. They are responsible for distributing electricity to homes and other consumers within the Alaoji - Onitsha Regions. This role makes them the direct customers of TCN and a major stakeholder in ensuring improved electricity supply to consumers and realizing other objectives of this project.

Imo State Ministry of Petroleum and Environment (ISMPEnv)

The Imo State Ministry of Petroleum and Environment is charged with the obligation of developing and implementing environmental policies, formulating, enforcing programs and legislation, environmental protection and control, environmental technology including efficient implementation of research and development.

Abia State Ministry of Physical Planning and Urban Development (Renewal) (AbSMPPUD)

The Bureau's core mandate is to strengthen land administration, acquire, prepare, allocate and register all land transactions as well as the physical planning of non-urban centres in the state. The Bureau Abia state Ministry of Physical Planning and Urban Development (renewal) (AbSMPPUD) has is an agency under the ministry's supervision.

The functions of the Agency include

- Land acquisition
- Compensation
- Land allocation
- Processing of Certificates of Occupancy for production and collection
- Registration of land transaction
- Change of land use purpose
- Merger of land titles
- Renewal of land ownership (Re-grant)
- Conversion of land titles
- Non-urban services (planning recommendation, building plan approval)
- Geographical information services
- Project management of metropolitan and other Urban Roads

Anambra State Environmental Protection Agency (AnSEPA)/ Imo State Environmental Protection Agency (ISEPA)/ Abia State Environmental Protection Agency (ASEPA)

The agencies are responsible for preparing and updating periodic master plans for the development of environmental science and technology and advise the government of the financial and material requirement for the implementation of such plans; to establish a mechanism to predict ecological disasters; identify the problems of drainage and sewage systems and carry out measures to improve, protect and remedy their ecosystems .Also protection and development of the environment, and also ensuring a healthy environment.

Abia State Ministry of Transport (ASMT)/ Anambra State Ministry of Transport (AnSMT)

The major roles of the ministry are;

- To formulate and implement effective policies in respect to road transportation to ensure that adequate road safety measures are put in place across the state.
- To co-ordinate the creation of motor parks, identification and development of railways and river transportation.
- To ensure effective and efficient movement of goods and services that will enhance socio-economic growth throughout the states.

Abia State Ministry of Environment (ASMEnv)

Abia State Ministry of Environment is charged with the obligation of developing and implementing environmental policies, programs and legislation, environmental protection and control, environmental technology including efficient implementation of research and development.

Anambra State Ministry of Environment (AnSMEnv)

Anambra State ministry of environment is charged with the responsibility of formulating, enforcing, coordinating policies, statutory rules and regulation on solid waste collection, disposal, general environmental protection and flood control in the state. To also ensure the attainment if a clean, beautiful and sustainable environment across the state through the application of the best practices in the management of the environment, to initiate, implement and monitor all issues relating to climate change in order to mitigate the negative impact of climate.

Abia State Ministry of Women Affairs (ASMWA)/ Imo State Ministry of Health, Women Affairs and Social Development (ISMHWASD)

The responsibilities of the Ministries in both states are majorly to facilitate efforts in providing micro credits to the indigent women from donor agencies (UNICEF, UNFPA) strengthen the capacity of caregivers, OVC, NCOS, and CSO sensitize Abia women on the issues of child rights, HIV/AIDS, harmful traditional practices initiate programs that promote the economic empowerment of women provide decent health care delivery, in reducing maternal mortality and morbidity by collaborating with the ministry of health and also strengthen the child's parliament through seminars exchange programmes, debates, radio/TV shows.

Anambra state Ministry of Lands, Survey and Town planning (AnSMLST)/ Imo State Ministry of Land Survey Housing and Urban Planning (ISMLSHUP)

The Ministry of these states is vested with the authority of land administration. They are also charged with the survey of state lands, determination of land use and control, compensations, housing policies and urban development. The ministry is also responsible for the supervision of the PIU, mapping and surveying, registration of title to lands, development and maintenance of open spaces.

Local Government Areas (LGAs)

The project will pass through sixteen LGAs, four in Abia State – Osisioma, Aba North, Aba South, Ugwunagbobo, four in Anambra State- Ekwusigo, Idemili south, Ihiala, Ogbaru and eight in Imo State- Owerri municipal, Mbatoli, Ngor–Okpala, Owerri-north, Owerri-west, Oru-east, Oru- west and Njaba. These LGAs are involved in the ESIA approval process. According to the EIA Act, the LGAs will have representatives in the panel that will review the report and advise the Minister to make decisions on the project. The LGAs also have roles in the administration of lands in rural areas and hence, will be involved in the resettlement process.

The Customary District Councils

The line route will pass through the Chiefdoms and several villages under them. The Igwe's (traditional head of chiefdom) have important role to play in the project with respect to mobilization of the community members to support the project, grievance redress, peace and security of personnel, equipment and facilities to be installed. Close contact and regular consultation shall be maintained with customary chiefs throughout the life of the project.

Table 9.2 presents Responsibilities for implementation and monitoring of mitigation measure during initial decommission and construction phase.

Table 9.2: Responsibilities for Implementation and Monitoring of Mitigation Measure During Initial Decommission and Construction Phase

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO2, CO, NOx, CO2, PM)	Affected communities in area of influence	Minor	• Use good international practice: • Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations • Stationary generators to be located to facilitate dispersion	Negligible	EPC Contractor	AfDB-PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
	Elevated dusted levels in nearby communities as a result of dust raised by vehicle movements, wind, and handling of dusty material	Affected communities in area of influence	minor	• Use good international practice: • Cover properly loose materials and keep top layers moist • Use binder material for erosion and dust control for long term exposed surfaces • Regular cleaning of equipment, drains and roads to avoid excessive buildup of dirt	Negligible	EPC Contractor	AfDB -PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Spray surfaces prior to excavation • Use covered trucks for the transportation of materials that release dust emissions • Speed limits on-site of 15kph on unhardened roads and surfaces				
Climate change	GHG emissions that could add to climate change effects	Global warming	Minor	• Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area • Limit clearing during access road widening	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Noise, vibration & EMF	Nuisance noise from construction activities	Affected communities in area	Moderate	• Use good international practice: • Develop a detailed plan that relates to noise control for relevant work practices and discuss	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
		of influence Construction workers		this with construction staff during health & safety briefings • Select 'low noise' equipment or methods of work • Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources). • Avoid dropping materials from height, where practicable • Avoid metal-to-metal contact on equipment • Maintain and operate all vehicles and equipment's in accordance with manufacturers recommendations • Avoid mobile plant clustering near residences and other sensitive land uses • Ensure periods of respite are provided in the case of unavoidable maximum noise level events				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Inform all potentially impacted residents of the nature of works to be carried out; the expected noise levels and duration, as well as providing the contact details of the CLO. • Noisy activities (activities that can be heard in nearby communities) restricted to day-time working hours				
Soils, geology and land-use	-Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation (at the tower foundation pits and possibly parts of the access roads)	Soil on construction site	Moderate	• Construction of foundations to be undertaken in the dry season. • Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers. • Protect excavated soil materials from erosion. • Ensure that the land is physically restored (include revegetation where possible) before	Minor	EPC Contractor	AfDB -PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ASMLST,ISMLSHUP,ASMLSUP

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				leaving to next tower location and before the next rainy season. • Use of existing track for transport of man and material to the extent possible. • The metallic structures should be protected against corrosion. Also, where the subsoil is clayey and incompetent, transmission line tower foundation should be anchored on friction piles to prevent settlement.				
	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants,	Soil on construction site, especially by construction camp	Moderate	• Use good international practice: • Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	aluminum oxide paint, etc.)	and each tower		• Install oil/water separators and silt traps before effluent, leaves the site.				
				• Minimize bare ground and stockpiles to avoid silt runoff. • Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas). • Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains. • Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. • Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques.		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Set-up and apply procedure regarding dealing with contaminated soils. • Development and implementation of a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly. • Spread sheet underneath the tower structure prior to start any painting activity.				
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well and bore hole	Moderate	See above measures to mitigate 'Potential contamination of soil' impact	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
	Exploitation of water resources (e.g. casting of	Rivers and streams crossed	Minor	Rivers and streams shall not be dammed for the purpose of water abstraction	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv,

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	foundations) sourced from nearby water bodies through tanks							ASMEnv and AnSMEnv
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities	Flora and fauna and habitat in the area of influence	Major	• Promote the use of existing access roads for machinery and vehicle movements. • Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads • Herbicides should not be used for vegetation clearing • Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control	minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnvand AnSMEnv
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread		Minor		Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Implementation of the invasive species management plan as part of the Vegetation Management Plan presented in Chapter 7. • A monitoring program of invasive species propagation within the right-of-way should be instituted and, if present, must be removed. • Monitoring of invasive species in collaboration with ASMEnv, ISMPEnv, and AnSMEnv				
	Loss of species that offer Provisioning Services		minor	Clearance activities to be restricted to the minimum required area.	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams crossed	moderate	• Natural flow of a River shall not be blocked • Conduct activities during the dry season to minimize disturbance of sensitive shoreline and wetland areas	minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Adjust pylon siting to span rivers and wetlands areas, or limit equipment access in wetlands, wherever possible. • Perform all vegetation clearing work manually along streams/rivers and swamps. • Avoid vegetation clearing along stream shores and on steep slopes. • Based on an appropriate project design, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. • Maintain vegetated buffer zones within and around wetlands and along both sides of watercourse crossings. Restore as soon as				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				possible any disturbed areas in the riparian buffer zone. • Avoid equipment and vehicle movements in rivers, floodplains and wetland areas. If unavoidable, reduce access to a minimum length in wetlands and floodplains and select the most optimized site for the access considering human uses and areas of higher ecological integrity				
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the RoW.	People living close to the construction sites.	Minor	• Maintain construction site in orderly condition and do not distribute material over many sites before usage.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ASMLST, ISMLSHUP, ASMLSUP

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW	Moderate	• Site clearance activities to be restricted to the minimum required area. • Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas • See below measures under 'Resettlement'	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ASMLST, ISMLSHUP, ASMLSUP
Stakeholder and Community expectation/ relations Management	Management of Community concerns linked to impacts associated with construction phase issues (like air and dust emissions, traffic, influx and community safety/security,	Affected communities in area of influence	Moderate	• Follow mitigation for construction phase air quality, noise and traffic.	Moderate	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ISEPA, ASEPA and AnSEPA
				• Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv,

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	noise/vibration, etc.) and adverse impact/inconveniences resulting from it. In addition, dealing with community/stakeholder perceptions around cumulative impacts linked to the new plant and transmission lines operations Management of legacy issues on account of			including movements of oversized loads) by billboards, posters and community meeting				ASMEnv and AnSMEnv
				• Set-up and effectively monitor construction grievance mechanism		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				• Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this ESMP.		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				• Engage communities in the monitoring activities to enhance transparency and involvement.		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				• Enhance ongoing consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv,

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	environmental pollution from stakeholder concerns around existing transmission lines.			of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan				ASMEnv and AnSMEnv
				• Ongoing reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts.		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	Minor	• Implement a TMP including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), maintain log of traffic related incidents, sensitization of road users and people living close to the construction site.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ASMT and AnSMT

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	Temporary influx of outside workers in the communities, risking tensions between outside (partly possibly expatriate) labour and local population, due to differences in wealth and culture.	Affected communities in area of influence	Minor	• A Local Content Plan should be prepared to facilitate involvement of local labour. See HR policies and procedures below. • No hiring of short-term labor to be made at the site gate.	Minor			FMENV, ISMPEnv, ASMEnv and AnSMEnv
				• Develop a Code of Conduct for workers. All workers to receive training on community relations and code of behavior. • Periodic refreshing as needed based on community liaison/grievance mechanism feedback.		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
	Potential for increase in prevalence of sexually transmitted diseases in local	Affected communities in area	Minor	• Provide STD awareness material to all workers. Provide condoms to workers.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	communities and other diseases	of influence						
Resettlement	Households living in the RoW need to be relocated and assets in the RoW will be lost	Affected properties and livelihood	Major	• Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household.	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ASMLST, ISMLSHUP, ASMLSUP
Labour and working conditions	Exploitation of workers	Labour force	Minor	• Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Provide reasonable, and if applicable negotiated, working terms and conditions. • Establish worker's grievance mechanism, so that potential conflicts can be dealt with in an early and proper way. • No use of child labourers (workers under age 18) or forced labour. • Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. • Provide proper work place facilities for water/sanitation/rest rooms. • If case of retrenchment needs first viable alternatives are analyzed and then adverse impacts of retrenchment on workers are reduced				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				as much as possible. A transparent retrenchment plan will be prepared. • A worker's grievance mechanism will be in place.				
	Activities and staff at site may create security risks	All staff working at the construction site	Minor	• Make security plan and emergency response and contacts with security forces. Coordinate if applicable with TCN security measures for their site.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force	Moderate	• Develop project specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training and certifications to be followed by all workers including subcontractors. Especially slip-trip and fall hazards with tower erection and electrocution need attention.	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Employment and economy	Creation of temporary jobs for local residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals	Positive	• Prepare a local content plan to enhance ability to locate local hires and Nigerian nationals. Include provisions for hiring women and youth and for "equal pay for work of equal value". • A local hiring office (or offices) to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.	Positive	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv ISMHWASD and ASMWA
	Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Nigerian companies and local SMEs	Positive	• Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities.	Positive	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	Minor	• Coordinate with medical posts and emergency services to prepare for water supply, waste management and incidents.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				• Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.		EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected communities-	Minor	• Report possible change finds to Appropraite authorities	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
	Potential interactions between construction works	Affected communiti	Minor	• Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.	Negligible	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv,

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	and cultural festivals due to traffic, noise and/or vibration impacts	es along the RoW						ASMEnv and AnSMEnv

Table 9.3: Responsibilities for Implementation and Monitoring of Mitigation Measure (OperationPhase)

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Noise, vibration & EMF	Noise & EMF from overhead line due to Corona effect and EMF effect	Affected communities along the RoW	Minor	Noise generation is unavoidable. Avoiding over loading Transmission Lines Installation of mesh at strategic places	Minor	TCN Line Operations		FMENV, ISMPEnv, ASMEnv and AnSMEnv
Soils, geology and land-use	Potential contamination of soil from inadvertent release of hazardous or contaminating material	Soil along RoW of TL and access roads	Negligible	NA	Negligible			
Water resources	Contamination of surface water	Affected communities in area of influence, RoW	Negligible	NA	Negligible		AfDB - PIU	
Terrestrial ecology	Avian collision	*Tricholaema hirsute, Dyaphorophyla nigriipenn*	Moderate	"Bird diverters" on the top (ground) wire to make the lines more visible to birds shall be installed. Installation on both	Minor	EPC Contractor	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
		is, Muscicapa comitata		earth wires in a staggered pattern Installation only on the middle lower 60% of the span Installation at 10 m intervals on each earth wire				AnSMEnv
	Loss of vegetation due to routine clearance of vegetation	Flora and fauna within the RoW	Negligible	NA	Negligible		AfDB - PIU	
Aquatic ecology	Degradation of aquatic species due to construction activities around surface water bodies	River crossings along the RoW	minor	Natural water courses shall not be obstructed. Wastes shall not be disposed along water courses or sensitive areas. Existing access roads shall be utilized during maintenance of the RoW. Avoid equipment and vehicle movements	Negligible	TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				in rivers, floodplains and wetland areas.				
Visual amenities	Transmission lines and towers will be visible from far and become an extrinsic element in the landscape. Cumulative with the other Transmission lines this may result in a loss of the visual amenity.	Affected communities in the area of influence	Minor	The RoW does not affect forests or valuable landscapes. Vegetation will be felled, but if possible, smaller trees can be kept. Towers have an open structure, not hampering the view very much.	Negligible	TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnvand AnSMEnv
Stakeholder and Community expectation/relations Management	Management of Community concerns linked to impacts associated with operation phase issues (like air and dust emissions, traffic, and community safety/security, noise/vibration, etc.) and adverse impact/inconveniencies resulting from it.	Affected communities in the area of influence	Moderate	Follow mitigation for operation phase air quality, noise and traffic.	Minor	TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				Inform communities about details of operation activities (e.g., employment opportunities) by		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEn

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	Dealing with community/stakeholder perceptions around cumulative impacts linked to the new plant and existing cement plant operations. Disappointment about electricity supplied to national grid, while locally electricity supply has reduced reliability			billboards, posters and plant visit				v and AnSMEnv
				Set-up, manage and manage grievance mechanism		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this ESMP.		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				Engage communities in the monitoring activities to enhance transparency and involvement.		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
								AnSMEnv
				Enhance ongoing consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Commission on Non-Ionizing Radiation Protection (ICNIRP).				AnSMEnv
				Interference with radio/TC transmission during rain needs to be explained to the communities		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW	Moderate	Develop an emergency response plan following TCN and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with	Minor	TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities: Mitigation Action	Responsibilities: Supervision	Responsibilities: Monitoring
				emergency services of LGAs				
				Annual safety audit of the transmission lines and poles and maintenance of the RoW to keep free of higher vegetation and structures.		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
				Communicate to communities in RoW the safety risks of the transmission lines and provide response measures. Put sign boards on towers about electrocution risk.		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Labour and working conditions	Exploitation of workers	Labour force for maintenance work	Minor	Follow human resources policies and procedures of TCN, following Nigerian Labour Law and ILO conventions.	Negligible	TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Provide reasonable, and if applicable negotiated, working terms and conditions. Establish worker's grievance mechanism, so that potential conflicts can be dealt with in an early and proper way. No use of child labour (workers under age 18) or forced labour. Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. A worker's grievance mechanism will be in place.				AnSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	Occupational H&S risks in operation and maintenance	Labour force	Moderate	TCN should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height and electrocution in maintenance and repair works, emergency prevention and management. Use personal protection equipment. Have medical emergency equipment at hand.	Minor	TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnvand AnSMEnv
Employment and Economy	Improved electricity supply for the national grid, creating opportunities for businesses and economic development in the country.	National level Nigeria	Positive	Regular maintenance of the project to ensure reliable production of power	Positive	TCN Line Operations	AfDB - PIU	

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Possible Encroahment of the TL RoW	Health impacts associated with exposures to EMF	PAPs		Establishment of perimeter fencing for the RoW using local native shrubby species Conduct sensitization programs for PAPs on the health impacts on residing within specified buffer for TL		TCN Line Operations	AfDB - PIU	FMENV, ISMPEnv, ASMEnv and AnSMEnv
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities in the RoW	Minor	Consult with local communities on festivals and potentials for interaction with maintenance works. If required cease works on the specific dates.	Negligible	TCN Line Operations	AfDB - PIU	

Table 9.4 provides details of monitoring during the construction and operation phases.

Table 9.4 Environmental and Social Monitoring Plan During Construction Phase and Operation Phases of the Project

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
Air quality	800,000	quarterly	3,200,000	Noise, vibration & EMF	880,000
Noise, vibration	600,000	quarterly	2,400,000	Pollution Control /Emmergency Response	10,900,000
Emergency Response (Risk Management of PetroleumProducts in use)	4,000,000	Daily at Project site/ Monthly during OPS	16,000,000	Internal Monitoring environmental Internal Audit (Monitor operational Technology, Codition of Equipment, Facility, etc)	3,700,000
Water quality	3,200,000	Twice a year	6,400,000	Vegetation integrity and Fauna protection	350,000
Aquatic ecology				Stakeholder relations Management/	10,900,000
Visual amenities	3.000,000	Quarterly	1,200,000	Health, Safety and Security	2,350,000
Sanitation/wastes management					

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
Vegetation integrity and Fauna protection	500,000	Once a year	350,000	House keeping/Sanitation/Sensitization	5,000 000
Stakeholder relations Management	10,200,000	quarterly	28.800,000	Environmental Audit (Holistic External Audit of TCN facility in line with EIA Act 86, 1992	15,000,000
Health, Safety and Security	3,300,000	Quarterly	1,200,000	Health, Safety and Security	350,000
Project Monitoring (Logistics)	2,000,000	Quarterly		Toolbox Training on Hazardous material handling, storage and disposal	7,000,000
Toolbox training on Hazardous materials	500,000	Monthly at the Regional Level	2,000,000	Waste management	12,000,000
Develop and implement GBV/SEA Framework and Action Plan	1, 034, 125		4, 136, 500		
Total per project phase			61,550,000		63,430,000
Overall estimate	124,980,000				

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
Air quality	800,000	quarterly	3,200,000	Noise, vibration & ffEMF	880,000
Noise, vibration	600,000	quarterly	2,400,000	Pollution Control /Emmergency Response	10,900,000
Emergency Response (Risk Management of PetroleumProducts in use)	4,000,000	Daily at Project site/ Monthly during OPS	16,000,000	Internal Monitoring environmental Internal Audit (Monitor operational Technology, Codition of Equipment, Facility, etc)	3,700,000
Water quality	3,200,000	Twice a year	6,400,000	Vegetation integrity and Fauna protection	350,000
Aquatic ecology				Stakeholder relations Management/	10,900,000
Visual amenities	3.000,000	Quarterly	1,200,000	Health, Safety and Security	2,350,000
Sanitation/wastes management					
Vegetation integrity and Fauna protection	500,000	Once a year	350,000	House keeping/Sanitation/ Sensitization	5,000 000
Stakeholder relations Management	10,200,000	quarterly	28,800,000	Environmental Audit (Holistic External Audit of TCN facility in line with EIA Act 86, 1992	15,000,000
Health, Safety and Security	3,300,000	Quarterly	1,200,000	Health, Safety and Security	350,000
Project Monitoring (Logistics)	2,000,000	Quarterly		Toolbox Training on Hazardous material handling, storage and disposal	7,000,000
Toolbox training on Hazardous materials	500,000	Monthly at the Regional Level	2,000,000	Waste management	12,000,000
Develop and implement GBV/SEA	1, 034, 125		4, 136, 500		

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
Framework and Action Plan					
Total per project phase			61,550,000		63,430,000
Overall estimate					

9.4 Management Subplans/Programs

The ESIA study did triggered development of specific management plans to wit;

- Air Quality Management Plan
- Water Resources Management Plan;
- Waste Management Plan;
- Biodiversity Management Program;
- Community Health and Safety Management Plan
- Traffic Management Plan

Each plan outlines developmental and implementable procedures as part of the overarching ESMS to be developed and implemented by TCN and the Contractor, as applicable.

Furthermore, the Contractor is required to develop and implement the following Construction triggered Management Plan

- Access Roads Location and Management Plan;
- Soil and Erosion Management Plan;
- Update the Traffic Management Plan;
- Training and Skill Transfer Program;
- Worker’s Health and Safety Management Plan;
- Rehabilitation and Revegetation Plan;
- Environmental and Social Code of Conduct;
- Contractors’ GRM for Communities and Workers;

Method Statements, including, but not limited to erosion control, water crossing, work in heights, and others that may be required by the PIU.

These specific management plans will be drafted by the Contractor, based on the requirements presented in this ESMP, and submitted to TCN for approval in consultation with AfDB prior to activity kick off.

9.4.1 Air Quality Management Program

Justification and Objectives

Generation of particulate matter and emission of GHG is expected mainly at the initial decommissioning and construction phases of the project. When super imposed on the ambient condition, baseline levels above regulatory limits for some microenvironment are likely. This plan is aimed at controlling GHG emissions and PM generation particularly at preconstruction and construction phases. No significant impacts on air quality were identified for the operational phase while the 50year operational period before decommissioning makes it untenable to have included decommissioning in the Plan.

Legal Framework

Legislative safeguards for air quality in Nigeria are enshrined in FEPA 1999 and FMEnv 2004 document on regulatory limits as outlined in Table 9.6.

Actions and Implementation Schedule

Tables 9.5 provides applicable control and actionable mitigation measures during the initial decommissioning and construction phases (various applicable activities were spelt out in Table 9.6), in order to reduce the emission footprint of GHG and PMs. It also provides in-built design systems to achieve emission reduction. Implementation of the spelt-out mitigation measures shall address GHG emissions and PM generation concerns.

Table 9.5: Air quality management program – actions, description and implementation schedule

Control and Mitigation Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	Movement of men and machineries to be planned to avoid residential areas, hospitals and schools as practicably possible	Initial decommissioning	Contractor	FMEnv
	Schedule maintenance of machineries shall be strictly adhered to avoid release of avoidable noxious gases. Scheduled daily equipment working hours, operator's training program and weekly safety briefings shall be some factors in the internal monitoring system.	Initial decommissioning During construction	Contractor	FMEnv
	Minimizations of hauling distances by sourcing construction materials near-by l as much as possible. An allowable 0.2- 0.4 m space be left unloaded for any construction materials carrying trucks.			
	Trucks carrying dusty materials needed be adequately covered;			
	Stockpiles of granular materials need be waterproofed protected and/or sprinkled with water constantly			

Control emissions of dusts and pollutant gases	Use of water as dust suppressants shall be employed in every work front with unpaved surfaces twice per week in wet seasons and daily during dry seasons.	Twice weekly in wet seasons and daily (in the dry season, during construction	Contractor	FMEnv
	The construction lay down area shall be sprinkled with water twice a week during wet seasons and daily during dry seasons.		Contractor	FMEnv

Follow-up Monitoring on Mitigation effectiveness and Grievance Receipt

Air quality monitoring actions shall be developed during the initial decommissioning and construction phase in areas less than 250m to residential areas and 100m to hospitals and schools. Parameters to be measures are CO, CO_2, SO_X, NO_X and CH_4. A biweekly frequency monitoring is planned.

FMEnv Air sampling methods adopted in Chapter 6 (Result Interpretation).

Table 9.6 summarizes the follow-up and monitoring actions and the implementation schedule.

Table 9.6 – Air quality management program - follow-up and monitoring actions, description and implementation schedule

Follow-up or Monitoring Action	Description	Implementation schedule
Periodic air quality monitoring	Air quality monitoring stations shall be established during construction phase at the defined threshold distances near three sensitive receptors, Homes, schools and hospitals.	Biweekly during construction
Air quality monitoring in response to complaints	If complaints from the local population regarding air quality are registered, (i) Corrective actions for simple complaints such as need for additional or more frequent watering program for dust control, traffic speed issues shall be implemented ASAP and (ii) air quality monitoring will be undertaken near the affected sensitive receptors, to verify the ambient air quality levels and define additional mitigation, if required.	When necessary

Corrective Actions

In the event that the air quality values recorded exceed FMEnv regulatory limits, or if complaints from the local communities are lodged, causal factors for such elevated concentrations shall be identified and corrected. Elevated concentrations normally result from failure to adhere to any or some of the mitigation measures listed in Table 9.2.

In the event of non-compliances, additional mitigation measures shall be defined on case by case basis ranging from warning, verifiable evidences of vehicle having been serviced and increase frequency of training and safety briefings.

A monitoring campaign will be undertaken in areas where non-compliances were recorded, to verify the resolution of the issue.

Reporting

Performance Indicators

Table 9.7 lists the performance indicators to be monitored for the Air Quality Management Program:

Table 9.7: Performance indicators for Air Quality Management Program

Indicator	Target	Trend
Number of TPM exceeded during periodic monitoring	<10% of monitored sites with recorded elevated concentrations above FMEnv standard	% of recorded TPM concentrations above FMEnv regulatory limits decreases bi-weekly
Concentration of SO_X, CO, CO_2, CH_4 exceeds FMEnv regulatory limit during periodic monitoring	<10% of monitored sites should exceed FMEnv regulatory limits	% of recorded measured gases decreases biweekly
Number of community complaints regarding air quality	1 complaint per month per near sensitive receptor	Number of complaints decreases bi-weekly
Number of verification monitoring campaigns in response to complaints	Equal to number of complaints	NA
Number of additional air quality mitigation measures undertaken in response to complaints	Equal to or greater than number of complains	NA

Note: NA. – Not Applicable.

The performance indicators results shall be compiled quarterly

Reports

Table 9.8 summarize the documental records that will be kept, to control the execution of this specific environmental management program. These documents will be prepared, archived and maintained by the PIU.

Table 9.8: Record Documents for the Air Quality Management Program

Document Title	Document Type	Frequency of Record or Report
Record of periodic air quality monitoring	Record	Quarterly
Record of air quality associated community complaints	Record	On occurrence
Record of air quality monitoring in response to complaints and mitigation responses	Record	On occurrence
Performance Report	Report	Quarterly

9.4.2 Water Resources Management Program

Justification and Objectives

The purpose of the Water Resources Management Program is to guarantee conservation of the water resources present in the Project area. The plan includes control and mitigation actions to protect water resources, namely actions to prevent their siltation, abstraction and their contamination by effluents generated during the proposed activities.

Legal Framework

The present plan takes into consideration both the Nigerian legislation referring to water resources, including Harmful Waste (Special Criminal Provisions) Act, Cap H1, LFN 2004, Rivers Basin Development Authority Act, Ca R9, LFN 2004, Water Resources Act, Cap W2, LFN 2004, National Environmental Standards and Regulation Enforcement Agency (NESREA) Act, 2007 as well as applicable international guidelines (AfDB and WHO standards). The FMEnv/WHO specific limits for each measured parameter are present in this chapter.

Actions and Implementation Schedule

Table 9.9 lists the control and mitigation measures to be applied during construction, in order to minimize impacts on surface and groundwater resources while Table 9.10 lists Water Resources Management Program actions, description and implementation.

Table 9.9: Control and Mitigation Measures to be Applied during Construction

Control and Mitigation Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Minimize the changes on natural run-off patterns	The Contractor is required to submit method statement for each of the 15 water crossings for FMEnv approval; Avoid dumping or water abstracting water from the river/dams for construction activities (including movement of machinery), as much as possible; Whenever possible, carry out works on river/dams' areas, in the dry season, Do not obstruct water channels, even if temporary. Ensure that suitable transversal culverts, viaducts, etc. are in place; Any river/dams affected accidently shall be rehabilitated as close to	Initial decommissioning /During construction	Contractor	PIU

	its pristine state as possible; Temporary stream diversions will be big enough to allow free flow of water without damming and submerging riparian vegetation for long periods; Use of sandbags, useof fiber rolls, reno- mattresses, and plastic liners where appropriate shall be employed as erosion control measures in sloppy or temporary stream diversion areas. Minimize the clearance of riparian vegetation. Clearing of riparian vegetation shall be done in stages, as working areas progress. Trees, shrub and grass species will be retained wherever possible. The affected areas will be rehabilitated, using native species on completion of works.			

	Water channels will be kept free from obstruction at all times. Any erosion damage will be repaired as soon as possible.			
Prevent water quality contamination/abstraction	No soil, vegetation, waste or construction materials will be discharged on water courses; Natural water resources, including sources, streams or open water bodies, will not be abstracted any reason, any activity requiring washing shall only be conducted in within lay down area; Prohibit workers to use natural waterways for recreational purposes, bathing or washing;	Initial decommissioning During construction	Contractor	PIU

Table 9.10: Water Resources Management Program – actions, description and implementation schedule

Control and Mitigation Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Prevent water quality contamination	Store oils, fuels and other hazardous and potentially pollutant products in bunded walls or in impervious structures; Dedicated impervious surface and containment structures (situated not less than 100m from residential areas) shall be provided for equipment and vehicles maintenance. Defined parking lots shall be inspected daily for spillage and cleaned up immediately if spills occur. Provide an impervious surface and containment structures for fuel supply. Perform scheduled routine maintenance on vehicles to prevent oil leaks.	Initial decommissioning During construction	Contractor	PIU
Prevent water quality contamination	Develop a plan for prevention and containment of spills. Ensure spill preventive training of all site staff. Immediate spills containment, abstraction of freed products and appropriate soil remediation efforts should be conducted. Use of circumferential hydrologic barriers or hydraulic barrier walls should be developed to prevent groundwater contamination The lay down area for any water usage activity such as equipment washing should be sapped to a vacuum-packed invulnerable secluded withholding sink far away from natural drain channels to prevent inadvertent spills from polluting soil and water components. Ensure non-	Initial decommissioning During construction	Contractor	PIU

	absolution of produced waste in the receptive environment through collecting and channeling to oil and grease separation pits			
Prevent turbidity and sedimentation rate into water bodies	Sites of over burden stockpiling should not be established on or nearby or along water drainage routes. Soil over burden should be covered during wet seasons and/or during intense windy conditions; When possible, removal of vegetation should be conducted in phases.	During construct ion	Contract or	PIU

Remedial Actions

Remedial actions are affected when and if deviations from the expected outcomes are observed during thefollow-up and monitor actions. The extent, scale and pattern of the remedial actions or supplementarymitigation measures shall be case specific. Table 9.10 outlines the proposed remedial actions. Table 9.11 is a drawn –up follow up monitoring program for the WRM.

Table 9.11: Water Resources Management Program – Remedial actions, description and implementation schedule

Follow-up or Monitoring Action	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Monitor rate of turbidity and sedimentation of water bodies	Planned on the spot assessment of water bodies to determine sedimentation and turbidimetric load	Monthly during Initial decommissioning and construction (when working near water bodies)	contractor	PIU
Monitor erosion damage or risks to riverbanks	Conduct planned on the spot assessment of water bodies for	Monthly during Initial decommissioning and construction (when	contractor	PIU

	the erosion risk determination to shorelines.	working near water bodies)		
Monitor occurrence of spillages in water resources	Conduct planned spillage assessment of parking lots, fuel supply areas, and other lay down areas for spill occurrence; Conduct containment and clean - up operations if spills are observed. Document all assessment schedules including cleaning protocols Record all accidental spillages occurring in water resources. Record the date, location, approximate volume of each spillage and implemented corrective measures.	During Initial decommissioning andConstruction Phase, weekly. When applicable	contractor	PIU
Remedy erosion damage to shorelines and divans, and blockage of water flow channels	Any undue erosion damage or risks to water bodies shall be corrected using consolidating ingredients or other suitable techniques; Extreme sedimentation to water courses shall be corrected using siltation/dredging technique where blockage of flow is the causal factor.	Whenever necessary	Contractor	PIU

Act on significant increases of water bodies sedimentation	If situations of high sediment load inputs are observed, locally appropriate remedial measures such as: Silt fences can be placed around affected areas to sifter dregs; Patterned weirs should be placed in the erosive paths to reduce erosion; Temporary ditches, berms, and pit lakes or ponds could be constructed to collect runoff so that entrained deposits could settle out of the water prior to being released from the site into water bodies.	Whenever necessary	Contractor	PIU
Act on accidental spillages	Containment and clean- up operations should be instituted if any accidental spill is detected. Determine the causal factor(s) responsible for the spill and implement preventive measures to avoid future occurrence	Whenever necessary	Contractor	PIU

Performance and Reporting

Table 9.12 lists the performance indicators to be monitored for the Water Resources Management Program:

Table 9.12 – Performance indicators for Water Resources Management Program

Indicator	Target	Trend

Number of rivers/streams where significant sedimentation increases, or erosion damage were detected	< 2 per quarter	Number of events decreases quarterly
Number of remedial actions implemented in response to river sedimentation increase or erosion damage	Equal to number of events detected	NA.
Number of accidental spills	< 1 per quarter	Number of events decreases quarterly
Number of remedial measures implemented in response to accidental spills	Equal to number of spills	NA.

Note: NA– Not Applicable

The performance indicators results shall be determined and compiled in quarterly reports, as indicated in the following section.

Reports

Table 9.13 summarizes the documental records that will be kept controlling the execution of this environmental management program. These documents will be prepared, archived and maintained by the PIU, in order to document the results of the program implementation. Records of relevant events will be made following the occurrence and a quarterly Performance Report will be prepared and submitted to the FMEnv.

Table 9.13: Record documents for the Water Resources Management Program

Document Title	Document Type	Frequency of Record or Report
Record of periodic effluent water quality monitoring	Record	Monthly
Record of periodic visual inspection of rivers and stream sedimentation	Record	Monthly
Record of periodic spill inspections	Record	Weekly
Record of accidental spill	Record	On occurrence
Performance Report	Report	Twice a year

9.4.3 Waste Management Plan

Objectives

The purpose of this plan is to provide guidance to personnel and Contractors on management of miscellaneous hazardous and non-hazardous waste generated during the Life of the Project particularly during construction.

The waste management approach focuses on the implementation of the three "R" s (Reduce, Reuse and Recycle) as defined by the Federal Ministry of Environment. Waste management comprises the collection, conditioning, transportation and deposition at a legally designated final place.

Adequate waste management is basic to prevent soil and water resources contamination. It is also important to maintain community and occupational health of workers and indigenes by avoiding proliferation of pests and diseases.

The present program takes into consideration the Nigerian as well AfDB/TCN EHS General Guidelines.

Scope and Responsibilities

These procedures apply to those units and their personnel that are involved in the management of hazardous and non-hazardous wastes. The Waste Management Plan is applicable to all initial decommissioning and construction activities. The operational phase is also expected to generate relevant amounts of vegetal waste, especially during RoW maintenance. Waste management procedures shall also be applied in substations.

The responsibility for implementing the proposed waste management actions and procedures falls with the various Contractors involved in the Project's construction phase, which will need to use the guidelines provided in this plan to develop specific waste management procedures applicable to their activities. TCN is responsible for auditing the Contractors' activities, to ensure that best practice waste management procedures are being followed.

Availability of Waste Disposal Facilities

The development of this plan and its upgrade by the Contractor took/shall take into consideration availability of waste facilities in Abia, Anambra and Imo States.

Waste management in the project area is the responsibility of Imo State Environmental and Protection Agency (ISEPA), Abia State Environmental and Protection Agency (ASEPA) and Anambra State Waste Management Agency (ASWMA). No public landfills exist in the Project area, rather many municipal waste sites.

As for hazardous waste, there is one licensed facility in the projectarea (DEL Waste Management Company Limited, Rivers State). This facility is an adequate final destination for the small volumes of solid and hazardous waste likely to be generated by the Project.

Waste Management Actions

Table 9.14 below summarizes the proposed waste management actions.

Table 9.14: Waste management actions

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Prepare waste inventory	• Prepare inventory of any hazardous and non-hazardous waste • Classify the waste; • Define sources, volumes and indicate appropriate final destination for each type of waste, taking into consideration the specifications of the region in question in what concerns the availability of waste treatment and disposal facilities.	Initial decommission phase	Contractor	PIU
Reduce waste production	• Working sites must be kept clean, neat and tidy at all times; • Avoid leaving garbage unattended to in order to avoid attracting pests and nocturnal carnivores; • Implement daily cleaning routines to minimize waste; • Promote the recycling and recovery of waste in coordination with municipal authorities • Use materials which can be reused easily; • List and estimate the volume of waste that can be reused, recycled or re-process (example, wood scraps, soils, none used materials); • Ensure that the quantities of construction materials on site are as accurate as possible, to avoid surpluses that could result in construction waste.	During construction	Contractor	PIU

Non-hazardous waste segregation	• Provide specific colour coded containers of appropriate sizes (according to the expected waste volume) for the placement of waste in different working areas. The segregation will be carried out as close as possible to the place of production. These shall ensure adequate hygiene and sealing conditions; • Strictly prohibit littering with plastic or other wastes by all project personnel; • Provide different containers for each type of waste that can be reused, recycled or re-processed. Containers will be clearly identified according to their categorization and classification, allowing to clearly identify its contents; • Waste segregation must be carried out accordingly, ensuring that waste does not exceed the top of containers; • The containers must be constructed of an appropriate material to prevent leakage, clean and always closed; • All produced waste will be sorted according to its type. Waste segregation will be initially done by workers; • Produced waste will be removed daily and temporary stored in Temporary Store Facilities until transported to final destination.	During construction	Contractor	PIU

Temporary storage facilities for non-hazardous waste	• Non-hazardous waste must be temporarily stored, prior to final destination, at only one designated area. This area must be duly delimited and signed ("Waste Storage Area"). The area should have a firm water-proof base that is protected from the ingress of storm water from surrounding areas. It must also have an effective drainage system to a waterproof spillage collection area, where any spillage can be recovered and suitably treated. This area must be clearly demarcated and should not be accessible to unauthorized persons. The containers should not be easily corrodible but rodent-resistant, insect-resistant and have handles at the sides and tight-fitting overlapping covers. • Inert waste may be stored in the open without the need for a waterproofing floor in a designated and delimited area; • Location of waste Temporary Storage Facilities must be at least 50 m from water courses and ground depressions; • Maintain a good organization of space and cleaning of waste storage areas; Waste materials that can be reused by the community, such as removed soil and stones, cut wood and other building materials could be made available for pick up in an orderly fashion and with proper safety arrangements.	During construction	Contractor	PIU
Non-hazardous waste final destination	• Prior to transport, an FMEnv certified laboratory shall confirm it to be nonhazardous. If confirmed as non-hazardous, a waste manifest detailing content, volume, the generating company should be	During construction	Contractor ,	PIU

	produced in duplicate and a copy handed to the driver. The transport of waste must be carried out in an appropriate vehicle, capable of containing the waste, and in good operating condition. These vehicles must be easily washable; • Transfer operations of waste containers must be carried out safely: without compromising its segregation, and without causing leaks or spills and originating dust; • The final destination and transport of waste are the responsibility of Contractor; • The final destination and transport of waste must be agreed and authorized by the State waste management authorities. The necessary licenses must be obtained; • Prohibit the burial or dump of any type waste in unauthorized location • Use accredited waste vendors from affected states • Prohibit waste incineration; • Non-hazardous waste will be removed on a weekly basis; PIU and the Contractor will agree on and document the final disposal site for the waste ensuring that it meets FMEnv, states and AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS) requirements and will keep records of the delivery of the waste at such facilities.			
Hazardous waste segregation	• Provide containers for segregation of hazardous waste. Ensuring that waste does not exceed the top of containers and have an appropriate size.	During construction	Contractor,	PIU

	Containers will be made of appropriate material so that they are not damaged by their content and that damaging or dangerous substances are formed. They shall ensure adequate hygiene and sealing; • Provide different colour coded containers for each type of hazardous waste to be produced. • Hazardous waste will not be mixed with other types of waste; • Containers will be placed on wooden pallets or plastic pails; • Maintain containers clean and always closed; All produced waste will be sorted and placed in the corresponding container.			
Temporary Storage Facilities for Hazardous waste	• Hazardous waste will not be stored at the work fronts, and must be transported daily to Temporary Storage Facilities built by the Contractor for this purpose or hired through a certified service provider; • Hazardous waste must be temporarily stored, prior to final destination, at only one designated area. This area must be duly delimited and signed ("Hazardous Waste Storage Area") and with restricted access. The area must be roofed, properly ventilated and have impermeable surface floor; • Location of the Waste Temporary Store Facilities must be away (100 m) from water courses and ground depressions; • No smoking will be allowed in the vicinity of hazardous waste storage area. Place appropriate symbolic signage (No smoking, No naked light and danger);	During construction	Contractor,	PIU

	• Provide extinguishers near the waste storage areas; Maintain a good organization of space and cleaning of waste storage areas.			
Transport of Hazardous Waste	• The transporting vehicle/medium within the site of generation must be waterproof and of high mechanical stability. The vehicle must display the hazard sign, the remedial measures/first aid sign during accidental discharge, telephone number of contact person(s) need be boldly inscribed on the vehicle. • The transport of hazardous waste, within the facilities of the Contractor up to the storage location, will be made resorting to appropriate equipment or vehicles capable of containing the waste and in good operating conditions. These vehicles must be easily washable. The transport vehicle will be dully identified with signs for the transportation of hazard material; • Hazardous waste must be transported (internal transportation) in containers. The transport must have steel clamps for securing the containers and guarantee safe transport; • The transportation of hazardous waste transport outside the facilities of the Contractor can only be made by an entity licensed by DEL Waste Management Company Limited, Rivers State When the hazardous waste is collected, a manifest, in four copies, will be completed, indicating the quantities, quality and destination of the collected waste; one copy is kept by the waste generating entity, another copy is	During construction	Contractor ,	PIU

	kept by the waste transporting entity, the third copy is kept by the entity receiving the product and the fourth copy is sent to DEL Waste Management Company Limited, Rivers State,Provide the workers responsible for the handling of hazardous waste with adequate PPE (work wear, gloves, boots and masks).			
Hazardous Waste Final Destination	• The final disposal of hazardous waste will be made at an infrastructure licensed by DEL Waste Management Company Limited, Rivers Statefor storage, treatment and/or final disposal of hazardous waste. The nearest such infrastructure is the DEL Waste Management Company Limited, Rivers State Whenever possible, enforcement of the buyback policy with the suppliers should be invoked.	During construction	Contractor ,	PIU

Follow-up Actions

Table 9.15 summarizes the follow-up and/or systematic and/or periodic verification actions proposed forwaste management.

Table 9.15: Waste Management Follow-up Actions

Follow-up and/or verification action	Description
Inspection of the waste storage areas	Perform daily visual inspections of the hazardous and non-hazardous waste storage areas, to verify if the existing containers are adequate to the volume of waste produced, the correct waste sorting and conditioning is being carried out. Also ensure zero spill processes is continually in place, and that any accidental spill is promptly contained and clean- up operations instituted immediately. Verify the integrity of the containers and other environmental control systems/equipment.

Inspection of working areas	Perform daily visual assessment of work areas for organizational sanctity and site cleanliness
Verification of final disposal sites	Undertake annual due diligence visits to the final disposal sites to confirm that final elimination is in compliant with applicable TCN, FMEnv. and AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS)

Remedial Actions

Table 9.16 summarizes the corrective actions and their implementation schedule.

Table 9.16: Waste Management Plan - corrective actions, description and implementation schedule

Corrective Actions	Description	Implementation Schedule
Spill mitigation actions	Removal of substances accumulated in the spill containment trays sinks; Repair or change the damaged container that leaks.	When applicable
Response to complaints	In response to workers or community complaints about odors or pest's proliferation, increase the frequency of waste collection.	When applicable
Corrective action for improper waste storage	Provide or increase the quantities of proper containers in the storage areas where waste increases are evident. Increase the frequency of waste collection.	When applicable
Corrective action for littering and illegal dumping	Increase awareness about waste management.	When applicable

Performance and Reporting

Table 9.17 lists the performance indicators to be monitored for the Waste Management Plan.

Table 9.17: Performance indicators for Waste Management Plan

Indicator	Target	Trend

Weekly volume of waste produced, by type (hazardous and non-hazardous)	Volumes will be recorded. No target is applicable (as volumes will depend on activity).	Volume of waste per workday decreases quarterly (showing efforts to reduce waste production)
Weekly volume of waste transported to final deposition	Equal to weekly volume of waste produced.	NA
Number of improper waste management procedures detected	< 5 per quarter	Number of events decreases quarterly
Number of adopted corrective actions in response to detection of improper waste management procedures	Equal to number of improper waste management procedures detected	NA.

Note: NA. – Not applicable.

The performance indicators results will be determined weekly and compiled in quarterly reports, as indicated in the following section.

Reports

The following table summarizes the documental records that will be kept controlling the execution of the waste management plan. These documents will be prepared, archived and maintained by the contractor, in order to document the results of the plan's implementation.

Table 9.18: Record documents for the Waste Management Plan

Document Title	Document Type	Frequency of Record or Report
Weekly volume of waste produced, by type	Record	Weekly
Weekly volume of waste by category transported to final deposition	Record	Weekly
Weekly volume of waste recycled or reused	Record	Monthly

Record improper waste management procedures detected and remediation actions undertaken	Record	Weekly
Performance Report	Report	Quarterly

9.4.4 Biodiversity Management Program

Justification and Objectives

The construction and operation of the proposed Project will result in some biodiversity impacts, on vegetation (Freshwater Habitat) and wildlife, particularly *Halcyon badia, Polybroides typhus, Merops gularis, Miscicapa comitata, Muscicapa cassini* (raptor species) and *Polybroides typhus* (migratory avian species). Baseline result showed five threatened flora (*Sericanthe toupeto* (Endangered), and *Afzelia africana, Dalbergia latofolia, Ricinidendron heudelotii and Lophira alata* (Vulnerable) species in the study area. Invasive species (*Chromolaena odorata, Mimosa pudica and Dalbergia sisso*), was also censored. Monitoring and management actions for these biodiversity components are required, so as to continuously evaluate the Project's impacts and the efficacy of the proposed mitigation. The PIU will prepare a Biodiversity Management Program (BMP). The BMP will establish baseline values for the managed/monitored activities, implementation schedule, and responsibility for carrying out the monitoring and corrective actions, supervision responsibilities, budget estimates, and source of funding.

Monitoring and Management Actions and Implementation Schedule

Table 9.19 lists:

The scope of the BMP, which includes: (a) invasive species; (b) deforestation rate in all habitats and wildlife poaching activities, biodiversity monitoring and management actions; and (c) birds fatality monitoring (d) IUCN threatened species monitoring

- Brief description of the actions to the implemented;
- Implementation schedule;
- Responsibilities for implementation of management and monitoring program; and
- Supervising agency(ies)
- For each activity in Table 9.20, the BMP will identify:
- Baseline values (including direct and indirect/induced impacts);

- Monitoring indicators (including direct impact of the transmission infrastructure constructed, as well as indirect/induced impacts of the right of way, access roads, and other ancillary infrastructure);
- List of potential remedial actions and their triggers;
- Estimated costs / indicative budget; and
- Source of funding

Details on the monitoring methodology are provided in the following sections:

Table 9.19 – Biodiversity monitoring and management actions, description and implementation schedule

Monitoring and Management Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Invasive flora species monitoring and management	• Monitor the presence and proliferation of invasive flora species along the RoW, access road, lay down areas, construction materials storage camp and borrow pit areas. • Use cultural practices to remove invasive/alien species if observed.	Annually during construction and twice per year during the first five years of operation	Contractor, (construction) PIU (operation) to be carried out by Independent Biodiversity Consultant financed by TCN	PIU
IUCN flora species monitoring and management	• Monitor the population and regeneration potential of the replanted species • If the population of these species appears to be below baseline value	Once in every three months for the first ten years after construction phase	PIU (operation) to be carried out by Independent Biodiversity Consultant financed by TCN	PIU
Deforestation rate and the extent of wildlife poaching monitoring and management – including remedial actions of impacts on riparian habitat, on both flora and fauna	• Establish the baseline for present deforestation rates and wildlife poaching activities prior to the start of clearing; • Monitor the direct and indirect / induced impacts on natural and critical natural habitat (In this case, swamp forest near), on both flora and fauna on a 2 km spatial boundary on both sides of the RoW. Establish deforestation and poaching monitoring and development of corrective actions;	Annually during construction and during the first five years of operation.	Contractor, PIU (construction) PIU (operation) to be carried out by Independent Biodiversity Monitoring and Management	PIU

	• Register the presence of people and/or structures in and near the RoW and the actions taken by local authorities to prevent illegal logging, poaching or encroachment. These impacts should be assessed through ground monitoring, as possibly via GIS mapping. • If activities with significant negative impacts are observed, on natural and/or critical habitat on flora and fauna, mitigation measures such as targeted protection, reforestation and anti-poaching programs shall be developed and enforced	Biannually during the next 5 years of operation.	Consultant financed by TCN	
Birds and bats fatality monitoring	- Monitor bird and fruit bat fatalities due to power line collisions and (if any) electrocutions.	Operation (quarterly during the first five years of operation)	PIU (operation) to be carried out by Independent Birds Monitoring and Management Consultant financed by TCN	PIU

Code of Conduct. The BMP shall specify or cross-reference all the biodiversity-related environmental rules that all contractors and project workers will be expected to follow, along with the required induction training prior to beginning work and the penalties for non-compliance.

Implementation Arrangements. For each planned activity, the BMP will indicate (i) expected implementation schedule (during construction and operation); (ii) institutional responsibilities for implementation (PIU, FMEnv, Contractor, and/or collaborating governmental entity or NGO); and
(iii) Indicative budget and expected source of funds for each key BMP activity during construction and operation (funding would be from AfDB and TCN).

Monitoring Methodology

Invasive Species

The invasive flora species monitoring plan will start with the construction phase and at that time patches or individuals of invasive flora species will be identified and referenced via Geographic Positioning System (GPS). The identified patches/individuals will be removed and their potential for regrowth will be monitored annually during construction and twice per year during operation phases (at least during the first 5 years), or until no patches are detected.

If new locations of flora invasive species are detected along the corridor, access roads or lay down areas, or borrow pit areas during maintenance, those will be monitored, and removed or controlled as well.

The expansion of the monitored invasive species will be evaluated and if needed and new measures to control them will be proposed.

IUCN Species

The IUCN species monitoring plan will start after the construction phase. There is potential for deforestation by locals on replanted threatened species, especially for fuel wood as indicated in the baseline. The PIU shall organize sensitization programs in the project area on the adverse impacts of logging threatened species. Monitoring shall be carried out every three months to assess the regeneration potential of the replanted species. If in five year, the population of the IUCN species does not double baseline population, the PIU shall cause replanting to be carried again in other potentially viable sites within the project area.

Induced Impacts

The following actions will be developed as part of the BMP:

Establishment of a baseline for present deforestation rates and wildlife poaching activities 2km on both sides of the Right-of-Way via ground-truthing, and possibly using GIS models

In case monitoring of the BMP observed significant negative impacts, PIU will re-vegetate or put in place targeted species manage, solve or reduce these problems, rather than only continue to watch them. The problems areas will be referenced via GPS;

Minimizing Right-of-Way and Access Road Induced Impacts. Besides providing options for reforestation or targeted protection of natural habitats and increased poaching, the BMP shall seek to prevent and minimize such impacts in the first place. Effective strategies for doing this should include, as feasible, (i) Restrict TL and Access road ROW clearing only to project footprint (ii) Avoid clearing riparian habitats as practically possible.

Birds and Bats Migration

Vegetation clearing, especially at tower sites will result in fragmentation and loss of bird habitat and thus loss of bird species in the area throughout construction phase (6 months). Monitoring will be carried out to ascertain rate of adaption and migration. Monitoring shall be carried out in the operation phase (at least during the first 5 years and then re-evaluated as to the need to continue the program). This monitoring will be carried out by a qualified Biodiversity Consultant team to be contracted by TCN and led by an experienced specialist. The Consultant team shall define and follow a scientifically valid monitoring protocol that will define specific search dates, localities, and procedures

Corrective Actions

Table 9.20 presents the main remedial actions.

Table 9.20: Corrective actions, description and implementation schedule

Corrective Actions	Description	Implementation Schedule

Act on expansion of invasive flora species	If invasive Area of Occurrence (AOO) and/or Extent of Occurrence (EOO) is observed to be increasing and threatening native species and habitats, actions to control and remove these patches will be implemented after being properly evaluated.	Whenever necessary
Clearing of IUCN species	If the baseline population of these species reduces, replanting programs shall be initiated	Whenever necessary
Act on high levels of impacts on natural habitat, flora and fauna	If deforestation and poaching in post opening up of the RoW doubles the initial rate prior to commencement of pre-construction/construction, reforestation or targeted protection and anti-poaching measures need be instituted.	Whenever necessary
Act on high levels of bird and bat migration	If bat and bird's migration indicate increasing trend, the monitoring consultant shall recommend to TCN measures to restore bird habitats	Whenever necessary

Performance and Reporting

Table 9.21 lists the performance indicators to be monitored.

Table 9.21: Performance indicators for Biodiversity Management Program

Indicator	Target	Trend
Number and extent of invasive flora species patches	Zero increase from pre-project conditions.	Both EOO and AOO increase between successive monitoring periods.
Deforestation of natural habitat areas and wildlife poaching activities	Deforestation and impacts on swamp habitat and wildlife poaching activities should not significantly exceed (by double or more) the pre- project levels.	Deforestation impacts on natural and critical natural habitat and wildlife poaching stabilized after the application of additional mitigation measures.
Clearing of IUCN threatened plant species	Population of replanted threatened plant species are mature and doubles the initial number cleared	Population of the species continues to flourish with high regeneration potentials

Bird migration	For raptor and migratory species such as Polyboroides typus, the target for migration shall be zero. For more common species, the target should be minimally low (to be specified by the Consultant for particular species groups).	Fatality rate decreases in monitored segments, after application of additional corrective measures.

The performance indicators results will be determined and compiled in quarterly reports, as indicated in the following section.

Reports

Table 9.22 summarizes the documental records that will be kept, to control the execution of this monitoring and management program.

Table 9.22: Record Documents for the Biodiversity Management Program

Document Title	Document Type	Frequency of Report
Invasive species monitoring report	Report	Semi-annually (twice per year)
IUCN flora species	Report	Quarterly
Baseline Report. Monitoring Report and Management Report of impacts on natural and critical natural habitat, on both flora and fauna (deforestation rates and wildlife poaching activities)	Report	Semi-annually
Polyboroides typus, mortality monitoring report	Report	Quarterly

9.4.5 Community Health and Safety Management Plan

Objectives

The construction of the proposed Project could result in the increase of community health and safety hazards, due to increased light, noise and dust emissions, increased traffic, workforce mobilization, population influx and security personnel. Management of these risks will require implementation of the mitigation measures proposed in the chapter seven of this report regarding these issues, which are compiled in this Community Health and Safety Management Plan.

Scope and Responsibilities

The Project Implementation Unit (PIU) is the ultimate responsible party for the implementation of all mitigation and management measures. Note that much of the mitigation will involve a strong participation of the Contractor, through the development of additional management plans and the management of day to day activities in the field, as detailed here. However, the PIU will continuously guide and supervise the Contractor, in all issues that are related to engagement with communities and minimization of impacts on their health and safety.

Proposed Actions and Implementation Schedule

Table 8.23 presents the main actions for the implementation of the Community Health and Safety Management Plan.

Table 9.23: Community Health and Safety Management Plan actions, description and implementation schedule

Actions	Description	Implementation Schedule	Responsibility	Supervision
Minimize hazard risk to communities from Project traffic	• The Contractor will develop, and submit for PIU approval, an updated Traffic Management Plan, detailing the management procedures and mitigation measures to minimize traffic related hazard risks to communities. The Plan will include the mitigation provided here under: • Movement of construction vehicles shall be limited to pre- approved construction routes. These will be defined in order to avoid	Preconstruction Phase	Contractor	PIU

	crossing residential areas, schools or hospitals whenever feasible; • Speed limits not exceeding 30 km/h will be set for construction heavy vehicles moving in unavoidable sensitive receptors (schools, hospitals and homes) and 60km/h on paved roads. Drivers shall be trained on set speed limits and safe driving.			
Minimize hazard risk to communities from Project traffic	• Install temporary official traffic signs on local roads around the work fronts before and during the execution of the works together with local transit authorities; • Consult with community on traffic restrictions and schedule, provide alternative connectivity where needed, and conduct regular driver and community traffic safety awareness programs; • Use manned traffic control in key sensitive areas and crossings especially near any places where people in general and children in particular congregate; • Manage traffic and machinery to avoid accidents involving domestic animals and cattle. Provide for animal crossings and access to watering sites, if needed. • Reroute traffic or limit access if needed, in coordination with communities and local authorities.	Preconstruction Phase	Contractor	PIU

Minimize noise nuisance on communities	• Construction activities, in particular the noisier ones, will be limited to the daytime period (between 08:00 and 05:00) and to working weekdays, avoiding working during the night-time and on weekends, whenever near residential areas; • The contractor will avoid placing fixed equipment in proximity to sensitive receptors; • Use of portable screens during substations construction if situated near inhabited places, where possible; • If noise complaints are received from local communities in the morning or evening periods, despite compliance with the previous measures, and if the following investigation confirms the noise impact, then further reduce the work schedule in those periods. In such cases, the work schedule will be defined in a participatory manner, through consultation with affected communities;	During Construction	Contractor	PIU
Ensure good practices in labor management and minimize risks of social conflicts with workforce	• The Contractor will develop and implement a Local Recruitment and Working Conditions Plan, which will include the following principles: • Create mechanisms to ensure that the recruitment and hiring procedures are conducted in a transparent and just manner, are coordinated with the community leaders and LGA Administration, maximize local	Planning and During Construction	Contractor	PIU

	employment including women and young workers and transfer technical skills to the local labor force; • Forbid workers from hunting or buying bush meat. Inform workers of these restrictions in the induction sessions and enforce and monitor them appropriately • Give priority to hire local workers, provided applicants have the necessary skills; • Employment opportunities will be adequately advertised, so as not to limit application opportunities;			
Ensure good practices in labor management and minimize risks of social conflicts with workforce	• The process of contracting staff will be transparent and follow pre- established and accepted criteria and a process coordinated with local leaders that aims to maximize opportunities for the local workforce; • Avoid hiring at the gate – establish local and regional recruitment centers and provide pick up points for applicants from communities; • Ensure respect for local labor laws and worker rights, and together with the labor policy, Health and Safety Management Plan, ensure safe and fair working conditions; • Develop and implement a worker's grievance management system.	Preconstruction and During Construction	Contractor	PIU
	• Policy and sanctions against violence or exploitation, including of a sexual nature (for example the prohibition of the exchange of money, employment, goods, or services for			

Minimize risks of social conflicts with workforce	sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior); • Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas); • Policy and sanctions against sexual relations with anyone under the age of 18 (except if married prior to employment); • Description of disciplinary measures for infringement of the code and company rules. If workers are found to be in contravention of the CoC, which Contractor will explain to them and require them to sign at the commencement of their contract, workers must face proportionate disciplinary procedures; • Failure to keep by these standards will be stated in the contracts as grounds for contract termination. Inform all hired workers of these restrictions and the possible consequences of breaking them. • The Contractor will further be expected to: • Publicize the CoC in settlements potentially around the project area. This will help ensure that the local residents are aware of the expected behavior of the construction staff; • Provide schedule and transportation that allows workers to visit their families or to have	Preconstruction and During Construction	Contractor	PIU

	leisure time in urban centers at reasonable intervals. • The Contractor will require its subcontractors to subscribe and adhere to this code and will diligently supervise its implementation at all levels, including engaging the community in confidentially and actively identifying any inappropriate behavior.			
GBV/SEA prevention and response framework	• PIU and the Contractor will work together to continuously assess risks and identify and implement prevention, response and referral processes with respect to any cases involving Sexual Exploitation and Abuse / Gender Based Violence (SEA/GBV). This will focus on: • training of PIU and Contractor personnel, (ii) community and worker awareness, (iii) making available safe and confidential channels of communication and complaints, and (iv) a referral system and mechanism for survivors of GBV/SEA; • PIU will develop and implement a GBV/SEA prevention and response framework that will address the following elements: • How the project will put in place the necessary protocols and mechanisms to address the SEA/GBV risks; • How to address any GBV incidents that may arise;	Preconstruction and During Construction	Contractor	PIU

GBV/SEA prevention and response framework	• A policy against GBV/SEA including a CoC and agreed sanctions. These will be provided by the contractor and consultants as part of the Contractor ESMP. Have all employees of contractors (including sub-contractors), supervision consultants and other consultants with a footprint on the ground in the project area sign CoCs; • For purposes of the construction and operational phases of the project, develop an induction program, including a CoC, for all workers directly related to the project. • Specific arrangements for the project by which GBV risks will be addressed, including: • Awareness Raising Strategy, which describes how workers, local communities and Project personnel will be sensitized to SEA/GBV risks, and the worker's responsibilities under the CoC; • Referral Pathway: Identification of qualified GBV service providers (NGOs) and setting up a referral pathway so GBV survivors will be referred, and the services will be available (health, legal, psychosocial, safety planning, etc.); • Establish a SEA/GBV Accountability and Response Framework, to be finalized with input from the contractor, which will include at minimum:	Prior to mobilization of construction	Contractor	PIU / Third party auditor per Action Plan

	• Allegation Procedures: How the project will provide information to employees and the community on how to report cases of SEA/GBV, CoC breaches to the GRM; • SEA/GBV Allegation Procedures to report SEA/GBV issues to service providers, and internally for case accountability procedures which will clearly lay out confidentiality requirements for dealing with cases; • Mechanisms to hold accountable alleged perpetrators associated to the Project; • Disciplinary action for violation of the CoC by workers. It is essential that such actions be determined and carried out in a manner that is consistent with local labor legislation and applicable industrial agreements; • The supervision consultant TOR and the training plan will include provisions to promote monitoring and reporting on the implementation and effectiveness of the SEA/GBV Action Plan to prevent and mitigate SEA/GBV risks associated with the project; • Reporting on the Framework implementation will be done on a monthly basis.			
	• Contractor will develop a Security Management Plan, detailing the security arrangements to be deployed at lay down areas and construction sites, or any location with Project presence. This plan will be			

Minimize community security hazards due to interaction with security personnel	compliant with AfDB operational safeguards (see chapter 2) • This plan will include mandatory training for all security personnel, in what regards human rights, proportionate force use and adherence Co contractor's code of conduct; • Security will be supplied by NCSDC; PIU will make an effort to engage with the authorities, so that the any engagement with the communities is in compliance with the Voluntary Principles on Security and Human Rights.The Contractor will develop a policy and management plan to reduce the transmission of STIs, including HIV / AIDS. This strategy will: • Make provision for awareness, counselling and testing for all Project personnel, including voluntary testing for STDs and HIV/AIDS as part of any health screening program (workers will not be denied employment or discriminated against in any way based on their HIV status); • Provide guidance and counselling to workers with HIV/AIDS to access treatment through existing health facilities or NGO campaigns or programs; • Ensure that all Project personnel are given specific HIV and STD prevention training; • Undertake information, education and communication campaigns around safe sexual practices and transmission of STDs and HIV/AIDS as well as condom distribution at	Planning / During Construction	Contractor	PIU

	stopping locations on key transport routes targeting commercial sex workers and truck drivers; • Support public health or NGO initiatives to reduce STD transmission including working through schools, women's and youth groups; • The Contractor will provide non-local workers with a schedule and transportation that avoids limiting off-time activities at nearby communities; • Conduct community awareness campaigns in communities crossed by the line			

Actions	Description	Implementation Schedule	Responsibility	Supervision
	• The Contractor will develop a policy and management plan to reduce the transmission of STIs, including HIV / AIDS. This strategy will: • Make provision for awareness, counselling and testing for all Project personnel, including voluntary testing for STDs and HIV/AIDS as part of any health screening program (workers will not be denied employment or discriminated against in any way based on their HIV status); • Provide guidance and counselling to workers with HIV/AIDS to access treatment through existing health facilities or NGO campaigns or programs; • Ensure that all Project personnel are given specific HIV and STD prevention training;			

Minimize workforce and community health risks	• Undertake information, education and communication campaigns around safe sexual practices and transmission of STDs and HIV/AIDS as well as condom distribution at stopping locations on key transport routes targeting commercial sex workers and truck drivers; • Support public health or NGO initiatives to reduce STD transmission including working through schools, women's and youth groups; • The Contractor will provide non-local workers with a schedule and transportation that avoids limiting off-time activities at nearby communities; • Conduct community awareness campaigns in communities crossed by the line	During Construction	Contractor	EDM

9.4.6 Traffic Management Program

Justification and Objectives

The Project is expected to generate relatively high volumes of traffic during the initial decommissioning and construction phases of the project. It is therefore important to ensure that traffic is managed in a manner that facilitates efficiency as well as ensuring the safety of personnel and the local community. The vehicular traffic generated as a result of the Project not only requires management on Site itself, but also insofar as traffic impacts may be experienced along local road networks and in urban/residential areas. The outline TMP has also been prepared for the purpose of identifying appropriate and safe methods of access for decommissioning and construction traffic to the proposed development.

Objectives of TMP

The objectives of this outline TMP are to:

Outline minimum road safety measures to be undertaken at site access/exit locations, during the works and including approaches to such access/egress locations;

Demonstrate to the developer, contractor and supplier the need to adhere to the relevant guidance documentation for such works; and

Provide the basis for the preparation of a final TMP by the contractor appointed to carry out the works.

The PIU shall be responsible for ensuring that the contractor manages the decommissioning and construction activities in accordance with this outline TMP. The contractor will prepare a final TMP which is fully in accordance with the outline TMP.

Objectives and measures are also included for the management, design and construction of the project to control the traffic impacts of construction insofar as it may affect the environment, local residents and the public in the vicinity of the construction works.

The final TMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned by the Board

Traffic Management Signage

The contractor shall undertake consultation with the relevant authorities for the purpose of identifying and agreeing signage requirements. Such signage shall be installed prior to works commencing on site.

Proposed signage may include warning signs to provide warning to road users of the works access / exit locations and the presence of construction traffic. All signage shall be provided in accordance with the Nigerian Highway Code Part 2, Section B - road signs, signals, and markings

In summary, the contractor will be required to ensure that the following elements are implemented:

- Consultation with the relevant authorities for the purpose of identifying and agreeing signage requirements;
- Provision of temporary signage indicating site access route and locations for contractors and associated suppliers; and
- Provision of general information signage to inform road users and local communities of the nature and locations of the works, including project contact details.

Programming

In order to reduce impacts on local communities and residents adjacent to the proposed sites, it is proposed that:

- The contractor will be required to liaise with the management of other construction projects and the local authorities to co-ordinate deliveries.
- The contractor will be required to schedule deliveries in such a way that decommissioning/construction activities and deliveries activities do not run concurrently e.g. avoiding pouring of concrete on the same day as material deliveries in order to reduce the possibility of numbers of construction delivery vehicles arriving at each tower location simultaneously, resulting in build-up of traffic on road network..
- The contractor will be required to schedule deliveries to and from the proposed temporary construction lay down area such that traffic volume on the surrounding road network is kept to a minimum.

Decommissioning/ construction phase programme of works shall be developed by the contractor in liaison with the relevant local authorities, specifically taking into account potential road repair works that are included in the FRSC road works schedule. In particular, works should be programmed where possible such that any road works are carried out following the presence of construction traffic for the proposed development.

Heavy Duty trucks deliveries to the development site will be suspended on the days of any major traditional festivals that have the potential to cause larger than normal traffic volumes.

The contractor will be required to interact with members of the local community to ensure that deliveries will not conflict with sensitive events such as traditional festivals.

Heavy Duty trucks (HDT) deliveries will avoid passing schools at opening and closing times where it is reasonably practicable.

Construction activities will be undertaken during daylight hours for all construction stages. It is not anticipated that construction works will be carried out on Friday or that any construction works will be carried out in hours of darkness.

Licensing

The PIU and contractor shall ensure that:

All Project vehicles comply with relevant traffic and transport licensing requirements (such as with regard to licensing requirements relating to the transportation of over-sized loads or hazardous materials, including hazardous waste).

All drivers of vehicles used during the Project shall have the requisite licenses to operate any vehicle (or machinery) operated by them on Site or on any public roads.

All Project vehicles shall have valid roadworthy certificates and licenses.

Routing and direction of traffic and site access

The movement of all vehicles to and from Site shall be along designated Federal roads, state roads and site access roads. Most materials for the construction works shall be transported from the Lagos port down to the project site. The distance between these locations is about 1,132 km on the average. The most appropriate route for large Project vehicles (such as HDT, Light Duty Trucks and buses) transporting equipment, materials and employees (along public roads) to and from the Site shall be determined by the contractor and PIU in consultation with the FRSC, local road traffic authorities and the local community. A copy of the approved routes must be maintained on Site together with this Plan (this is the responsibility of the Contractor and his Site Manager).

Any anticipated or scheduled traffic delays occasioned by Project vehicles (such as abnormal loads, i.e. the transformers) shall be coordinated with FRSC and local traffic authorities in advance.

Recommended Traffic Management Speed Limits

Adherence to posted/legal speed limits will be emphasized to all staff/suppliers and contractors during induction training.

Drivers of construction vehicles/HDTs will be advised that vehicular movements in sensitive locations, such as local community areas, shall be restricted to 60 km/h. Special speed limits of 30 km/h shall be implemented for construction traffic in sensitive areas such as school locations. Such recommended speed limits will only apply to construction traffic and shall not apply to general traffic. It is not proposed to signpost such speed limits in the interest of clarity for local road users.

Road Cleaning

It shall be a requirement of the works contract that the contractor will be required to carry out road sweeping operations to remove any project related dirt and material deposited on the road network by construction/delivery vehicles. Road Sweepers will dispose of material following sweeping of road network, to licensed municipal waste facility around the site.

Vehicle Cleaning

It shall be a requirement of the works contract that main contractor will be required to provide wheel washing facilities, and any other necessary measures to remove mud and organic material from vehicles exiting tower construction sites. In addition, the cleaning of delivery trucks such as concrete delivery trucks shall be carried out at the lay down area and shall not be undertaken at the tower site locations.

Road Condition

The extent of the heavy vehicle traffic movements and the nature of the load may create problems of:

Fugitive losses from wheels, trailers or tailgates; and

Localized areas of subgrade and wearing surface failure.

The contractors shall ensure that:

Loads of materials leaving each site will be evaluated and covered if considered necessary to minimize potential dust impacts during transportation.

The transportation contractor shall take all reasonable measures while transporting waste or any other materials likely to cause fugitive loses from a vehicle during transportation to and from site, including but not limited to: (i) Covering of all waste or material with suitably secured tarpaulin/covers to prevent loss; and (ii) utilization of enclosed units to prevent loss.

The roads forming part of the haul routes will be monitored visually throughout the construction period

In addition, the contractor shall, in conjunction with the PIU:

Undertake additional inspections and reviews of the roads forming the haul routes one month prior to the construction phase to record the condition of these roads at that particular time.

Such surveys shall comprise, as a minimum, a review of video footage taken at that time, which shall confirm the condition of the road corridor immediately prior to commencement of construction. This shall include video footage of the road wearing course, the appearance and condition of boundary treatments and the condition of any overhead services that will be crossed. Visual inspections and photographic surveys will be undertaken of bridges and culverts that are along the haul roads.

Where requested by the local authority prior to the commencement of construction operations, pavement condition surveys will also be carried along roads forming part of the haul route. These will record the baseline structural condition of the road being surveyed immediately prior to construction.
Throughout the course of the construction of the proposed development, ongoing visual inspections and monitoring of the haul roads will be undertaken to ensure any damage caused by construction traffic is recorded and that the relevant local authority is notified. Arrangements will be made to repair any such damage to an appropriate standard in a timely manner such that any disruption is minimized.

Upon completion of the construction of the proposed development, the surveys carried out at pre-construction phase shall be repeated and a comparison of the pre and post construction surveys carried out. Where such comparative assessments identify a section of road as having been damaged or as having deteriorated as a result of construction traffic, the road will be repaired to the pre-construction standard or better by the TCN.

Road Closures

During the course of the works, it is not envisaged that road closures will be required. In areas where existing carriageways are narrow, it is envisaged that Traffic Management measures such as temporary traffic lights will be utilized to facilitate traffic. It is envisaged however that temporary road closures will be required at guarding locations for the purpose of removal following construction. The most notable of these temporary road closures will be on the Aba – Port Harcourt express way, Umuikaa – Owerri, and Owerri – Onitsha express Way. These closures will be short in duration, with road closure times and appropriate measures to be agreed with the FRSC and other relevant stakeholders prior to the removal of guarding. It is envisaged that road closures will be undertaken during nighttime when traffic volumes are at their lowest, subject to agreement with the FRSC and other relevant stakeholders.

Enforcement of Traffic Management Plan

All project staff and material suppliers will be required to adhere to the final TMP. As outlined above, the principal contractor shall agree and implement monitoring measures to confirm the effectiveness of the TMP and compliance will be monitored by the resident engineer on behalf of TCN. Regular inspections/spot checks will also be carried out to ensure that all project staff and material supplies follow the agreed measures adopted in the TMP.

Details of Working Hours and Days

Construction of the proposed development is envisaged to be undertaken during daylight hours for all construction stages besides it is expected that the EPC with all his sub Contractors in collaboration with the Client and the communities around the project sites shall be having regular meetings strictly for management of the ptoject sites and the people around them if project activities would involve noise, traffic obstruction/disruption,walk way obstruction, production of dust and wastes, long periods outages, etc. This meetings shall be commence immediately after the kick off meeting and site hand over to the EPC..It is not anticipated that construction works will also be carried out on Sundays, or Bank Holidays or that any construction works will be carried out in hours of darkness.

Pedestrian and Passenger Safety

All construction personnel transported to and from the Site shall be safely accommodated in appropriate passenger vehicles. No employee shall be transported on the back of open trucks. The Contractor's Construction Safety Officer shall ensure that this requirement is adhered to at all times.

All vehicles transporting employees shall be appropriately maintained and shall not carry more passengers than the number of persons for whom seating accommodation is provided.

Assembly points for local construction workers embarking passenger vehicles shall be located a safe distance from areas/routes of high vehicle traffic. Those residing in hotels shall be picked up daily from their various hotels. Roads and areas used by construction vehicles shall, as far as possible be avoided by all personnel. Designated pedestrian routes shall be demarcated where appropriate.

Vehicle and pedestrian safety shall be emphasized in the Safety Induction Training required to be provided by the Contractor.

All employees and construction personnel shall be trained and informed as to the dangers and risks posed by construction and other traffic, such training shall also include appropriate precautionary measures required to be undertaken to facilitate safe and efficient traffic management (e.g. checking for traffic before crossing roadways and utilizing designated pedestrian routes).

Drivers shall be adequately trained in the recognition and avoidance of road hazards, vehicle maintenance, safety requirements and comply with the FGN Highway code.

Emergency Procedures During Construction

- The contractor shall ensure that unobstructed access is provided to all emergency vehicles along all routes and site accesses at what speed limit?
- The contractor shall provide to the local authorities and emergency services, contact details of the contractor's personnel responsible for construction traffic management.

In the case of an emergency the following procedure shall be followed:

- Emergency Services will be contacted immediately by dialing 555;
- Exact details of the emergency/incident will be given by the caller to the emergency line operator to allow them to assess the situation and respond in an adequate manner;
- The emergency will then be reported to the Site Team Supervisors and the Safety Officer;
- All construction traffic shall be notified of the incident (where such occurs off site);
- Where required, appointed site first aiders will attend the emergency immediately; and
- The Safety Officer will ensure that the emergency services are en route.

Communication

Client –Contractor –Donor and media-creation of sensitization communication. The contractor shall ensure that close communication with the relevant local authorities and the emergency services shall be maintained throughout the construction phase. Such communications shall include:

- Submissions of proposed traffic management measures for comment and approval;
- On-going reporting relating to the condition of the road network and updates to construction programming; and
- Information relating to local and community events that could conflict with proposed traffic management measures and construction traffic in order to implement alternative measures to avoid such conflicts.

The contractor shall also ensure that the local community is informed of proposed traffic management measures in advance of their implementation. Such information shall be disseminated by sensitization in the way and manner best comprehensible by the affected community using the liaison personnel.

Decommissioning and Construction Methodologies

- The contractor shall take cognizance of the construction methodology as detailed in chapter four of this report in the preparation of the final TMP. In particular, the contractor shall address the following construction elements in the development of the plan:

  - Decommissioning and dismantling works
  - Tower Foundations;
  - Tower Assembly and Erection
  - Conductor / Insulator Installation (Stringing of Overhead Lines) including Guarding provision and removals; and
  - Reinstatement of Lands.

- The contractor shall provide detailed traffic management arrangements for all construction stages and submit for approval to the relevant local authorities and the FRSC.

- The contractor shall submit for approval to the TCN and to the Local Authority, as part of their final TMP, details in relation to construction staff vehicle pooling and parking.

- This Traffic Management Plan (TMP) will form part of the construction contract and is designed to reduce possible impacts which may occur during the construction of the proposed development.
- The outline TMP shall be used by the appointed contractor as a basis for the preparation of a final TMP and shall detail, at a minimum, the items detailed in this outline TMP and any subsequent requirements of the FRSC and local authorities.
- TCN's PIU shall be responsible for ensuring that the contractor manages the construction activities in accordance with this outline TMP and shall ensure that any conditions of planning are incorporated into the final TMP prepared by the appointed works contractor.

CHAPTER TEN
CONCLUSION

10.1 Conclusion

The Environmental and Social Impact Assessment (ESIA) of the proposed project has been carried out in line with statutory requirements for environmental management in Nigeria and as such ensures that potential environmental, social and health impacts of the project are fully appraised. This ESIA report has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost-effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. A management plan that would be effective throughout the project's life cycle has also been put in place to assure environmental sustainability of the project.

The environmental baseline condition of the project area which was carried out based on a one season (wet) data, supplemented with dry season secondary data (Ukanafun –Oma Power Gas Plant Project, 2014) showed that the physical, chemical and biological characteristics as well as meteorological, climatic and hydrological characteristics were generally consistent with previous studies carried out within the environment with some few exceptions. Also documented were unique assemblages of wild flora and fauna species with abundances that relate to the nutrients and chemical composition of the ecosystems.

The identified adverse impacts of the proposed project include potential; air and noise pollution, soil, sediment, groundwater water and surface water contamination from accidental discharges of effluent, workplace accidents, traffic, community conflict, migratory and raptor avian species, IUCN plant species. Consequently, cost-effective mitigation/ amelioration measures have been designed to ensure that these impacts are prevented, reduced or controlled to as low as reasonably practicable in order to ensure conservation of biodiversity in the area and enhance continual compliance with environmental standards and requirements in Nigeria. It is understood that the project will result in substantial social and economic benefit for Nigeria. The EMP developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation.

Socio-economic consultations with the project host communities and other relevant stake holders were also carried out and shall continue throughout the life cycle of the project

It is therefore hoped that all data/evidence contained in this report is sufficient in the development of an environmental impact statement (EIS), and afterward in the acquiring of necessary permits for commencement of project.

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APPENDICES

Appendix 1.4

Terms of Reference by FMEnv

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Email:ea@ead.gov.ng, www.ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMEnv/EA/EIA/5096/Vol. I/47
16th August, 2019.

The Managing Director/CEO,
Transmission Company of Nigeria,
Plot 441, Zambezi Crescent,
Maitama,
Abuja, FCT.

RE: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED NIGERIA TRANSMISSION EXPANSION PROJECT (NTEP) LOT-2 RECONSTRUCTION OF ALAOJI-ONITSHA TRANSMISSION LINE, ABIA, ANAMBRA & IMO .

Please refer to your letter dated 13th May, 2018.

2. The Ministry has reviewed the scoping report and Terms of Reference for your proposed project and made some additions to the Environmental Baseline Studies (EBS) as reflected below:

- Mitigation measures/plan for workers influx and camp management.
- Measures to prevent gender based violence (GBV), sexual exploitation and abuse
- Labour management plans
- Estimate of areas to be deforested in hectares
- Socio-economic and asset inventory surveys for resettlement impacts and RAP formulation
- Preparation of a Resettlement Action Plan (RAP) to address any land acquisition and displacement impacts.

3. The additions in paragraph Two (2) above and the other contents of your revised ToR will be considered as the minimum content of the EIA studies.

4. The Environmental Baseline Studies shall be witnessed by officials of the Ministry. The Environmental Baseline Studies should be in line with International Best Practices.

5. The laboratory analysis of the samples must be carried out in an FMEnv accredited Laboratory and witnessed by officials of the Ministry. You are also to ensure full quality assurance/quality control (QA/QC) measures for the laboratory analysis in line with standard practices and notify the Ministry in good time to enable adequate participation in the exercise.

- Evidence of accreditation by Federal Ministry of Environment for the Laboratory where the sample analysis would be carried out.
- Chain of Custody.
- Certificate of Analysis duly stamped and signed by the Laboratory Manager.
- Evidence of Laboratory witnessing by the Federal Ministry of Environment.

7. Upon completion of the EIA studies, the proponent are to submit to the Ministry Ten (10) hard copies along with two (2) electronic copies of the draft EIA report and also email a copy to eia@ead.gov.ng

8. Thank you for your co-operation.

Abbas O. Suleiman
For: Honourable Minister

Appendix 3.1

Applicable Codes and Standards

In general, the TCN Standard applies for the Transmission line and is herein referred to.
The following Standards are excerpts from the PHCN standards:

Quality Assurance and Safety

• Local Norms, Rules and Regulations for Health, Safety and Environmental Protection; Environmental Guidelines and Standards for Petroleum Industry in Nigeria, Ministry of Petroleum Resources- "Revised Edition 2002";
• Workmen's Compensation Decree/1987;
• Electrical Regulations/1988.
• Land Use act of 1998
• Power Reform Decree of 2005
• BS EN ISO 9001 Quality System – Model for Quality Assurance in Design, Development, Production, Installation and Servicing Safety Management
• OHSAS18001:2007 Occupational Health and Safety Management Systems Requirements;
• ISO9001:2008 Quality management systems: Requirements
• ISO14001:2004 Environmental management systems: Requirements with guidance for use;
• ICAO International Civil Aviation Organisation Annex 14Civil
• ACI 301 Specifications for Structural Concrete for Buildings
• ACI 318 Building Code Requirements for Reinforced Concrete
• ACI Committee 543 title no. 70-50 1974 "Recommendations for Design, Manufacture, and Installation of Concrete Piles".
• BS 4-1 1993 Structural steel sections. Part 1. Specification for hot rolled sections
• BS 12 1996 Specification for Portland cement

• BS 410-1 2000 Test sieves –Technical requirements and testing Part 1- Test sieves of metal wire cloth, Part 2- Test sieves of perforated metal plate

• BS 812 Part 100 Testing aggregates, General requirements for apparatus and calibration, Part 101 Guide to sampling and testing aggregates, Part 103.1 Sieve tests, Part 103.2- Sedimentation tests, 105.1 Flakiness index, 105.2 Elongation index of coarse aggregate, Part 106 Determination of shell content , Part 109 Determination of moisture content, Part 110, Determination of aggregate crushing value, Part 111- Ten percent fines value, Part 112- Aggregate impact value, Part 113- Aggregate abrasion value, Part 117- Water soluble chloride salts, Part 118- Determination of sulphate content, Part 119- Determination of acid soluble material in fine aggregate. Part 120- Drying Shrinkage, Part 121- Determination of soundness, Part 123-Determination of alkali silica reactivity, Part 2, Determination of density.

• BS 882 Specification for aggregates from natural sources for concrete

• BS 1014 Pigments for Portland cement and Portland cement products

• BS 1139-1.2 Metal scaffolding Part 1-Tubes, Aluminum tube, Part 2, Couplers, Specification for steel and aluminum couplers, fittings and accessories for use in tubular scaffolding, Part 4, Prefabricated steel splithears and trestles

• BS 1881 All Parts Testing concrete, Method of sampling fresh concrete on site

• BS 3416 Bitumen based coatings for cold application suitable for use in contact with potable water

• BS 4027 Sulphate resisting Portland cement

• BS 4483 Steel fabric for the reinforcement of concrete

• BS 5075-2 Concrete admixtures- for air entraining admixtures

• BS 5328 Concrete Part 1- Guide to specifying concrete, Part 2- Methods for specifying concrete mixes, Part 3- Procedures to be used in producing and transporting concrete, Part 4- Procedures to be used in sampling, testing and assessing compliance of concrete.

• BS 5390 Code of practice for site investigations

• BS 8004 Code of Practice for Foundations

• BS 8110 Structural use of concrete Part 1, Part 2 and Part 3.

• BS 8666 Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete.

Mechanical Codes and Standards

• ANSI B18.21.1 Lock Washers

• ANSI B18.5.1 Square and Hex Bolts and Screws

• ANSI B18.2.2 Square and Hex Nuts

• ASCE Manual 10-90 Guide for Design of Steel Transmission Towers

• ASTM-A123 Standard Specification for Zinc (Hot Galvanized) Coatings on products fabricated from Rolled, Pressed and Forged Steel Shapes, Bars and Strip

• ASTM-A153 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

• ASTM-A572 Standard Specification for High Strength Low Alloy Columbium- Vanadium Steels of Structural Quality

• ASTM-A325 Standard Specification for High Strength bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers

• ISO 898-1 Mechanical properties of fasteners, Bolts Screws and Studs

• ISO 630- Structural Steel-plates, wide flats, bars, sections and profiles.

• ISO 7411- Hexagonal bolts for high strength structural bolting with large widths across flats

• ISO 657-5, Hot rolled structural steel sections equal and unequal leg angles

• ISO 7452- Hot rolled structural steel tolerances on dimensions and shapes

• ASTM-A394 Standard Specification for Galvanized Steel Transmission Tower Bolts and Nuts

BS 4 Part 1 Structural Steel Sections, Hot Rolled Sections

• BS 729 Hot Dip Galvanized Coatings on Iron and Steel Articles

• BS 1856 General Requirements for the Metal-Arc Welding of Mild Steel

• BS 2642 General Requirements for the Arc Welding of Carbon Manganese Steel

• BS 4360 Weld able Structural Steel

• IEC 61284 Overhead lines- requirements and test for fittings.

• BS 729 Hot Dip Galvanized Coatings on Iron and Steel Articles.

• BS EN 1481 Hot dip galvanized coating on fabricated iron and steel articles, specification and test method.

Electrical

• IEC 270 Partial Discharge Measurements

• IEC 61232 Aluminum-Clad Steel wires for Electrical Purposes.

• IEC 60121 Recommendation for commercial annealed aluminum electrical conductor wire

• IEC 61089 Round wire concentric lay overhead electrical stranded conductors.

• IEC 60889 Hard drawn aluminum wire for overhead line conductors

• IEC 61394 Characteristics of greases of aluminum, aluminum alloy and steel bare conductors.

• IEC 61395 Overhead electrical conductors - Creep test procedures for stranded conductors

• IEC 60270 High voltage techniques- Partial Discharge Measurements.

• IEC 61897 Overhead lines - Requirements and tests for Stockbridge type aeolian vibration dampers

• IEC 61894 Overhead lines - Requirements and tests for spacers

• IEC /TR 62263 Guidelines for installation and maintenance of optical fibre cables

• IEC 60793 Measurement and test procedures Part 1

• IEC 60794 Optical Fibres Part 1-2, General Specification

• IEC 1232 Aluminum Clad Steel Wire for Electrical purpose

• IEC 60874 Part 0-2 Connector for optical fibres and cables

• IEC 60120 Recommendations for Ball and Socket Couplings of String Insulator Units.

• IEC-60383-1 Insulators for overhead lines with a nominal voltage greater than 1000V. Ceramic or Glass units for ac systems acceptance criteria.

• IEC-60383-2- Insulators for overhead lines with a nominal voltage greater than 1000V. Insulator strings and insulator sets for ac systems test methods and acceptance criteria.

• IEC-60071-2- Insulation Coordination Part 2. Application guide

•IEC 60591 Sampling rules and acceptance criteria when applying statistical control methods for mechanical and electromechanical tests on insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000V.

•IEC-60437 Radio Interference Test on High Voltage Insulators.

•IEC 61467- Insulators for overhead lines with nominal voltage greater than 1kV, power arc test on insulators sets

•IEC 60575- Thermal mechanical performance test and mechanical performance test on string insulator units

•IEC 60270- Partial discharge measurements

•IEC-60305 Insulators for overhead lines with a nominal voltage above 1kVCermaic or glass insulators for ac systems- characteristics of insulators units of cap and pin type.

•IEC /TR 62263 Guidelines for installation and maintenance of optical fibre cables

•IEC 60793 Measurement and test procedures Part 1

•IEC 60794 Optical Fibres Part 1-2, General Specification

•IEC 1232 Aluminum Clad Steel Wire for Electrical purpose

•IEC 61284 Overhead lines- requirements and test for fittings.

•IEC 60372 Locking device for ball and socket couplings of stringinsulator units.

•IEC 60672 Specification for ceramic and glass insulating material

•IEC 60874 Part 0-2 Connector for optical fibres and cables

•IEC 61211 Insulator of ceramic or glass for overhead lines with a nominal voltage greater than 1000V-Puncture testing

•BS 215 Part 1 & 2 Aluminum stranded conductors, steel reinforced

•BS 3288 Insulator and conductor fittings for overhead power lines.

•BS 729 Hot Dip Galvanized Coatings on Iron and Steel Articles.

•BS 443 Specification for zinc coatings on steel wire and for quality requirements

•BS 183 General purpose galvanized steel wire

•BS 1559 Reels and drums for bare conductors

•BS-137 Insulators of Ceramic Material or Glass for Overhead Lines with a nominal voltage greater than 1000 V.

•BS 3288 Part 1- Part 4. Performance and general requirements for insulators and conductor erhead power lines.

•BS EN ISO1461 Hot dip galvanized coatings on fabricated iron and steel articles Specifications and test methods

•BS EN 50189 Conductors and overhead lines — Zinc coated

•BS EN 1481 Hot dip galvanized coating on fabricated iron and steel articles, specification and test method.

•IEEE Std 524-1980 Guide to installation of overhead Transmission line conductors

•IEEE 31TP65-156 Standardization of Conductor Vibration Measurements.

•IEEE 1138 Standard construction of composite fibre optic ground wire

•IEEE 524a-1993- IEEE Guide to Grounding During the Installation of Overhead Transmission Line Conductors

•TU TG 652 & 654 Characteristics of single mode optical fibre and cable

•IEEE 1138 Standard construction of composite fibre optic ground wire

•IEEE 812 Standard fibre optics, Definition of terms

•ITU TG 652 & 654 Characteristics of single mode optical fibre and cable

Appendix 6.1

Air Quality, Noise, and EMF Result

AIR QUALITY (ALAOJI - IHIALA)	Alaoji-Ihiala													Ihiala-Onitsha						
PARAMETERS	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQ9	AQ10	AQ11	AQ12	AQ13	AQ14	AQ15	AQ16	AQ17	AQ18	AQ19	AQ20
SO2	0.050	0.009	0.021	0.019	0.024	0.039	0.058	0.054	0.022	0.059	0.087	0.020	0.024	0.042	0.077	0.047	0.022	0.019	0.059	0.047
NO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2	404.3	445.8	451.8	460.6	434.4	454.3	426.4	391.7	399.9	428.5	450.2	414.3	456.5	430.6	482.1	431.8	445.3	422.0	414.9	444.2
VOC	0.111	0.159	0.213	0.002	0.255	0.250	0.577	0.344	0.093	0.347	0.283	0.300	0.354	0.294	0.008	0.377	0.316	0.278	0.358	0.303
HCL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO	2.25	6.87	0.38	11.25	10.73	4.57	6.06	6.96	3.30	1.15	9.17	2.77	5.75	7.65	2.60	1.84	10.23	10.55	6.46	0.72
H2S	2.10	2.20	2.12	1.99	1.56	2.00	1.77	2.26	2.00	1.55	1.98	2.05	1.71	1.68	2.02	1.60	1.92	2.21	1.83	1.98
SPM	0.017	0.175	0.003	0.010	0.103	0.102	0.071	0.145	0.040	0.099	0.035	0.050	0.040	0.026	0.061	0.010	0.051	0.132	0.051	0.023

Noise/ EMF Result

NOISE AND EMF	Alaoji-Ihiala													Ihiala-onitsha						
PARAMETERS	NQ1/EMF1	NQ2	NQ3	NQ4	NQ 5/EMF2	NQ6	NQ7	NQ8	NQ9	NQ 10/EMF3	NQ11	NQ12	NQ13	NQ14	NQ 15/EMF4	NQ16	NQ17	NQ18	NQ19	NQ 20/EMF5
Noise dB(A)	56.4	62.1	56.9	61.9	62.0	62.3	65.0	57.8	62.5	60.0	61.6	61.9	55.7	67.6	58.3	58.4	61.6	57.8	60.0	60.9
LAF (dBA)	51.8	61.3	62.3	63.3	67.1	58.1	62.7	69.4	71.3	66.7	69.5	69.5	62.2	66.0	51.0	65.2	62.1	69.8	71.6	75.5
LMIN. (dBA)	23.4	28.6	26.7	25.8	28.1	26.3	31.2	29.9	26.9	26.3	31.6	24.3	29.8	28.0	27.4	24.7	25.2	22.4	28.9	28.6
LMAX. (dBA)	66.1	62.2	65.6	63.2	57.9	66.9	59.5	73.0	64.1	58.1	42.0	57.7	63.8	57.2	61.0	50.9	42.3	59.9	60.3	46.3
EMF	0.28				0.28					0.28					0.26					0.27

Micro-climatic Result (Meteorology)

	MET1	MET2	MET3	MET4	MET5	MET6	MET7	MET8	MET9	MET10	MET11	MET12	MET13	MET14	MET15	MET16	MET17	MET18	MET19	MET20
Wind speed	5.6	6.9	5.6	5.1	5.7	6.0	5.2	6.4	5.7	6.1	5.3	4.9	6.0	5.0	6.1	5.1	4.8	5.5	5.1	5.3
temp (oC)	27.4	27.8	26.1	26.6	25.9	26.6	25.0	26.4	27.0	25.6	27.9	27.5	26.4	27.5	25.6	25.9	28.3	26.3	26.6	27.1
RH (%)	66.5	66.3	65.7	66.5	66.8	65.8	65.9	66.1	65.1	66.3	65.8	66.7	66.1	65.5	66.5	65.5	66.0	65.5	65.3	65.5
Wind direction	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east	North-east

Appendix 6.2

SOIL PHYSICO-CHEMICAL PROPERTIES

(0cm - 15cm)			Alaoji-Ihiala											Ihiala - Onitsha							
PARAMETERS		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20
PH		6.67	6.66	6.64	6.59	6.77	6.70	6.70	6.71	6.69	6.67	6.78	6.73	6.87	6.73	6.65	6.77	6.75	6.77	6.77	6.80
Elect. Conductivity (µS/cm)		78.1	84.1	78.9	92.6	83.6	88.2	81.6	91.9	89.9	90.9	82.0	83.1	83.1	82.5	80.1	93.9	93.2	83.8	87.2	84.4
Moisture Content (%)		13.5	12.7	11.7	10.8	10.6	11.4	9.3	13.4	9.8	6.5	12.0	10.2	10.3	10.6	13.0	9.3	11.8	12.1	11.1	9.1
PSD(%)	Clay	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Silt	17.5	4.3	14.3	11.8	6.0	12.2	11.9	15.4	8.5	8.4	6.5	9.6	5.7	2.3	6.7	4.2	8.1	14.4	25.1	4.8
	Sand	88.4	86.8	90.2	90.1	93.5	90.7	87.1	83.9	89.3	88.9	91.6	86.9	93.6	88.4	88.6	89.8	91.0	94.4	89.6	90.4
PCB		52	62	53	61	57	65	55	54	51	58	52	54	52	57	59	58	52	56	57	58
Ext. nitrate		4.26	4.62	3.23	4.73	4.12	4.43	4.66	4.27	4.05	3.97	4.77	4.49	4.47	3.82	3.85	3.74	3.47	3.58	5.40	3.88
Ext. sulphate		25.0	24.6	24.6	24.7	24.9	25.0	25.5	25.1	24.4	25.6	24.6	25.6	24.8	25.1	23.8	25.3	26.2	25.0	24.9	25.0
Ext. phosphate		0.50	1.80	3.41	2.99	0.03	0.96	1.65	1.42	1.03	1.30	2.40	0.81	2.12	1.22	0.72	1.46	1.45	2.39	0.51	1.22
Phosphorus		20.1	12.2	16.3	16.1	6.1	13.1	15.9	10.1	12.0	20.0	16.4	8.1	8.4	17.0	16.2	14.0	15.3	15.1	14.5	15.9
Calcium		6.66	4.66	5.30	6.89	5.80	6.65	4.38	4.35	5.48	5.40	6.15	3.93	5.92	5.33	6.59	5.29	3.82	6.20	3.69	5.58
Magnesium		0.76	0.72	0.85	0.59	0.70	0.71	0.50	0.61	0.65	0.91	0.71	0.64	0.69	0.98	0.70	0.75	0.62	0.61	0.64	0.55
THC		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total chromium		0.78	0.94	0.88	0.94	0.76	0.98	0.79	0.85	0.93	0.89	0.74	0.83	0.99	1.09	0.99	0.98	0.81	1.05	0.51	0.55
Total iron		99.0	92.9	98.2	64.2	79.8	88.1	79.7	70.3	98.6	83.4	87.2	70.8	73.9	89.8	99.3	85.8	78.8	73.7	97.2	80.5
Copper		5.84	6.82	7.07	6.45	8.08	6.70	7.38	8.76	7.09	7.13	7.75	6.05	10.14	9.34	7.27	6.99	7.80	7.32	7.11	6.93
Lead		0.26	0.22	0.29	0.18	0.27	0.23	0.28	0.29	0.21	0.26	0.24	0.15	0.22	0.30	0.21	0.14	0.30	0.16	0.25	0.24
Manganese		5.48	6.29	5.67	6.32	6.08	6.37	6.17	5.36	6.50	5.26	5.96	6.50	6.62	6.97	5.34	6.59	7.19	6.54	6.60	6.71

Nickel		0.81	0.66	0.54	0.82	0.61	0.57	0.62	0.64	0.69	0.67	0.48	0.39	0.72	0.62	0.73	0.59	0.58	0.70	0.67	0.69
Zinc		1.28	1.28	1.17	1.05	1.12	1.17	1.18	1.14	1.14	1.31	1.24	1.22	1.18	1.22	1.25	1.19	1.22	1.18	1.24	1.19
Arsenic		0.31	0.32	0.33	0.30	0.25	0.29	0.23	0.28	0.26	0.24	0.25	0.27	0.26	0.20	0.30	0.29	0.34	0.23	0.25	0.35
Mercury		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium		0.23	0.23	0.26	0.22	0.24	0.25	0.30	0.24	0.28	0.25	0.25	0.23	0.23	0.23	0.26	0.26	0.21	0.23	0.20	0.31
Cadmium		0.42	0.39	0.66	0.36	0.63	0.49	0.47	0.52	0.55	0.29	0.49	0.43	0.46	0.49	0.26	0.47	0.42	0.34	0.28	0.28
Boron		0.79	1.66	1.16	1.65	1.66	1.28	1.58	1.34	1.26	1.50	1.50	1.84	1.06	1.84	1.40	1.59	1.73	1.16	1.82	1.47
(15cm - 30cm)																					
PARAMETERS		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20
PH		5.49	5.49	5.48	5.51	5.49	5.48	5.49	5.52	5.50	5.49	5.51	5.44	5.50	5.51	5.49	5.50	5.52	5.48	5.47	5.50
Elect. Conductivity (µS/cm)		148.2	142.0	161.3	164.1	127.9	118.7	107.9	122.0	166.2	172.9	133.2	175.4	154.1	187.6	136.0	146.4	139.8	115.7	145.4	168.9
Moisture Content (%)		15.1	14.0	13.0	15.1	17.0	16.9	14.2	16.4	14.5	14.0	13.1	14.0	15.1	16.8	18.2	15.5	13.6	17.6	15.4	13.7
PSD(%)	Clay	1.88	2.04	2.54	2.46	2.25	2.58	3.02	3.11	2.79	2.40	2.59	1.97	2.77	2.22	3.16	3.13	2.63	2.84	2.80	2.73
	Silt	10.5	16.1	7.8	5.9	10.8	13.3	10.3	11.8	16.3	16.3	14.0	13.8	9.0	17.8	12.2	10.5	11.5	17.4	12.2	13.9
	Sand	93.9	92.0	83.3	90.7	102.8	92.8	88.3	88.4	79.4	78.6	85.9	83.4	86.7	97.7	97.7	86.1	91.1	84.5	79.6	82.0
PCB		52	43	23	34	35	21	34	35	23	26	29	32	33	23	34	21	42	27	59	57
Ext. nitrate		4.1	5.1	6.1	5.0	5.8	4.2	4.4	5.5	5.4	5.0	6.9	4.6	6.0	5.7	6.6	4.9	6.2	4.9	6.0	4.5
Ext. sulphate		22.3	23.1	21.8	23.5	22.8	23.0	23.8	23.0	23.0	23.0	22.4	23.3	22.9	23.2	23.4	21.8	23.4	22.7	21.9	23.3
Ext. phosphate		1.70	2.55	2.21	2.66	2.71	3.00	2.15	1.32	2.45	2.37	2.21	1.37	1.31	3.60	2.68	2.82	2.28	1.71	0.96	1.45
Phosphorus		12.5	14.6	17.8	6.0	15.5	12.0	12.3	13.5	14.4	11.7	12.5	21.5	14.1	12.5	17.5	14.5	15.9	15.5	13.3	10.7
Calcium		3.59	6.05	4.90	4.02	4.87	4.95	3.00	1.66	5.49	4.37	5.59	2.85	2.99	3.82	4.62	3.42	6.89	1.95	3.41	2.92
Magnesium		1.15	0.81	0.64	0.55	0.69	0.96	0.70	0.80	0.82	0.65	0.46	0.84	1.03	0.86	0.87	0.44	0.53	0.79	0.82	0.85
THC		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total chromium		1.70	1.69	1.26	0.87	1.61	1.58	2.07	1.20	1.58	1.43	1.37	1.39	1.39	1.42	1.88	1.13	1.39	1.47	1.59	1.59

Total iron		111.6	107.9	123.5	127.3	121.9	130.9	113.9	122.6	138.7	103.0	125.1	122.4	119.1	136.2	111.9	119.7	108.3	106.8	141.1	131.7
Copper		7.23	4.70	6.21	6.48	9.54	9.01	6.20	9.73	8.58	7.64	7.99	9.35	7.92	8.63	6.99	5.56	8.15	6.91	8.74	4.78
Lead		0.14	0.13	0.22	0.12	0.03	0.13	0.27	0.22	0.23	0.09	0.11	0.17	0.16	0.24	0.26	0.19	0.26	0.16	0.17	0.24
Manganese		9.67	8.62	8.96	7.37	7.35	7.97	5.63	5.77	8.26	9.09	7.88	7.97	8.34	6.62	6.96	6.86	8.25	7.02	10.00	7.24
Nickel		0.80	0.70	1.00	0.98	0.89	0.95	0.90	1.01	0.92	1.08	0.97	1.08	0.93	0.83	0.97	0.73	1.05	1.20	0.96	0.92
Zinc		0.71	1.97	1.26	1.32	0.86	1.50	1.11	1.49	1.20	1.41	0.81	0.92	1.31	2.11	1.00	1.19	1.02	1.38	1.27	0.32
Arsenic		0.44	0.29	0.44	0.39	0.47	0.27	0.43	0.36	0.37	0.36	0.35	0.24	0.29	0.35	0.36	0.33	0.28	0.28	0.41	0.23
Mercury		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium		0.22	0.37	0.33	0.32	0.26	0.24	0.28	0.32	0.33	0.23	0.27	0.25	0.24	0.27	0.38	0.35	0.22	0.24	0.27	0.27
Cadmium		0.49	0.48	0.40	0.15	0.57	0.53	0.54	0.90	0.44	0.53	0.46	0.70	0.67	0.63	0.55	0.54	0.78	0.43	0.57	0.29
Boron		1.45	1.60	1.07	1.95	1.21	1.56	1.59	1.26	0.87	1.35	2.33	1.63	1.30	2.09	2.04	1.86	1.47	1.21	1.78	1.62

Soil Microbiology

SAMPLE STATIONS	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
SS1 (0-15cm)	*Bacillus sp* *Pseudonomas sp* *Staphylococcus sp* *Flavobacterium sp* *Chromobacterium sp*	1.9 x 102	*Bacillus sp* *Pseudonomas sp* *Staphylococcus sp*	1.0 x 102	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	2.3 x 103	*Mucor sp* *Penicillium sp*	2.2 x 102
SS1 (15-30cm)	*Bacillus sp* *Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp* *Protues sp*	1.7 x 102	*Escherichia sp* *Klebsiella sp* *Protues sp*	1.6 x102	*Aspergillus sp* *Mucor sp* *Candida sp* *Trichoderma sp*	1.41 x 102	*Mucor sp* *Candida sp*	1.37 x 102
SS2(0-15cm)	*Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomyces sp*	1.92 x 103	*Enterobacter sp* *Micrococcus sp*	1.72 x 102	*Rhizopus sp* *Candida sp* *Trichoderma sp*	1.7 x 102	*Rhizopus sp* *Candida sp*	1.7 x 10
SS2(15-30cm)	*Serriatia sp* *Staphylococcus sp*	2.5 x 102	*Actinomyces sp*	1.9 x 102	*Aspergillus sp*	1.2 x 104	*Mucor sp*	1.2 x 102

	Enterobacter sp *Actinomyces sp* *Flavobacterium sp* *Chromobacterium sp*		*Flavobacterium sp* *Chromobacterium sp*		*Mucor sp* *Penicillium sp* *Fusarium sp*		*Aspergillus sp*	
SS3(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Staphylococcus sp* *Proteus sp* *Arthrobacter sp*	3.1×10^3	*Bacillus sp* *Pseudonomas sp*	2.1×10^2	*Aspergillus sp* *Penicillium sp* *Fusariumsp* *Mucor sp* *Rhizopus sp* *Trichoderma sp*	1.9×10^3	*Penicillium sp* *Fusarium sp* *Rhizopus sp*	1.5×10^3
SS3(15-30cm)	*Proteus sp* *Escherichia sp* *Klebsiella sp* *Serriatia sp* *Flavobacterium sp*	1.9×10^3	*Escherichia sp* *Klebsiella sp*	1.1×10^3	*Candida sp* *Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	2.1×10^3	*Mucor sp* *Aspergillus sp Candida sp*	2×10^3
SS4(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Staphylococcus sp*	1.77×10^3	*Staphylococcus sp*	1.5×10^2	*Penicillium sp* *Fusarium sp*	1.2×10^3	*MucorspRhizopus sp* *Candida sp*	1.1×10^3

	Actinomyces sp				*MucorspRhizopus sp* *Candida sp*			
SS4(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Enterobacter sp* *Serriatia sp*	2.0 x10^5	*Pseudonomas sp* *Proteus sp* *Enterobacter sp*	1.0 x 10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	1.9 x 10^5	*Mucor sp* *Aspergillus sp* *Fusarium sp* *Penicillium sp* *Candida sp*	1.8 x 10^2
SS5(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Enterobacter sp* *Serriatia sp*	3.0 x 10^2	*Bacillus sp* *Pseudonomas sp* *Proteus sp*	2.2 x 10^1	*Candida sp* *Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	4.5 x 10^4	*Candida sp* *Aspergillus sp*	3.7 x 10^4
SS5(15-30cm)	*Micrococcus sp* *Actinomyces sp* *Arthrobacter sp* *Staphylococcus sp* *Flavobacterium sp*	3.1 x 10^5	*Arthrobacter sp* *Staphylococcus sp*	1.5 x 10^5	*Penicillium sp* *Fusarium sp* *MucorspRhizopus sp* *Candida sp*	1.9 x 10^2	*Penicillium sp* *Fusarium sp* *Mucor sp*	1.1 x 10^2
SS6(0-15cm)	*Proteus sp*	4.1 x 10^5	*Staphylococcus sp*	3 x 10^2	*Penicillium sp* *Fusarium sp*	4.1 x 10^2	*MucorspRhizopus sp*	4.1 x 10^1

	Arthrobacter sp *Staphylococcus sp* *Flavobacterium sp* *Chromobacterium sp*		*Flavobacterium sp* *Chromobacterium sp*		*MucorspRhizopus sp* *Candida sp*		*Candida sp*	
SS6(15-30cm)	*Pseudonomas sp* *Proteus sp* *Escherichia sp* *Enterobacter sp* *Serriatia sp*	4 x 10^2	*Enterobacter sp* *Serriatia sp*	2.3 x 10^2	*Aspergillus sp* *Mucor sp* *Candida sp* *Trichoderma sp*	4 x 10^2	*Mucor sp* *Candida sp* *Trichoderma sp*	3.6 x 10^1
SS7(0-15cm)	*Serriatia sp* *Staphylococcus sp* *Enterobacter sp* *Actinomyces sp* *Flavobacterium sp* *Chromobacterium sp*	4.1 x 10^1	*Staphylococcus sp* *Enterobacter sp* *Actinomyces sp* *Flavobacterium sp*	1.5 x 10^1	*Fusarium sp* *Mucor sp* *Penicillium sp* *Rhizopus sp* *Candida sp* *Aspergillus sp*	1.9 x 10^2	*Penicillium sp* *Rhizopus sp* *Candida sp* *Aspergillus sp*	1.9 x 10^1
SS7(15-30cm)	*Proteus sp* *Escherichia sp* *Klebsiella sp* *Serriatia sp*	3.6 x 10^2	*Escherichia sp* *Klebsiella sp* *Serriatia sp*	2.5 x 10^2	*Candida sp* *Aspergillus sp* *Mucor sp*	3.5 x 10^2	*Candida sp* *Aspergillus sp* *Mucor sp*	2.3 x 10^2

	Flavobacterium sp				*Penicillium sp* *Fusarium sp*			
SS8(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Escherichia sp* *Klebsiella sp*	3.5 x 10^2	*Pseudonomas sp* *Proteus sp* *Escherichia sp*	2.5 x 10^1	*Mucor sp* *Penicillium sp* *Fusarium sp* *Rhizopus sp* *Candida sp*	2.5 x 10^2	*Fusarium sp* *Rhizopus sp* *Candida sp*	2.1 x 10^2
SS8(15-30cm)	*Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	4.1 x 10^2	*Micrococcus sp* *Escherichia sp*	1.2 x 10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	2.6 x 10^3	*Penicillium sp*	1.6 x 10^2
SS9(0-15cm)	*Serriatia sp* *Staphylococcus sp* *Enterobacter sp* *Actinomyces sp* *Flavobacterium sp* *Chromobacterium sp*	4.4 x 10^3	*Staphylococcus sp* *Enterobacter sp* *Actinomyces sp*	1.1 x 10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	3.1 x 10^3	*Mucor sp* *Penicillium sp* *Fusarium sp*	3 x 10^2
SS9(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Escherichia sp*	4.3 x 10^2	*Proteus sp* *Escherichia sp*	2.1 x 10^2	*Mucor sp* *Penicillium sp* *Fusarium sp* *Rhizopus sp*	5.6 x 10^3	*Fusarium sp* *Rhizopus sp* *Candida sp*	4.7 x 10^2

	Klebsiella sp				*Candida sp*			
SS10(0-15cm)	*Micrococcus sp* *Actinomyces sp* *Arthrobacter sp* *Staphylococcus sp* *Flavobacterium sp*	2.3 x 10^4	*Arthrobacter sp* *Staphylococcus sp*	1.6 x 10^4	*Candida sp* *Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	4.2 x 10^2	*Mucor sp* *Penicillium sp* *Fusarium sp*	2.8 x 10^2
SS10(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	3.9 x 10^2	*Micrococcus sp* *Escherichia sp*	3.2 x 10^2	*Rhizopus sp* *Candida sp* *Trichoderma sp*	3.0 x 10^3	*Trichoderma sp*	2.5 x 10^2
SS11(0-15cm)	*Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomyces sp*	3.1 x 10^5	*Micrococcus sp*	2.7 x 10^4	*Fusarium sp* *Mucor sp* *Rhizopus sp* *Candida sp*	2.1 x 10^5	*Mucor sp* *Rhizopus sp* *Candida sp*	1.1 x 10^2
SS11(15-30cm)	*Proteus sp* *Escherichia sp* *Klebsiella sp* *Serriatia sp* *Flavobacterium sp*	4.4 x 10^4	Escherichia sp Klebsiella sp Serriatia sp	1.9 x 10^3	*Aspergillus sp* *Mucor sp* *Candida sp* *Trichoderma sp*	2.9 x 10^2	*Mucor sp* *Candida sp* *Trichoderma sp*	1.7 x 10^2

SS12(0-15cm)	*Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	2.9×10^3	*Escherichia sp* *Klebsiella sp*	1.2×10^2	*Mucor sp* *Penicillium sp* *Fusarium sp* *Rhizopus sp* *Candida sp*	3.8×10^4	*Rhizopus sp* *Candida sp*	3.2×10^4
SS12(15-30cm)	*Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	3.1×10^4	*Micrococcus sp* *Escherichia sp*	2.9×10^2	*Fusarium sp* *Mucor sp* *Rhizopus sp* *Candida sp*	4.7×10^2	*Rhizopus sp* *Candida sp*	3.2×10^2
SS13(0-15cm)	*Proteus sp* *Escherichia sp* *Klebsiella sp* *Serriatia sp* *Flavobacterium sp*	4.1×10^3	*Proteus sp* *Escherichia sp* *Klebsiella sp*	2×10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	2.9×10^3	*Penicillium sp* *Fusarium sp*	2.1×10^2
SS13(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Escherichia sp* *Klebsiella sp*	2.6×10^4	*Pseudonomas sp* *Proteus sp* *Escherichia sp*	2.1×10^3	*Penicillium sp* *Fusarium sp* *Mucor sp* *Rhizopus sp* *Candida sp*	3.6×10^4	*Mucor sp* *Rhizopus sp*	2.3×10^4
SS14(0-15cm)	*Arthrobacter sp* *Enterobacter sp*	3.8×10^2	*Arthrobacter sp* *Enterobacter sp*	2.4×10^2	*Rhizopus sp* *Candida sp*	1.5×10^2	*Candida sp*	0.9×10^2

	Micrococcus sp *Actinomyces sp*				*Trichoderma sp*		*Trichoderma sp*	
SS14(15-30cm)	*Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	4.7×10^2	*Klebsiella sp*	4.1×10^2	*Fusarium sp* *Mucor sp* *Rhizopus sp* *Candida sp*	3.9×10^4	*Mucor sp* *Rhizopus sp* *Candida sp*	3×10^4
SS15(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	3.9×10^2	*Pseudonomas sp* *Micrococcus sp* *Escherichia sp*	3.7×10^2	*Candida sp* *Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	3.6×10^3	*Candida sp* *Aspergillus sp* *Mucor sp*	2.1×10^2
SS15(15-30cm)	*Serriatia sp* *Staphylococcus sp* *Enterobacter sp* *Actinomyces sp* *Flavobacterium sp* *Chromobacterium sp*	3.6×10^4	*Serriatia sp* *Staphylococcus sp* *Enterobacter sp* *Actinomyces sp*	3.1×10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	5.1×10^2	*Mucor sp* *Penicillium sp*	4.2×10^2
SS16(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Escherichia sp*	3.8×10^3	*Proteus sp* *Escherichia sp* *Klebsiella sp*	1.7×10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp*	4.2×10^4	*Aspergillus sp* *Mucor sp* *Penicillium sp*	3.5×10^4

	Klebsiella sp				*Fusarium sp*			
SS16(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Escherichia sp* *Klebsiella sp*	4.2×10^2	*Pseudonomas sp* *Proteus sp* *Escherichia sp* *Klebsiella sp*	3.6×10^2	*Mucor sp* *Penicillium sp* *Fusarium sp* *Rhizopus sp* *Candida sp*	4.2×10^4	*Fusarium sp* *Rhizopus sp* *Candida sp*	3.6×10^4
SS17(0-15cm)	*Pseudonomas sp* *Proteus sp* *Escherichia sp* *Enterobacter sp* *Serriatia sp*	3.2×10^4	*Pseudonomas sp* *Proteus sp* *Escherichia sp*	2.1×10^3	*Fusarium sp* *Mucor sp* *Penicillium sp* *Rhizopus sp* *Candida sp* *Aspergillus sp*	4.8×10^2	*Fusarium sp* *Mucor sp* *Penicillium sp* *Rhizopus sp* *Candida sp*	4.3×10^1
SS17(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Enterobacter sp* *Serriatia sp*	3.4×10^2	*Pseudonomas sp* *Proteus sp* *Enterobacter sp*	3.3×10^2	*Aspergillus sp* *Mucor sp* *Candida sp* *Trichoderma sp*	3.3×10^2	*Aspergillus sp* *Mucor sp* *Candida sp*	3×10^2
SS18(0-15cm)	*Micrococcus sp*	5.1×10^3	*Arthrobacter sp* *Staphylococcus*	2.9×10^2	*Penicillium sp* *Fusarium sp*	4.3×10^2	*Rhizopus sp* *Candida sp*	3.2×10^2

	Actinomyces sp *Arthrobacter sp* *Staphylococcus sp* *Flavobacterium sp*		*sp* *Flavobacterium sp*		*Mucor sp* *Rhizopus sp* *Candida sp*			
SS18(15-30cm)	*Bacillus sp* *Pseudonomas sp* *Proteus sp* *Enterobacter sp* *Serriatia sp*	2.5×10^3	*Pseudonomas sp* *Proteus sp* *Enterobacter sp*	1.5×10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	3.7×10^3	Aspergillussp Mucorsp	3.5×10^2
SS19(0-15cm)	*Bacillus sp* *Pseudonomas sp* *Micrococcus sp* *Escherichia sp* *Klebsiella sp*	4.9×10^4	*Micrococcus sp* *Escherichia sp*	3.5×10^4	*Aspergillus sp* *Mucor sp* *Candida sp* *Trichoderma sp*	1.3×10^4	*Candida sp* *Trichoderma sp*	1×10^4
SS19(15-30cm)	*Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomyces sp*	3.9×10^3	*Arthrobacter sp* *Enterobacter sp*	3.1×10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	3.7×10^3	*Mucor sp* *Penicillium sp*	3.1×10^1

SS20(0-15cm)	*Proteus sp* *Escherichia sp* *Klebsiella sp* *Serriatia sp* *Flavobacterium sp*	4.8×10^4	*Escherichia sp* *Klebsiella sp* *Serriatia sp*	4.5×10^4	*Rhizopus sp* *Candida sp* *Trichoderma sp*	4.9×10^4	*Candida sp* *Trichoderma sp*	4.2×10^4
SS20(15-30cm)	*Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomyces sp*	4.7×10^3	*Enterobacter sp* *Micrococcus sp*	2.1×10^2	*Mucor sp* *Penicillium sp* *Fusarium sp* *Rhizopus sp* *Candida sp*	2.7×10^3	*Mucor sp* *Penicillium sp*	2.1×10^2

Appendix 6.3

Flora checklist

S/N	Species	Common name	Protected in Nigeria/Reserves	References on Protected species	IUCN status	Habit	Family	Average DBH (cm)	Density in Blanket															Average Density
									V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	1
1.	*Abrus sp*	Jequirity brean			LC	H	Fabaceae	5											1					1
2.	*Acacia albida*	White acacia			LC	T		8								1								1
3.	*Acacia seyal*	Shittah tree			LC	T		6						1										1
4.	*Acanthus montanus*	Bear's breech			LC	S	Acanthaceae	4		1	1													1
5.	*Aerangis biloba*	Aerangis			NE	C	Orchidaceae	2	+	1			1	1								1		1
6.	*Afzelia sp*	Doussle	Protected (P) Oban	Edet, *et al.*, (2012)	VU	T	Fabaceae	7	1	1		1	1	1	1	1	1		1	1			1	1

			, Afi forests	Aigbe & Omokhua, (2015) Omokhua, (2015)																				
7.	*Ageratum conizoides*	Goat weed	(P) Okomu reserve	Idu& Osemwegie, (2007)	NE	H	Asrer aceae	2	2					2										2
8.	*Albizia lebbeck*	*Flat-crown*	(P) Okomu, Okwang wo reserves	Osemwegie, (2007) Williams, (2008) Adeyemi, et al., (2015)	LC	T	Mimos oideae	19											1				1	1
9.	*Albizia zygia*	West African Albizia	(P) Oban , Afi, Okwang wo forests	Edet, *et al.,* (2012) Aigbe & Omokhua, (2015)	NE	T	Mimos oideae	18		1	2	1						1						1

				Williams, (2008) Omokhua, (2015)																				
10.	*Alchornea cordifolia*	Christmas Bush			NE	T	Euphorbiaceae	12	1	2	1		2	3	2	1		1	2	2			1	2
11.	*Anchomanes giganteus*	Forest anchomanes			NE	S	Areaceae	7		1	1			2										2
12.	*Andropogon citrata*	Broomsedge bluestem			LC	G	poaceae	2						1			2							2
13.	*Anielema sp*	Anielema			NE	S	Commelinaceae	6											1				1	1
14.	*Annona muricata*	wild custard-apple			NE	S	Annonaceae	2		1	1													1
15.	*Anthocarpus preissi*	Anthocarpus			LC	S	Asparagaceae	3															1	1

16.	*Anthocleista djalonensis*	Cabbage tree	(P) Oban, Okwangwo forest	Williams, (2008) Aigbe & Omokhua, (2015) Omokhua, (2015)	NE	T	Loganiaceae	15								1			1		2			2
17.	*Anthocliesta grandiflora*	Cabbage tree			NE	T	Loganiaceae	16					2					1						2
18.	*Anthocliesta nobilis*	Cabbage palm			NE	T	Loganiaceae	10							2							2		2
19.	*Antidesma venosum*				NE	T	Euphorbiaceae	8															1	1
20.	*Aspilia africana*	Wild sun flower			NE	H	Asteraceae	2							2									2
21.	*Azadirashta indica*	Neem			NE	T	Meliaceae	11										2						3
22.	*Bambusa vulgaris*	Indian bamboo			NE	T	Poaceae	10					3	3					2		3		2	3

23.	*Baphia nitida*	Camwood	(P) Oban, Okwangwo forests	Williams, (2008) Aigbe & Omokhua, (2015) Omokhua, (2015)	LC	S	Papilionoideae	10															1	1
24.	*Bauhinia purpurea*				LC	T	Fabaceae	12				1	1											1
25.	*Berlinia bracteosa*	Berlinia			LC	T	Caeslpinoideae	18		1														1
26.	*Cyathea australis*	Tre fern			NE	T	Cyatheaceae	9			1				1					1		1		1
27.	*Ceiba pentandra*	Silk Cotton Tree			LC	T	Malvaceae	20											1					2
28.	*Chromolaena odorata*	Siam weed	(P) Okomu reserve	Idu& Osemwegie, (2007)	NE	S	Asteraceae	8	2		2							2	1	3		2		2

29.	*Cola spp*	kola	(P) Oban, Okwangwo forests	Williams, (2008) Aigbe &Omokhua, (2015) Omokhua, (2015)	NE	T	Sterculiacteae	19				1												1
30.	*Combretum racemosa*	Velvet bush willow			NE	S	Combretaceae	7					1				2							2
31.	*Combretum tomentosum*	Bushwillows			NE	C	Combretaceae	3								1	2							2
32.	*Commelina africana*	Birdbill Dayflower			LC	H	*Commelinaceae*	6	+	+		2												1
33.	*Corypha umbraculifera*	Talipot palm			DD	T	Arecaceae	9							1									1
34.	*Dalbergia latifolia*	Coinvine	(P) Oban forest	Aigbe & Omokhua, (2015)	VU	T	Fabaceae	12											1					1

				Omokhua, (2015)																				
35.	*Dalbergia sissoo*				NE	T		10		1					1			1						1
36.	*Daniellia oliveri*	African copaiba balsam tree	(P) Oban forest	Aigbe & Omokhua, (2015) Omokhua, (2015)	NT	T		10						1									1	1
37.	*Dialium guineense*	Black velevet	(P) Afi forest	Edet, *et al.,* (2012)	NE	T	Caesalpinioideae	17			1													1
38.	*Diospyrous sp*	African ebony	(P) Oban, Afi, Okwangwo forests	Edet, *et al.,* (2012) Aigbe & Omokhua, (2015) Williams, (2008) Omokhua, (2015)	NE	T	Ebenaceae	12		1					1									1

39.	*Elaeis guineensis*	African oil palm	(P) Okomu reserve	Idu& Osemwegie, (2007)	LC	T	Arecaceae	20	1	2	2	2		3							2		1	2
40.	*Eluecine indica*	Goosegrass			NE	G		2			+													+
41.	*Ephioglossum pendulum*	Old-world adder's-tongue			NE	F	Ophioglossaceae	4	+	1			+	1										1
42.	*Ficus exasperata*	Sandpaper fig	(P) Afi, OkomuOkwangwo reserves	Edet et al., (2012) Osemwegie, (2007) Williams, (2008) Adeyemi, et al., (2015)	NE	S	Moraceae	8			1													1
43.	*Ficus leprieuri*				NE	T	Moraceae	10	+						+					1				1
44.	*Ficus sur*	Cape fig			NE	T	Moraceae	16	1		1	2	1										1	1

45.	*Gardenia imperialis*				NE	T	Rubiaceae	9														1		1
46.	*Gardenia jasminoides*	Cape jessamine			NE	T	Rubiaceae	10					1											1
47.	*Gmelina aborea*	Gmelina			NE	T	Lamiaceae	18			2				1			3		2				2
48.	*Grewia bicolor*	Grewia			NE	T	Malvaceae	18								1								1
49.	*Grewia occidentalis*	Crossberry			NE	T		9							1									1
50.	*Harungana madagascariensis*	Haronga			NE	T	Clusiaceae	17			1				1					1				1
51.	*Isoberlinia angolensis*	Mutondo			NE	T	Fabaceae	11													1			1
52.	*Lophira alata*	Azobe	(P) Oban, Afi, Okwangwo forests	Edet, *et al.*, (2012) Aigbe & Omokhua, (2015)	VU	T	Ochnaceae	14	1	2									1					1

				Williams, (2008) Omokhua, (2015)																				
53.	*Lophira lanceolata*	Red iron wood tree			NE	T		14				2												2
54.	*Machaerium scleroxylon*	Pau ferro			LC	T	Fabaceae	15						1			1				2			2
55.	*Milicia excelsa*	African teak, Iroko	(P) Okomu, Oban forest reserves	Idu&Osemwegie, (2007) Aigbe & Omokhua, (2015) Omokhua, (2015)	NT	T	Malvaceae	19										1						1
56.	*Mimosa pudica*	Sensitive plant, Touch me not			LC	H	Fabaceae	7	2		+											1		2
57.	*Mitragyna speciosa*	Kratom			NE	T	Rubiaceae	I9			1										1			1

58.	*Musanga cecropioides*	Umbrella Tree	(P) Afi, Okwang wo forests	Edet, *et al.*, (2012) Williams, (2008)	NE	T	Morac eae	12															1	1
59.	*Mussaenda elegens*				NE	S	Rubia ceae	8	+															+
60.	*Nephrolepsi s biserrata*	Giant sword fern			LC	F	Nephr olepid aceae	4					1	2			3							2
61.	*Newbouldia laevis*	tree of life	(P) Oban, Okwang wo forests	Williams, (2008) Aigbe & Omokhua, (2015) Omokhua, (2015)	NE	T	Bigno nacea e	14													1	1		1
62.	*Panicum maximum*	Panic grass			NE	G	Poac eae	3		3	1	3		2			2						2	2
63.	*Parkinsonia aculeata*	Jerusale m thorn			NE	T	Faba ceae	12															1	1
64.	*Paspalum distichum*	Knot grass			LC	G		2												+			+	1

65.	*Pennisetum purpureum*	Elephant grass, Napier grass			LC	H	Poaceae	3										1		1		1		1
66.	*Pentaclethra macrophylla*	African oil bean	(P) Oban , Afi forests	Edet, *et al.*, (2012) Aigbe & Omokhua, (2015) Omokhua, (2015)	NE	T	Mimosoideae	13													1			1
67.	*Phylanthus amarus*	Baronianus			NE	H	Phyllanthaceae	3										1						1
68.	*Phyllantus niruri*	Gale of the wind			NE	H		2														1		1
69.	*Phymatodes swlopendria*	Monarch fern, Musk fern			NE	F	Polypodiaceae	2							1					1				1
70.	*Platycerium spp*	Staghorn fern			NE	F		2	+		1							1						1

71.	*Polypodium leucotomos*				NE	F		2		1				1								+		1
72.	*Pterocarpus lucens*		(P) Okwangwo forest	Williams, (2008)	LC	T	Fabaceae	12	1	1					1			1	1	1		1		1
73.	*Raphia hookeri*	Raphia palm			LC	T	Arecacea	15					2				3		2				3	3
74.	*Rauvolfia sandwicensis*	Devil's pepper			NE	T	Apocynaceae	10													1			1
75.	*Ricinodendron sp*		(P) Oban, Afi, Okwangwo forests	Edet, *et al.*, (2012) Aigbe & Omokhua, (2015) Williams, (2008) Omokhua, (2015)	VU	T	Euphorbiaceae	11								1								1
76.	*Salacia reticulata*	*Salacia*			NE	H	Celastraceae	2					1											1

77.	*Selaginella apoda*	Meadow spikemoss			NE	H	Selaginellaceae	2	1															1
78.	**Sericanth**				EN	T	Rubiaceae	10										1						1
79.	*Sida acuta*	Wireweed			NE	H	Malvaceae	3										2				2		2
80.	*Spondias spp*	Yellow mombin	(P) Okomu reserve	Idu& Osemwegie, (2007)	NE	T	Euphobiaceae	10													1			1
81.	*Stachytarpheta indica*	Blue porterweed			NE	H	Verbenaceae	3														1		1
82.	*Symphonia globulifera*	Chew stick			DD	T	Clusiaceae	9							1									1
83.	*Tabernamontana divaricata*	Pinwheel flowe			NE	T	Apocynaceae	15													2			2
84.	*Terminalia catappa*	Country-almond			NE	T		13								1								1

85.	*Terminalia superba*	Shinglewood	(P) Oban, Afi, Okwangwo forests	Edet, *et al.*, (2012) Aigbe & Omokhua, (2015) Williams, (2008) Omokhua, (2015)	NE	T	Combretaceae	11	1		1		1			1					1		2	1
86.	*Tetrapleura tetraptera*	Aridan	(P) Oban, Afi forests	Edet, *et al.*, (2012) Aigbe & Omokhua, (2015) Omokhua, (2015)	NE	T	Fabaceae	9														1		1
87.	*Thalia dealbata*	Powdery alligator-flag			NE	H	Marantaceae	4												1				1
88.	*Thaumatococcus daniellii*	Miracle fruit			NE	H		3	1			2					2		1		1			1

89.	*Triplochiton scleroxylon*	African white wood	(P) Oban, Okomu forest reserves	Aigbe & Omokhua, (2015) Idu& Osemwegie, (2007) Omokhua, (2015)	LC	T	Malvaceae	19						1										1
90.	*Urena lobata*	Caesarweed	(P) Okomu reserve	Idu&Osemwegie, (2007)	NE	S		6														1		1
91.	*Vitex agnus-castus*	Chasteberry, Abraham's balm, lilac chastetree, or monk's pepper			NE	H	Lamiaceae	3							1			1		1				1